JYU DISSERTATIONS 324

Jouko Wacklin

The Challenge of Managing a Diversified Company

Tampella Corporation 1958–1995

UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF HUMANITIES AND SOCIAL SCIENCES

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ABSTRACT

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The dissertation asks to what extent the top management's capability of a conglomerate Tampella was sufficient to make decisions concerning long-term competitiveness and survival in the market, technology, and organizational dynamics? The dissertation is a comparative analytical narrative on Tampella's evolution between the years 1958 to 1995. The longitudinal approach is needed due to the slowly emerging consequences of strategic decisions – especially organizational changes. Furthermore, I evaluate the importance of different market variables in technological investment decision-making built on my industry-specific engineering capabilities.

I demonstrate that the top management team's capability was critical in ensuring Tampella's operations' varied performance. The in-depth analysis of the single case proves the importance of a firm's top management's capability to understand its businesses, technology, and organization's core functions. The Tampella analysis also reveals that a firm's cash flow management is among the most critical determinants for success and failure.

The dissertation contributes to the methodological and theoretical development of business history. The goal is a constructive dialogue between business history and the organizational theories and strategy on the other side. From the business history perspective, the dissertation focuses on a company's operational history from the perspective of capability literature. Furthermore, the dissertation focuses on industry history and industry research that highlights the pulp and paper industries' characteristics, including forestry cluster and their impact on a firm's profitability in the context of technology, markets, and their overall dynamics.

Keywords: market dynamics, technology change, organizational capability, leadership capability, pulp and paper industry, forestry cluster, institutions

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Väitöskirjani vastaa siihen, missä määrin monialayritys Tampellan ylin johto kykeni tekemään päätöksiä yrityksen kilpailukyvystä ja selviytymisestä sekä vastaamaan markkinoiden, tekniikan ja organisaation muutoksesta aiheutuneisiin haasteisiin. Tämä väitöskirja on analyyttinen ja vertaileva tutkimus Tampellan elinkaaresta vuosina 1958-1995. Käytän pitkittäistä ja kuvaavaa kvantitatiivista lähestymistapaa ymmärtääkseni strategisten päätösten pitkän aikavälin seurauksia. Lisäksi arvioin erilaisten markkinamuuttujien merkitystä teknologiainvestoinneissa.

Väitöskirjani perusteella yrityksen ylimmän johdon organisatoriset valmiudet ovat kriittinen tekijä yrityksen pitkän aikavälin kannattavan toiminnan varmistamiseksi. Analyysini osoittaa yrityksen ylimmän johdon kyvykkyyden tärkeyden yrityksen, tekniikan ja organisaation ydintoimintojen ymmärtämisessä. Osoitan myös, että yrityksen kassavirran hallinta on yksi kriittisimmistä tekijöistä yrityksen menestykseen ja epäonnistumiseen, jonka määrittelen perustuvan yrityksen ylimmän johdon kyvykkyyteen.

Väitöskirjani laajentaa vuoropuhelua liiketoimintahistorian ja organisaatioteorioiden ja strategia tutkimuksen välillä. Liiketoimintahistorian näkökulmasta tutkimus keskittyy yrityksen organisaation tietotasoon ja kyvykkyyteen. Lisäksi keskityn teollisuuden historiaan ja teollisuustutkimukseen, jossa korostuvat sellu- ja paperiteollisuuden ominaisuudet, mukaan lukien koko metsäklusterin toiminta, ja niiden vaikutus yrityksen kannattavuuteen tekniikan, markkinoiden ja niiden yleisen dynamiikan kontekstissa.

Avainsanat: markkinoiden dynamiikka, teknologian muutos, organisaation kyvykkyys, johtajuus, massa- ja paperiteollisuus, metsäklusteri, instituutiot

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1 INTRODUCTION

1.1 Why is top management's capability an important research topic in business history?

Management's capabilities to lead a company through external and internal challenges are a crucial component for success in any organization. In a diversified company engaged in technologically complicated lines of multiple businesses, these challenges are, one might argue, even more pronounced. The core issue in this dissertation is the capability of top management to interpret the external market environment and manage internal technology and organizational development accordingly.[1]

Organizational reality is often rather far from this ideal. It can be said that to manage any multi-business firm and maintain a company's competitiveness at the same time is a challenging task. Such was precisely the case with the Finnish conglomerate Tampella. It was through and through a technology-orientated company, and its top management faced the challenge to understand the benefits of technology integration in its business strategy and to have the decision-making capability to react without delays.[2] According to the outcome of many decades of managerial performance, it is evident that the determinants mentioned above had a significant negative impact on the company's profitability and competitiveness.[3] In this dissertation, I study Tampella's investment activities and technology choices, as well as the top management's organizational decision-making preceding these choices as determinants of competitiveness and, ultimately, the firm's downturn.[4]

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1 Mowery and Rosenberg 1979, pp. 105, 111, Cohendet and Llerena 2003, p. 286, Teece 2007, p. 1346.
2 Hayes and Clark 1985, p. 12.
3 Zahra and Covin 1993, p. 470, Crafts 2003, p. 19.
4 Skippari and Ojala 2008, pp. 238–262.

The primary motivation of this dissertation is based on the assumption that understanding the symbiotic nature of technology and business ensures sufficient financial preconditions for business continuity and further development.[5] Building on this idea, the main research question of this dissertation is, to what extent was Tampella's top management's capability sufficient to make decisions to create and maintain a profitable business in the context of the market, technology and organizational dynamics? Accordingly, Tampella provides a case study to examine top management's capabilities and their performative function in a diversified conglomerate company.[6]

Tampella was one of the largest Finnish conglomerate and private enterprises in the country, and it had a good position in terms of finance and its connections to the government.[7] Its history forms an exciting development path, where the changes in the competitive environment created a continuous flow of leadership challenges in terms of organizational design and technology. The technology management of Tampella thus offers an excellent case to study these competencies. Tampella operated in several lines of business, related and unrelated, such as the forest industry, metal (machinery workshops), textiles, power and plastics industries.[8] Such diversified business was typical of Finnish forest industry companies until the 1980s.[9]

Because Tampella represented conservative forest and metal industries, organizational features were one of the most critical factors to affect the firm's path-dependent technology changes and creative activities. From the perspective of Tampella as an organization, I focus on its management in terms of managerial attitudes,[10] learning-orientated culture,[11] managers' work experiences (including professionalism),[12] and the available market information.[13] The variables mentioned earlier support the management's decision-making process, which can encounter difficulties if the organization has no market- and learning-orientated organizational culture, managerial support and commitment for innovation and continuous improvement.[14] I primarily focus on the firm's capital investments, where an organization's changes and decisions usually take place.

During the 1950s and 1960s, Tampella's management focused on business which required the company to both expand its market to the West and make quality improvements on its products, whereas after the Second World War the

5 Porter 1991, pp. 102–103, Zahra and Covin 1993, p. 470, Teece 2007, p. 1326.
6 Hoskisson and Johnson 1992, pp. 625–634, Eisenmann and Bower 2000, pp. 348–355.
7 Skippari 2005, p. 81, Skippari et al. 2005, p. 63, Skippari and Ojala 2008, pp. 249–251.
8 Laurila 1997, p. 223, Laurila 1998, p. 116.
9 Laurila 1998, p. 113, Skippari et al. 2005, p. 51, Ojala and Lamberg 2006, p. 108. See Laurila 2002, Lilja and Tainio 1996, pp. 159–191.
10 Damanpour 1991, p. 558, Dougherty and Hardy 1996, p. 1148, Damanpour and Schneider 2006, p. 222.
11 Bull and Ferguson 2006, pp. 744–745, Burns and Stalker 2015, pp. 316–317.
12 Damanpour 1991, pp. 583–584.
13 Amabile 1998, p. 78, Freel 2000, pp. 76–77, Styles and Goddard 2014, p. 77, Hansen and Juslin 2005, p. 200.
14 Denzau and North 1994, p. 14, Dosi et al. 2003, pp. 14–16, Hansen et al. 2006, p. 217, Hansen et al. 2007, p. 1332.

company had focused especially on Soviet trade.[15] Based on the above considerations, Tampella's starting point in the 1950s was good for a successful business. It had its own machinery workshop, which made it possible to manufacture competitive paper and board machines for its production plants and its external customers. Furthermore, the machinery workshop was able to test the functionality of its technology without any delay at the firm's paper and board mills. In this way, it had every opportunity to deliver proven technology to its external customers, making its deliveries a significant reference with maximised sales profit. Furthermore, in Finland, Tampella had an excellent position to act as a member of the Finnish technology network, which provided it with external expertise and knowledge to develop its machinery and paper and board mills' performance.

In the 1970s and afterwards, Tampella's top management was constrained by massive debt simultaneously with large numbers of acquisitions and mergers, and the workshop's financing of customers' machinery. Around the same time, the challenges created by the Eurocan cooperation were felt, as well as the constraints of the TVW agreement signed by Tampella, Valmet and Wärtsilä.

Between 1980 and 1984, management's increased demands for international skills and knowledge were necessary due to the liberalisation of the financial markets, global competition, and the devaluation of Finnish currency.[16] Partly due to the challenges mentioned earlier, Tampella's machinery workshop started to focus on automation development, production flexibility and the establishment of a new spare parts business. Overall, between 1985 and 1989, Tampella's most significant interactions focused on debt management, concentration of operations, productivity improvement, development of new raw materials, and product-level wood-free paper and coated papers. The aforementioned organizational changes and individual actions were only temporarily successful as results improved and debt costs decreased. Finally, in the early 1990s, Tampella went bankrupt. External shocks and rapid changes in the operational environment hit the company hard when it was only partway to recovery. The significant reasons for the Nordic banking crises included external factors, such as the international economic downturn, bank credit losses, the increase in interest rates, and rapid fluctuations in exchange rates.[17] The collapse of Soviet trade added to the downturn in the national real estate market in Finland, and competitiveness weakened due to the revaluation of the Finnish mark and rising Western industrial interest rates.[18]

15 Skippari et al. 2005, p. 62.
16 Jalava et al. 2007, p. 301.
17 Kalela et al. 2001, pp. 52–101.
18 Jonung et al. 2009, p. 245, Kuusterä and Tarkka 2012, p. 724.

1.2 Understanding the effect of market dynamics

In this dissertation, I emphasise the importance of market orientation, including the understanding of customer requirements and the timing of related actions in managing technology to secure long-term customer relationships.[19] The customer-driven corporate culture was critical for Finnish companies like Tampella, due to customers being spatially distant from the company. Top executives needed constant information from the dynamic markets and about the changes in the competitive environment, which further emphasised the importance of the right timing of decisions related to technological changes.[20]

The basic approach in the analysis of the market part of the study is that the final decisions of the investments, technology adoption or portfolio changes of the business needed to include information about market dynamics, benchmarking technologies and other alternatives to reduce costs.[21] I focus on the technological investments and operational improvements of the various Tampella production units. This analysis defines the connection between market demand and technology change by focusing on the importance of sensing the competition environment, demand-pull, technology push, cooperation with end customers and suppliers, and product differentiation. It is based on the argument that top management needs to sense potential markets and react to significant changes in the competitive environment. The technological changes are defined in the time context of both investment decisions and operational performance activity. Then, the time dependence of technological change is analysed by market demand, market prices, financial crises, production volumes and production quality.[22] The analysis of the market part is based on the calibration model presented in Annex One. It defines the goodness and the importance of the investments made in Tampella. Some of its significant investments were quite positive and important for operations. Respectively, at its weakest, a single investment was significantly *negative* and vital for operations.

The timing of the technology change was also one of Tampella's critical factors for success, as its ability to create profit both in the machinery workshop and in the forest industry was strongly dependent on the global economic cycles and development in these industries. Utilising customer feedback should have been a critical factor for Tampella's machinery workshop to provide technologically competitive products for customers both in the short and the long term. In the case that machine delivery does not meet the requirements set for it, a general practice in the pulp and paper industry is that the customer does not pay his bills

19 Lee et al. 1999, p. 41, Cohen and Kozak 2001, p. 110, Crespell et al. 2006, pp. 570, 574, Ngo and O'Cass 2012, p. 864.

20 Senge 1990, p. 23, Adner and Levinthal 2001, pp. 616–617, Hult et al. 2004, p. 436, Teece 2007, p. 1328.

21 Dess and Davis 1984, p. 477, DeBresson and Lampel 1985, p. 185, Rosenberg 1994, pp. 12, 248.

22 Atkinson and Morelli 2011, pp. 1–70.

before the requirements are met, receiving replacement equipment and services free of charge. As a result, the machinery workshop's cash flow and profitability may deteriorate further in the short term if such failures in deliveries occur. That was precisely the case in 1969, for instance, when Tampella's Eurocan Pulp and Paper Kitimat investment's additional funding accounted for FIM 43.6 million, which raised the financial credit of the entire investment to USD 81 million.[23]

From a long-term perspective, Tampella's machinery workshop was capable of developing the technology required for continuous product developments, in terms of both quantity and quality, to meet the needs of customers. It is evident that the machinery workshop's capabilities regarding the technological changes were mainly based on demand-pull factors, but also partly on technology-push factors.[24] Based on the above, I analyse technology change in terms of the demand pull, technology push, cooperation with end customers and suppliers, and product differentiation.

From an organizational perspective, investment decisions and implementation require skilful management, as there may exist resistance within the organization to changes during business restructuring or managing the customer interface.[25] For this reason, in this study, the analysis of both organizational and technological activities is based on capacity expansion, manufacturing flexibility, scale and scope management, product cost structure, and quality improvements. The management needs to understand the factors of the pricing dynamics and mechanisms, consumers' changes in buying habits, end products' cost efficiency and multi-product production.[26] The analysis of the timing in terms of the economic cycles is based on understanding the market dynamics and portfolio diversification to adopt the technology.[27]

From the perspective of Tampella's pulp and paper industry, the optimal investment activity should have taken place when the market demand was *negative*.[28] This means that when demand is active, a company should design future investments and maximise profitability by having a full capacity utilisation rate in production. Immediately when the market declines, a company should implement the investments planned earlier. The aforementioned is only possible by having a market orientation strategy to gain necessary market information, and anticipatory portfolio management to generate new possibilities according to the customers' modified requirements. The top management's fundamental strategy decision is to take advantage of the downturn in markets and recessions when implementing their technology investments in

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23 *Talouselämä* 1969, No. 39.

24 Mowery and Rosenberg 1979, pp. 102–153, Dosi 1982, pp. 148–150, Cohen 1984, p. 777, Abernathy and Clark 1984, p. 21.

25 Chandler 1994, p. 115, Hansen et al. 2007, p. 1332.

26 Spence 1981, p. 49, David 1985, p. 336, Narver and Slater 1990, p. 32, Mansikkasalo et al. 2014, p. 28.

27 Mitchell 1927, pp. 182–186, Anderson and Tushman 1991, pp. 30–31, Bridges et al. 1991, p. 268.

28 Diesen 1998, pp. 127–128.

terms of an increase in production capacity and the technical development of the products sold.

Based on the above considerations, the research question from the market perspective is, to what extent did Tampella's top management take market factors into account in its decision-making around investments and utilise the received information about the changes in the competitive environment? The market factors to be analysed are product demand, product price, production quantity and production quality.[29]

1.3 Path dependence and firm-level technological development

The high value of technology investments and the estimated thirty-year lifetime of the machines highlight the significance of the technological and market path dependencies for the company's success in the forest industry.[30] This was also the case with the technology company Tampella, whose profitability was primarily based on technology designed to produce advanced paper and board machines in the machinery workshop and qualified paper and board grades in the forest business unit. In this case, the technology includes management of technological change processes, technological know-how, a managing organization in terms of knowledge and committed resources, and variations with the business strategy and specific competitive initiatives.[31]

In terms of the profitability of Tampella's business, the advanced technological development of its machinery workshop was a necessity due to international competition and a capital-intensive industry. In capital-intensive industries, technological discontinuity occurs when the company's past capabilities of the product or production technology become obsolete and a firm needs to rapidly adopt technology with new advantages.[32] Understanding market fluctuations is one of the essential prerequisites for ensuring long-term business operations. A good example is the collapse of global newsprint demand in the 1990s.

Based on the above considerations, the research question is, to what extent did the firm's machinery workshop create a competitive advantage for Tampella's paper and board production units in global market areas? This relates to whether Tampella's paper and board machinery technologies were altered in a way that made the previous capabilities obsolete and required a rapid adoption of new ones.[33] In the analysis section, I focus on such technology variables as the width and the speed of paper and board machines, both of which are significantly path-dependent and based on past managerial decisions.

29 Bergman and Johansson 2000, p. 22.
30 Magee 1997, pp. 234, 259.
31 Porter 1985a, p. 64.
32 Laurila 1998, p. 20.
33 Hoskisson and Johnson 1992, pp. 625–634.

1.4 Conceptual framework, methods and data

The presentation of this dissertation is an analytical and comparative narrative on Tampella's life cycle between the years 1958 and 1995.[34] The reader needs to understand that the analysis has been conducted without a statistical method, as its conclusions are based on the decisions made by the firm and their impact on the firm's performance. This dissertation does not examine the decision-makers' perceptions of their motives at the moment of the decision-making, but rather analyses these motives on the basis of the conclusions and outcomes they caused. This means, from the perspective of historical science, that I study company top management as part of an organization, as Alfred D. Chandler, for example, has done in several of his studies of large corporations. From a business economics perspective, I focus on researching a company's top management organization in line with the direction of management research. I do not study business leaders as individuals, because between 1958 and 1995, several firms' executives and top management experienced transformation from entrepreneurs to professional business leaders.[35] Similarly, the accuracy of the source material is not sufficient to analyse company management at the level of individuals.

I analyse the factors of the firm's technology development in detail at the plant and at the level of the paper and board machines. A long-term and descriptive quantitative approach is needed due to the consequences of the strategy, as organizational changes materialise particularly slowly.[36] The reason for the approach above is the conglomerate Tampella's diversified industry and its size (i.e. the number of its industries and employees), while the high turnover and the operations in the international market make it an exciting, yet challenging research subject. The fact is that the company failed to survive, despite its size and national industry network, clusters, sales cartels, and state interventions.[37] The company had every chance to succeed against the global competition, as its business environment was international already at a very early stage.[38] It enabled new possibilities to expand the businesses and high turnover based on a broadly diversified customer base. On the other hand, the global economic crises had significant effects on the company's financial performance.

I focus on the management's capability to sense the business opportunities brought by managing technology, which needed to be integrated into the company's business strategy by managing the organization.[39] Even though history has presented tremendous development over the last two centuries, not all academics see the importance of integrating technology into the core strategy of a

34 Gill et al. 2018, pp. 191–205.
35 Karonen 2004, p. 255. For instance, the appointment of the Board of Directors in the Kymi Paper mill at the end of the 19th century.
36 Hellgren and Melin 1993, p. 67.
37 Chandler 1994, p. 18.
38 Skippari 2005, p. 104.
39 Porter 1985a, p. 66, Markides 1997, p. 22, Toivanen 2004, pp. 301–302, Teece 2007, p. 1346.

company. The majority of business scholars would agree that the success of a company is often technology-dependent and based on market dynamics. Likewise, customer feedback is significant. Based on the literature review, only a few academics emphasise the capability of the company's management in value-adding customer feedback in increasing its business.

The basic idea behind this dissertation is that the firm's operations depended on both endogenous and exogenous factors in the logic of the technological decision-making of the technology change. The endogenous core variables are the top management's capability to manage an organization and the firm's underlying technology. The market is the exogenous variable. I strongly focus on examining management decision-making from an organizational perspective, based on the fact that the research material mainly comprises senior management minutes and meeting memos.

The technology change or investments, the firm's profitability, and diversified industries are the consequences of the top management's decision-making process in the context of the managing technology and organization, understanding the dynamics of the exogenous market events. The essential challenge of the Tampella conglomerate's executives and top management was to combine critical interconnected factors of endogenous technology and organization with the exogenous market, in order to secure needed financial resources in terms of sufficient cash flow and existing financial and machinery assets. Some scholars distinguish the technological orientation of manufacturing and market-orientated leadership, but this dissertation indicates that these strategies need to be managed and developed simultaneously and with the same business values.[40] It means that the development of the market, technology and organization need to be developed hand in hand.[41] Many scholars have the same approach regarding the mature pulp and paper industry as well, as they state that productivity is improved by small and gradual technological improvements and innovations, the scale and scope of operations, and the corporate strategies of expansion and diversification, new organizational innovation, geographical concentration, and finances.[42]

Analysing an organization's capability is a highly challenging research topic due to the conceptual fuzziness surrounding research on capabilities.[43] I define the organization's capability as including dynamic capability, which is critical to the company's short- and long-term success in the context of the investment.

An organization acts as a transformation agent, which engages in implementation based on the decisions of top management. That is the reason why business scholars focus on the critical factors of an organization's resources, such

40 Chandler 1994, p. 454.
41 Chandler 1994, p. 31.
42 Abernathy and Utterback 1978, p. 41, Porter 1985b, pp. 12–13, Hernández–Trasobares and Galve–Górriz 1999, pp. 1077–1086, Toivanen 2003, p. 5, Chandler 1994, p. 21, Wiersema and Bowen 2008, p. 119, Yang 2012, p. 37.
43 Laaksonen and Peltoniemi 2016, p. 2.

as managerial competence, the integrated customer-orientated attitude, and diversified organizational populations.[44] It is also the reason why the market-orientated decisions of executives and top management reflect the organizational culture in this dissertation. I do not study the organization's processes as I analyse the role and the decisions of the senior management, whereby the primary variable of the organizational behaviour is the leadership capability. In Tampella, managerial decision-making and technological investment considerations acted as the executive agent between the firm's various business units in both domestic and foreign sister companies.

The second determinant of the organizational behaviour, managerial competence, highlights the individual investment activities of the middle management. I primarily analyse the management's ability to understand the business environment combined with the market and technological investments in Tampella, particularly in the context of its long-term development and profitability. I focus on their capability to execute daily operational issues, as their working environment was framed and guided on the basis of the board members and executives' strategies and decisions.

Analysing management decisions in the past is challenging due to final decisions being the sum of multiple factors and a continuous process. The factors that affected Tampella's rational decision-making were, for instance, past decisions and the related consequences or alternatives, routines, personal preferences and conservatism, uncertainty and delays, co-ordination of the risk decisions and threats, incomplete and inconsistent goals, organization structures, learning and knowledge absorption.

The analysis itself proceeds as follows: first, the distribution of the organization capability factors among all units and one production unit is analysed at the level of organizational analysis. It defines the decision-making importance of the head offices and the local production units. After that, the distribution of the investment and operational performance activities based on the organization capability factors is analysed between business units and the distribution within the individual units. As a result, I can determine the company's dominating unit per the individual organization's capability variable.

In the historical analysis, the decision-making capability of the company's management reflects the ability of the operations to create the net profit. Other key economic indicators are the investments per turnover, the investment ratio to the earnings, the gearing and equity ratio, the calculated return on investments and equity, and productivity. These financial results are compared to the corresponding economic indicators of two early Finnish forest industry giants, Kymi Oy and Enso-Gutzeit.[45] These companies had many similarities with Tampella. Both of them had early internationalisation, the development of a large-scale enterprise with significant turnover, diversified businesses, and active control by the government, and both represented the Finnish forest industry.

44 Hannan and Freeman 1993, pp. 7–10.
45 Ojala 2001, pp. 27–55, Lamberg 2001, pp. 56–69, Lamberg 2005, pp. 93–122.

Internal factors emphasise the critical role of Tampella's machinery workshop, both for its product development and for the technological performance of its forest industry. This technological merit is compared to the speed and width of the machines manufactured by Tampella's machinery workshop, and its paper and board production plants to its global competitors in four different market areas.

In the following analysis, available technology is defined as a variable, a precondition for the top management's decision-making and, at the same time, the result of strategic decision-making by top management.[46] The character of the technology reflects that technical knowledge is both a result and cause of economic changes, as technological progress should reduce uncertainty and variation. Some other academics have stated that economics has little to do with technology development.[47] To manage technology, as a core internal factor, it is necessary to emphasise the role of Tampella's machinery workshop both in its product development and in the technological performance of its forest industry. As most scholars highlight the technology perspective, Tampella's technological development was also based on the firm's capability to succeed through technological change and creativity, which need to be based on research, innovations within the firm and industry, and the organizational culture to develop the technology.[48]

The research questions culminate precisely in whether Tampella's business was due to its internal factors, its managing technology or organization, or external and international market factors. According to the structure of the dissertation, Tampella was the first to analyse significant technological changes or investments concerning external market factors, which can be divided into five different variables. The Finnish institutions' vital role in Tampella's decision-making cannot be ignored entirely, as the state had different activities in terms of the firm's control as an owner and its funding as a customer. The presentation of this dissertation is narrative, and thus the contribution of the above factors to Tampella's life cycle is similarly presented alongside other relevant events.

In the analysis of the market part, I focus on the technological investments and operational improvements of the various Tampella production units. I define the connection between market demand and technology change by focusing on sensing the competition environment, demand-pull, technology push, cooperation with end customers and suppliers, and product differentiation. It is based on the argument that top management needs to sense potential markets and react to significant changes in the competitive environment. The technological changes are defined in the time context of both investment decisions and operational performance activity. Then, the time dependence of technological change is analysed in terms of market demand, market prices, financial crises, production volumes,

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46 Zahra and Covin 1993, p. 470.
47 Arrow 1969, p. 35.
48 Mokyr 2003, pp. 50–55, Piperopoulos 2012, pp. 6–8.

and production quality.[49] The analysis of the market part is based on the calibration model presented in Annex One. It defines the goodness and the importance of the investments made in Tampella. Some of its significant investments were significantly positive and important for operations. Respectively, at its weakest, a single investment was significantly *negative* and vital for operations.

In all industries engaged in international competition, and especially in the paper industry, a challenging issue is how management takes into account and observes the local and global economic cycles.[50] During an economic downturn, the company needs to be sensitive to capital investment timing, liquidity, the decentralisation of the markets, and the production amount and locations of the inventories. In this analysis, I focus on the connection between the economic crises and technological investment activities constrained by the following determinants: understanding of local market sensitivity, strong market position, diversification of sales areas, and timing of business cycles to adopt the technology.

This longitudinal study of Tampella's history requires a theoretical approach of previous academic research in all three areas.[51] The research questions are presented in the relevant sections of the literature and emphasise previous academic research in the paper industry, as well as the author's long personal experience of more than thirty years in this specific field. This pragmatic approach characterises the entire dissertation, in which the author has sought to concretise the impact of critical individual variables on the overall technological development of the company under study and the technological development of paper and board machines.[52] This issue is fundamental, because a diversified Tampella manufactured both machines and paper and board products.

Similarly, the author of this dissertation has worked for companies representing both industries, which is why it is reasonable to give practical details from both the machinery and paper industries' perspectives. Based on the aforementioned, one this dissertation's purposes is to create a dialogue between the author and the reader based on self-reflection on both sides, thus developing the expertise and knowledge of both.[53] In this dissertation, the self-reflection method is used differently in different contexts. From a market perspective, I use self-reflection to evaluate and bring different perspectives on the importance of different market variables in technological investment decision-making.[54] Furthermore, I use the self-reflection method to frame this analysis, because paper and board machine technologies are far too broad to be covered comprehensively. This means above all that empirical analysis of technology includes only two factors: the designed width and speed of the machines. These variables are the most critical factors in terms of paper machine production capacity. They correlate with the machinery manufacturers' level of competence and knowledge.

49 Atkinson and Morelli 2011, pp. 1–70.
50 Hjerppe 1989, pp. 53–60.
51 Bergh and Holbein 1997, pp. 557–571.
52 Ruohotie 2005, pp. 205–206.
53 Siebert 1999, p. 55, Ruohotie 2005, pp. 209–210.
54 Boud et al. 1985, p. 58.

In this dissertation, I do not analyse society's significance of a company's decision-making, even though the national investment in technology, human capital, and physical capital played an important role in the company's development.[55] The company-level technology investment's contribution to national economic growth, in turn, is a complex phenomenon, and it has multiple critical micro-level, qualitative aspects, including the socio-cultural relevance of these investments.[56]

This dissertation is based on extensive literature review of four primary factors under examination: market dynamics, technology change, organization, and leadership capability. The literature on Finnish economic history focuses on economic growth and integration into international and liberal trade systems.[57] In this growth, process scholars highlight the role of the state, which commands and co-ordinates the national financial and banking system, significant corporate governances, and the education system.[58] After the Second World War, Finland's and Tampella's memberships in various trade unions and institutions were perceived as an essential factor for important foreign trade.[59]

In macro-level economic history research, researchers utilise time series data such as gross domestic product per capita, labour productivity, foreign direct investments, the ratio of imports and exports to gross national income and its structure, the foreign trade exchange ratio, territorial distribution of foreign trade, total demand and supply by industry, and monetary value changes.[60] In the Finnish case, this data is usually compared, for instance, with those in other Nordic countries, Europe, and the United States.[61] More seldom, these national-level figures are compared with company-level development. This is because economic and business history research is to a certain extent separated in Finland and elsewhere.[62]

What matters in analysing the quantitative data in a time series is the possibility to determine the goodness of the company's operational activity, which in turn is based on the top management's strategies. Although the quantitative data in this study is based on annual balance sheets, these figures should not be directly compared with the absolute values. These figures primarily tell the reader the current meaning and magnitude of the variable, and secondly, the comparable time series of the entire analysis period. This is due to differences in company accounting practices, banking system legislation, and the monetary value of changes.[63] For instance, the comparison of the results should take into

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55 For the development of the Finnish society, see Ojala et al. 2006.
56 Barrell and Pain 1997, pp. 1770–1786, Carlsson 2003, pp. 15–16.
57 Ojala and Karonen 2006, P. 124.
58 Lilja et al. 1992, pp. 152–153, Eloranta et al. 2006, pp. 22–23, Wuokko 2017, pp. 27–29, Ojala et al. 2019, pp. 12–13. See Kuisma 2008.
59 Ojala and Karonen 2006, p. 97.
60 Barrell and Pain 1997, pp. 1770–1786, Broadberry et al. 2010, pp. 1–69, Bolt and Van Zanden 2014, pp. 627–651. See Schön 2010, Broadberry et al. 2015.
61 Eloranta and Ojala 2018, pp. 142–169, Ojala et al. 2019, pp. 9–18.
62 Ojala et al. 2017, pp. 305–333, Ojala 2017, pp. 446–456.
63 Hjerppe 1989, pp. 33–40.

account the changes in the value of money in 1963[64] and accounting law in 1974.[65] The effect of other specific factors on the general performance statistics published by the company is not distinguished in this analysis due to a lack of adequate verification. These kinds of factors include protective tariffs, cartel agreements, captive markets and monopoly positions based on their total or partial ownership by the state.[66] These determinants are widely studied in previous Finnish research.[67]

This dissertation utilises international and national information sources, such as the Central Archives of Finnish Business Records (Elka),[68] reports of Jaakko Pöyry Consulting Oy, Angnus Maddison's database, IMF's databases, and FAO databases. The primary company-level data is retrieved from the Tampella company archives held at Elka. This archival data includes detailed information on investment decisions made in the company. After systematic categorization of 724 investment activities of all factories and head offices from 1955 to 1995, the related performance has been examined from a longitudinal perspective, which pays attention to industry-specific time and location-based criteria. The analyses of the organizational factors related to Tampella's technology decisions are based on 339 investments or operational performance activities, which are listed in Annex 5. All activities' analysed data are listed in Annexes 3–5. The qualitative analyses are based on the companies internal reports, industry-specific journals (*Talouselämä Journal*, *Paper and Timber Journal*) and related academic literature. A detailed company history is based primarily on Tampella's annual reports between 1958 and 1995 and the Forest Industry Professional *Paper and Timber Journal* between 1957 and 1996. The approach mentioned above is justified by the fact that the company archives mainly focus on senior management records and meeting memos. Price and capacity data for global markets are based on the Worldbank's database between 1961 and 1995 and Maddison's database from 1958 to 1960. The technology data consists of Pöyry Consulting Group's paper and board machine data from 1950 to 1996.[69]

The contributions of this paper are as follows. First, this dissertation demonstrates that the organizational capability of a company's top management is a critical factor in ensuring a company's long-term profitable operations based on dynamic capability theory and mobilizing an in-depth single case study of a leading firm. The top management's capability to make decisions is based on the combination of technology management and creativity, organization behaviour,

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64 The year 1962 was the last year when Finland had an old mark. Its value was 100 times higher than the new mark.
65 Näsi 1990, pp. 204–205. See also Virtanen 2007.
66 Ojala and Karonen 2006, pp. 107–108.
67 Fellman and Shanahan 2018, pp. 647–648. See especially Fellman 2015, Jensen-Eriksen 2011, Jensen-Eriksen 2017, and Järvinen et al. 2012.
68 ELKA stands for Suomen Elinkeinoelämän Keskusarkisto (The Central Archives for Finnish Business Records).
69 Ainamo 2005, pp. 19–43. The Jaakko Pöyry Consulting group was the most important Finnish technology consultant company in the paper and pulp industry.

and understanding of market dynamics.[70] These are critical determinants for sensing business opportunities and generating a profitable business. Especially in the mature pulp and paper industry, the leaders' capability to sense the business environment is essential for a firm's long-term survival due to most critical technological change decisions being strongly path-dependent and nonergodic.[71] Furthermore, a market-orientated attitude is needed to secure the competitive advantage of both paper and board products and machinery types of equipment in the global markets. Without exception, ignoring market information leads to a firm's stagnation. An excellent example of this is the collapse of the Nokia corporation's handset business in 2013.[72]

Second, an in-depth analysis of a single case proves the importance of a firm's top management's capability to understand the core functions of its businesses, technology and organization. By understanding and learning, the firm is capable of surviving. From the technology perspective, it means that the technology needs to be integrated into the firm's strategy to maintain its competitive advantage and to avoid possible future constraints based on past investment decisions. From the organization perspective, it means continuous knowledge adoption and learning by motivated and committed employees. For instance, from the national perspective, the failure to make the best use of existing technology can create long-lasting challenges for the firm. The fate of the British paper industry's commitment to using esparto grass instead of available sulfite pulp as raw material until the 1880s is an illustrative case of the failure to adopt new technology in time.[73]

The third value-add is proving that a firm's cash flow management is among the most critical determinants for success and failure, which I based on the firm's executives and top management's capabilities. This is evident, as Tampella's top management did not understand its importance in time.

From the perspective of making an academic contribution, this dissertation extends the theoretical framework of business history and indicates a rarely used approach of dialogue between business history on one side and organizational theories and strategy on the other side. From the business history perspective, this dissertation focuses on the actual operation of a company based on an organizational knowledge and capability, while several business historians prioritize their research in relation to the emergence and diffusion of a multidisciplinary structure (see, e.g., Chandler 1982 on organizational structure, background, and consequences). Furthermore, this dissertation focuses on industry history and industry research that highlights the characteristics of the pulp and paper industries, including forestry clusters and their impact on a firm's profitability in the

70 D'Cruz 2008, p. 14.
71 Since 1897 in Inkeroinen and 1938 in Anjalankoski, their decisions had a nonergodic nature as the major technological changes in the early period had meaning and consequences for later choices based on the machinery, resources of the wood, water, and employees. *Paper and Timber Journal* 1972, No. 10, pp. 667–668.
72 Lamberg et al. 2019, p. 24.
73 Mokyr 1990, p. 261, Särkkä et al. 2018, p. 238.

context of technology, the markets and their overall dynamics.[74] Compared to several macro-level global comparative studies in the pulp and paper industry (such as Lamberg et al. 2012), this paper emphasizes the researcher's industry knowledge, which enables highly detailed factory-level research in the context of the markets, technology and organization.

1.5 Tampella as part of unique Nordic economic growth

The origins of modern economic growth, industrialisation, and modernisation are all well documented, as are the technological advances during these processes.[75] The black box, however, has been the organizational level, that is, firms and entrepreneurs taking technological advantages into use.[76] In Nordic countries as well, national economic growth was based on natural, technological, economic, human and collective resources, whose exploitation evolved together.[77] Industrialisation induced economic growth and structural change from agriculture to manufacturing industries. One consequence of this process was modernisation. That, in turn, changed the social and institutional order, knowledge, attitudes, and values, which, in turn, generated material and cultural growth.[78] This growth and modernisation were created through innovation and technological processes. According to David Landes, '*the creativity promoted growth and the growth provides opportunities for further innovation*'.[79] Since the eighteenth century, industries and machines were modified and transformed in the capitalised context to be faster and more significant in economic processes than before.[80] The most advantageous technological changes during the so-called first industrial revolution were related to steam power, chemistry, railway transport, paper, and metallurgy with steel, iron, and mechanical devices.[81]

This process of industrialisation, which also took place in Finland and at Tampella since the mid-19th century, was mainly based on the development of technology and national rail and waterway connections.[82] Nevertheless, the Finnish industrialisation is usually dated to the early 20th century rather than to the

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74 I am grateful to Professor Takafumi Kurosawa for the structuring of the academic contribution of this dissertation.

75 Rosenberg 1994, p. 9. There are, however, different explanations for economic growth; some of them, for example, emphasise technology development (Mokyr 2005, pp. 4–7), some internationalisation (O'Brien 2006, pp. 34–39), some human capital and institutions (van Zanden 2016, pp. 14–15) and some cultural change (McCloskey 2016, pp. 6–18). These discussions are summarised, for example, in Ojala 2017, pp. 446–456.

76 Rosenberg and Birdzell 1986, p. 2, Autio et al. 2014, p. 1099.

77 Ray 1980, pp. 9–19, Hjerppe 1998, p. 14, Lindmark and Vikström 2003, pp. 71–77, Oinas 2015, p. 1228.

78 Sölvell 2015, p. 478.

79 Landes 2003, p. 19.

80 Rosenberg and Birdzell 1986, pp. 2–3.

81 Simon 1986, p. 2, Landes 2003, pp. 2–3.

82 Ojala and Karonen 2006, p. 109.

19th century.[83] After the 1860s, Finnish wood products were mainly sold to Central and Western Europe after more liberal economic regulations and its own currency.[84] Paper sales were concentrated in the Soviet Union, especially after the paper mills started to use wood pulp as a raw material for paper instead of previously used rags. In 1860–1913, the total value of Finnish forestry exports increased by about 25 times, and exports of Finnish wood products to Central and Western Europe amounted to 3.4 million cubic metres in 1913.[85]

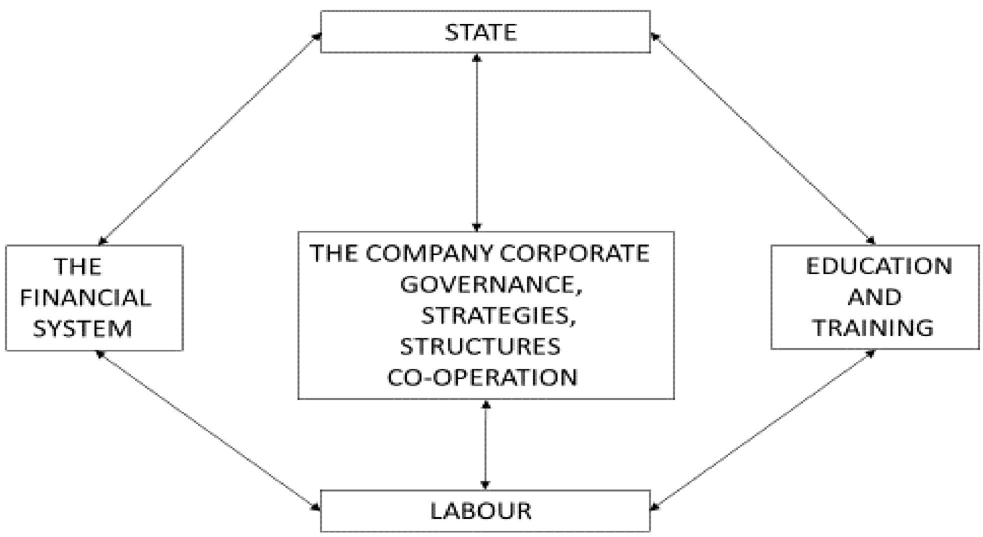
The economic and social growth of a small, agrarian European periphery, Finland, followed the path of such leaders as, for instance, Germany, Britain and the United States.[86] During the twentieth century, the development highlighted the interaction of variables illustrated in Picture 1.[87] The role of technology was critical for the growth of the Finnish national economy and the success of individual companies, including Tampella. Finland did catch up with other European countries, mainly in the 1960s and 1970s, and Sweden in 1965–2003.[88] Two significant reasons for the productivity growth were industrialisation and intra-industry productivity growth, which was based on the increased capital intensity of production, improved education and technology.[89]

The technological know-how in Finland was based primarily on technology transfer, including imported machinery and other types of equipment, which were mainly developed and produced in France, Germany, Britain, and the United States.[90] The technology transfer for paper machines was based on manufacturing licenses at the turn of the 1950s, direct foreign investments, recruitment of foreign experts to Finland, and travelling abroad for learning, including at Tampella.[91] After 1954, Valmet Oy delivered its first paper machine to the Simpele paper factory, and many Finnish machine suppliers received orders both from Finland and abroad. Among the most important ones was the board machine order in 1963 from the USA.[92] From the technology perspective, the most important single factor was the development of electricity as an energy source, which improved the profitability of the Finnish industry and also, for instance, American factories as a whole.[93] The introduction of electricity as the energy source is often referred to as the second industrial revolution.[94] In 1960, the Finnish electro-industry firm Oy Strömberg Ab, for example, focused on alternators, voltage regulators, and speed controls for electric motors. Over the next decade, they developed electronic control and automation systems, which significantly

83 On the timing of the Finnish industrialisation, see especially Hjerppe 1988, pp. 95–99.
84 Ojala and Karonen 2006, p. 106.
85 Kaukiainen 2006, pp. 11–12.
86 Kettunen 2006, pp. 9–10.
87 Fellman et al. 2008, p. 7.
88 Hjerppe and Jalava 2006, pp. 46–49.
89 Kokkinen et al. 2007, p. 157, Jalava 2019, p. 196.
90 Myllyntaus 1990, p. 626.
91 Poropudas 1996, p. 355, Särkkä et al. 2018, p. 44.
92 Hoffman 2019, p. 168.
93 Chandler, Jr. 1991, p. 32, Myllyntaus 1991a, pp. 31–32, Rosenberg 2004, p. 5, Jalava and Pohjola 2005, pp. 11–12, Jalava et al. 2007, p. 62.
94 Myllyntaus 1991b, pp. 309–311, Chandler 1992, pp. 91, 95.

improved paper machines' productivity development.[95] Technology imports from Scandinavia focused more on the power and wood-processing equipment.[96] As a result, the Finnish foreign trade grew and the share of the educated population increased, whereas family size, rural population and income inequality decreased. Between 1919 and 1939, Finnish exports increased fourfold despite increased protectionism, and from 1900 to 2000 Finland's national gross domestic product grew twelvefold.[97]

Picture 1 A conceptual model of the business system's institutional logic of the Nordic countries.



Source: Fellman et al. 2008, p. 7.

The development of Tampella was a gradual process, and it co-evolved with more general Western economic growth. The role of national governmental activities and innovation systems had an essential role in the success of the development of the national industries and companies such as Tampella.[98] Already before the Second World War, the Finnish market economy was relative liberal.[99] However, global political and financial decisions created uncertainties and unpredictable challenges.[100] In Western countries, private companies had autonomy in the decision-making and received advantages from innovations in trade, technology, and organizational innovations.[101] Equally important was the

95 Tushman and Anderson 1986, pp. 439–465, Hoffman 2019, p. 171.
96 Myllyntaus 1990, p. 625.
97 Hjerppe et al. 2006, p. 3, Kaukiainen 2006, p. 16, Haapala 2009, pp. 50–52.
98 Ojala et al. 2018, pp. 98–107.
99 Jalava et al. 2007, p. 301, Fellman 2019, p. 293.
100 Boies 1989, pp. 821–833.
101 Rosenberg and Birdzell 1986, p. 3.

availability of capital, labour and natural resources, released political and religious control, institutional innovations and integrated science and industrial technology.[102]

The growth of the economy, development of technology, and societal change as a whole were also core elements in Tampella's evolution to become one of Finland's largest companies. Especially in the early decades of the company, its top management experience and organizational performance were based on social position more than professional experience or education.[103] This was the case in several other Finnish companies at the time as well.

The successful delivery of war indemnities to the Soviet Union further supported bilateral trading, including at Tampella, which improved the technological development of its machinery workshop.[104] In turn, growth of the national economy, societal development and the national forest industry's network further supported the company's growth, for instance, by the increased availability of the educated population. Since the 1960s, the Finnish government invested in science and technology to adopt and utilise new technologies, which generated the availability of labour.[105] Especially important for Tampella were the national forest industry's intensive investments in technology, the central bank's favourable interest rate policy for industry, and the agreement of the National Forestry Financing Programs (Metsätalouden rahoitusohjelma, MERA) for funding between the government, forest industry companies and forest owners, which supported related forest industry activities.[106] Investments by Finnish forest industry companies increased the net sales of Tampella but also improved the development of the technology.

In general, still in the 1870s, Finland was significantly behind the average of the Western countries in terms of its gross national product.[107] The First World War, which began in 1914, weakened the economic development of all Europe, including Finland. Also, the Soviet Union's revolution and civil war in 1918 contributed significantly to the decline in Finland's gross domestic product until 1922.

Since the first globalisation period from the 1820s to 1913, Finland's economic growth has been tied to exports. Since the 17th century, these exports were mainly forest-related products, first tar and timber to its largest market, Western Europe, and later on pulp and paper products. The Soviet Union was the largest single trading country, where agricultural and the bulk of industrial products were exported. Nevertheless, the markets for traditional forest industry products such as timber were still in the West, while paper and pulp were exported mainly to the Soviet Union. Between 1809 and 1917, Finland was autonomous as a Grand Duchy of the Soviet Union, which ended in 1917 with Finland's independence.

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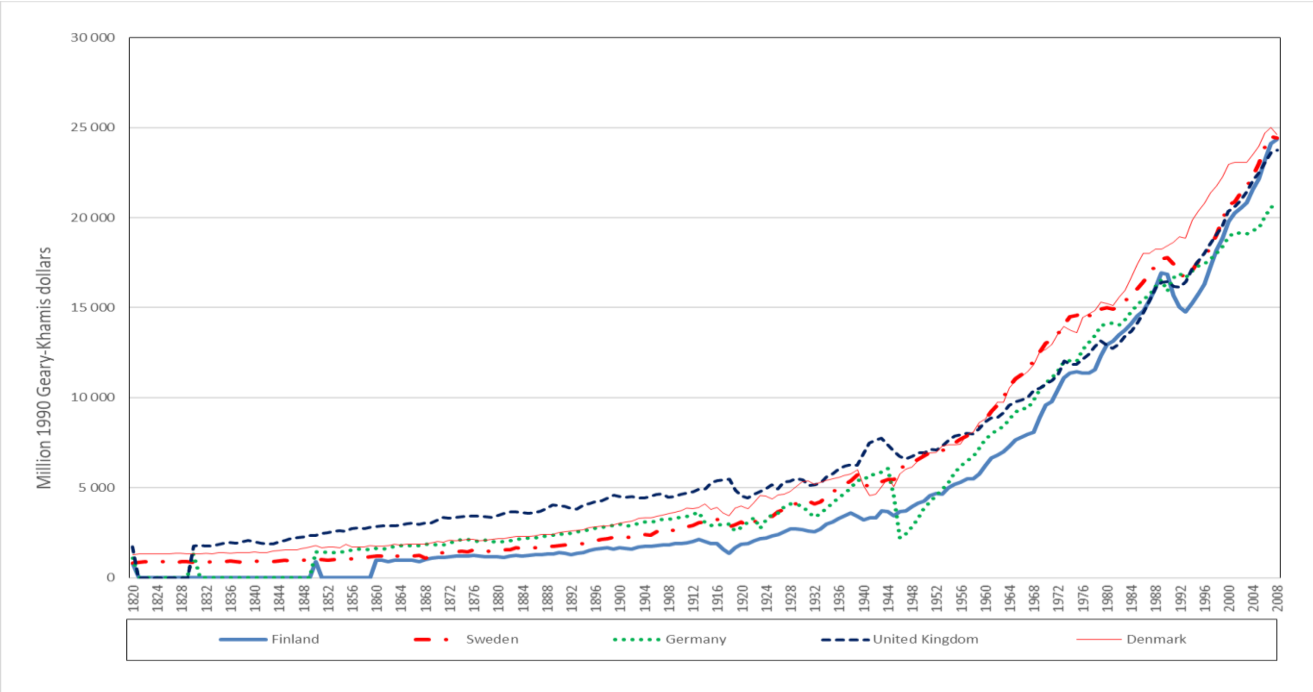
102 Rosenberg 1994, p. 96.
103 Skippari 2005, pp. 117, 179, Skippari and Ojala 2008, p. 258.
104 Skippari 2005, p. 75, Kochetkova 2017, pp. 43–44.
105 Skippari 2005, p. 95.
106 Jensen-Eriksen and Ojala 2015, p. 539, Ojala et al. 2018, p. 100.
107 Hjerppe 1990, p. 35.

One year after independence, the collapse of the Soviet Union trade forced Finland to look for new markets in the West. In this challenging task between the 1920s and 1930s, Finland succeeded well, with exports based on the paper and pulp industry's lower production costs than the other Nordic countries, the devaluation of the Finnish mark, active cartels and the centralised sales activities of the national pulp and paper company.[108] At the time, the leading Finnish export products were paper and board products, paper machines, elevators, and icebreakers. Finnish forest industry companies established sales cartels, such as the Finnish Paper Mills' Association, Finpap, and the Finnish Cellulose Union, Finncell, to promote sales in demanding Western markets and to take care of shipping activities already in the year 1918.[109] In addition to the aforementioned main activities, the sales cartels also shared risks, collected business and technology information, and borrowed funds.[110] The Nordic countries established a joint sales cartel, Scankraft, in the power and paper industry in 1932.[111] Similarly, Tampella established a joint venture (Tehdaspuu) with Ahlström and Kaukas in 1967, which focused on purchasing wood.[112]

When the First World War broke out, Finland's GDP per capita was on par with the rest of Europe, but still among the lowest in Western Europe.[113] After the Civil War (1918), Finland experienced economic growth until 1927. After that, Finland experienced an overheating of the domestic housing market and the global Great Depression of 1930, as a result of which Finland's gross domestic product fell by more than 4 per cent between 1929 and 1932, but then grew until 1938. Between 1939 and 1945, World War II caused an economic recession, but after the war growth accelerated again. After 1948, rapid growth began in Finland and also in other developed countries. As a result, Finland's GDP growth accounted for 4.9 per cent and GDP per capita 4.3 per cent between 1950 and 1973, which was among the highest in Europe (Picture 2).[114]

108 Kuisma 1993, p. 253, Kuisma 2011, pp. 245, 252, 257, Ojala and Tenold 2018, p. 267. See also Heikkinen 2000.
109 Kuisma 1993, pp. 253–255, Jensen-Eriksen 2017, p. 4. See Tampella internal memo in 18.5.1961 about Metex, which took care of the Finnish metal products' centralised sales to the Soviet Union and developed international sales.
110 Näsi et al. 2001, p. 39, Skippari et al. 2005, p. 62, Jensen-Eriksen 2010, pp. 10–11. See Heikkinen 2000.
111 Jensen-Eriksen 2013, p. 31.
112 Näsi et al. 2001, s. 181.
113 Hjerppe 1990, p. 35.
114 Hjerppe 1990, p. 36.

Picture 2 Gross Domestic Product per capita from 1820 to 2008 in Finland and certain European countries (in Geary-Khamis $).



Source: Maddison 2008 from 1820 to 2008.

From the interwar period to the end of the 1950s, Finland's foreign trade policy was protectionist and gradually became more open since the early 1960s. The purpose was to protect the domestic textiles, clothing, rubber, and leather industries, to regulate foreign trade, and to control the foreign ownership of natural resources.[115] After the Second World War, continuous development in the Finnish national forest industries, agriculture, and mining overall added value to the development of national technology. The structural change of the Finnish economy and society was different compared to many other advanced European countries. Finland's industrialisation had a late start, and the shift from an agricultural to an industrialised and post-industrialised country occurred rather late, as did the simultaneous growth of the service sector.[116] The Finnish state continued to regulate both import and international capital flow until the 1980s. For example, the Bank of Finland's monetary value control helped the cyclical forest and metal industry, including Tampella, in international competition. In the Nordic countries, foreign trade grew since the end of the 1950s, but in Finland less in terms of export quantity and value.

After the Second World War, Finland integrated into Europe by joining several international associations and organizations. The most significant ones were the World Bank and International Monetary Fund (IMF) in 1948, the General

115 Crafts 1994, p. 16, Paavonen 2019, pp. 91–92.
116 Kokkinen et al. 2007, p. 166, Hannikainen and Eloranta 2019, p. 19.

Agreement on Tariffs and Trade (GATT) in 1950, becoming an Associate Member of the European Free Trade Area (EFTA) in 1961 (full member in 1986), and the OECD in 1969.[117] Furthermore, Finland also had a long-standing bilateral trade agreement with the Soviet Union between 1947 and 1991.[118] The bilateral agreement with the Soviet Union was essential for Finland, as it compensated for periods of weak European demand. Finland continued its active foreign policy for the next thirty years, as evidenced by the membership of the European Economic Community (EEC) in 1973, the European Economic Area (EEA) in 1994, and the European Union in 1995.[119] The 1974 Finnish Free Trade Agreement with European Communities (EC) and the 1975 Coal and Steel Community agreement meant mainly the removal of customs duties and import quotas on trade in industrial products.[120]

Since the late 1950s, the Finnish export market also expanded outside Europe, and at the same time the export structure diversified. This development was based in particular on intensive investments by the business sector, which was supported by national institutions and legislation in terms of capacity, quality and knowledge.[121] Finland became one of the global technology leaders in forest industry. This technological progress in the forest industry, in turn, contributed to the development of other industries, such as electricity, the machine production industry, chemical industry, electronic industry, consulting, and development of waterways for transport.[122] In Finland, annual economic growth measured in terms of the real gross domestic product grew at almost 5 per cent between 1946 and 1974.[123] After that, both in Finland and Western Europe, the growth of gross domestic product was slow due to the international oil crisis and the subsequent inflation in Finland. The situation in Finland was eased by trade with the Soviet Union. Between 1974 and 1988, Finnish GDP grew by 3 per cent per year.[124]

During the 1980s and 1990s in Finland, two leading industries measured as production value-added were forest and metal.[125] From the mid-1960s to 1985, exports of wood and paper products and the metal industry stood at 35 per cent, with textiles and chemicals accounting for about 20 per cent.[126] Since the 1980s, the industrial transformation switched towards knowledge-intensive production in Finland, which generated economic growth.[127] The significant factors were past investments, capital markets tightly regulated by low-interest rates and generous tax subsidies for investments, networking between different industries and

117 Skippari et al. 2005, p. 58, Kaitila et al. 2006, pp. 25–37.
118 Paavonen 1998, p. 308.
119 Skippari et al. 2005, p. 58, Koskenkylä 2016, p. 11.
120 Paavonen 2019, p. 95, Hoffman 2019, p. 148.
121 Boschma and Sotarauta 2007, p. 69.
122 Sajasalo 2003, pp. 152–153.
123 Hannikainen and Eloranta 2019, p. 23.
124 Hjerppe 1990, p. 30.
125 Eloranta et al. 2010, p. 20, Paavonen 2019, p. 96.
126 Hjerppe 1989, p. 160. See Pihkala 1970.
127 Kander et al. 2019, p. 65.

cooperation between the various actors, and the state-controlled forest cluster, including mergers and acquisitions.[128] Historians also emphasise the importance of education and social capital in terms of trust and participation as a cause of national economic growth between 1950 and 1973.[129]

However, at the end of the 1980s, Finland started to decline. As a result, the welfare state's economic growth period ended, and it faced severe recession due to the years of the financial, bank and currency crises in the early 1990s.[130] Major reasons were the late response to the economic downturn, deregulation, a global recession, and a downturn in the forest-related industries.[131] As a result, interest rates rose to 18 per cent, and inflation fell from six per cent to two per cent before 1992.[132] It significantly weakened the international competitiveness of Finnish export firms. Besides, the global demand for industrial exports and the decline in Soviet trade further weakened the Finnish economy.[133]

During the economic downturn at the turn of the 1990s, Finland had to transform itself from a resource-based into a knowledge-based economy to stimulate the economy.[134] Due to this, in the early 1990s, the reformed joint strategy of the Finnish state and national industries was to promote future economic growth through improved productivity and further utilisation of technology and innovation.[135] As a result of this national program of survival, the 1990s was a period for Finnish re-industrialisation by significantly increasing investments for research and development, and education.[136] For instance, the textile industry disappeared due to the dissolution of the Soviet Union, but the chemical and electronics industries became Finland's largest industrial sectors. Nokia had a significant role in the recovery of Finland from the recession in 1992.[137] The success of Nokia enabled the electronics industry to become Finland's largest export industry before traditional metal, engineering, and forest-based industries.[138] Furthermore, Finland's industrial structure changed so that the development of service goods, such as information and communication technology (ICT) services, accompanied the export of electronic goods. This structural change was based on obtaining capital from abroad, partly due to the liberalisation of capital markets in Finland and the establishment of an ICT cluster in the mid-1990s.[139] The liberalisation of capital markets increased foreign investment in Finland, but Finnish direct investment abroad also increased significantly.

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128 Hjerppe 1988, p. 127, Lamberg 2005, pp. 168–170, Musiolik et al. 2012, pp. 1032–1048, Ojala et al. 2018, p. 24.
129 Alapuro 1979, pp. 19–29, Hjerppe 1998, p. 15, Hannikainen and Eloranta 2019, p. 21.
130 Lehtiö 2004, pp. 174–175, Kuusterä 2019, pp. 73–74, Fellman 2019, p. 298.
131 Rouvinen and Ylä-Anttila 2003, p. 88, Kiander and Vartia 2009, pp. 2–5, Kuusterä 2019, pp. 78–80.
132 Kalela et al. 2001, p. 5.
133 Hjerppe 1988, pp. 146–147.
134 Kalela 2001, pp. 52–101, Schienstock 2007, p. 105.
135 Hjerppe 1990, pp. 110–117.
136 Schienstock and Hämäläinen 2001, p. 36, Georghiou et al. 2003, p. 63.
137 Ali-Yrkkö and Hermans 2002, p. 3.
138 Rouvinen and Ylä-Anttila 2003, p. 89.
139 Hyytinen and Pajarinen 2003, p. 3, Rouvinen and Ylä-Anttila 2003, p. 87.

2 THEORETICAL ISSUES: TECHNOLOGY, MARKET DYNAMICS AND MANAGERIAL CAPABILITIES IN THE PULP AND PAPER INDUSTRY

2.1 The role of technology in the history of the pulp and paper industry

2.1.1 What does it mean to integrate technology into business?

Technological revolutions have revealed that the role of technology innovations and related investments are among the essential activities for an entrepreneur's profitability and wealth generation in the economic, strategy and performance context.[140] Technology-orientated companies such as Tampella, should integrate technology into their business strategy to reinforce one another, based on the fact that technology strategy is the basis for business strategy, and it is, thus, central to the concept of an enterprise.[141] In a diversified company, the comprehensive technology strategy should mean that the management creates operating conditions to secure income cash flow with advantageous technology and a managing organization to meet market demand and to be able to match the surrounding institutional framework.[142] The technology and the cumulative technological know-how are crucial resources for any company's strategy including in Tampella, due to uncertainty in technological development, technological complexity

140 Solow 1957, p. 320, Arthur 2005, pp. 2–4.
141 Porter 1985a, p. 78, Burgelman 1996, p. 208, Markides 1997, p. 22.
142 Barley and Tolbert 1997, pp. 93–117, Jensen-Eriksen and Ojala 2015, pp. 521–555, Särkkä et al. 2018, p. 6.

and international competition.[143] The integration of technology into the Tampella's strategy is interpret by the success of its technological development in terms of machinery speed and width in relation to its main competitors.

Williams et al. (1995) argue that functional level strategies should support business-level strategies in mature industries, such as the pulp and paper industry.[144] Adopting this to corporate culture was the goal of the Tampella's top management as well, as the technological orientation of the manufacturing had a significant correlation to the quality assurance process, and in the market orientation from manufacturing to the quality of the products and services. Zahra and Covin (1993) separate technology orientation into three different roles: development of technology, new product development, and automation and process innovations.[145] These variables were critical factors also in Tampella's international transactions. Previous studies support the argument that technology ought to be integrated into the business strategy: the technological change to increase returns means hardware, skills, capability frameworks and organizational practices with positive development feedback and the technology adoption.[146]

Based on the scholars' statements, creativity is typically influenced, for instance, by the appropriability of returns and profit-sharing plans and expectations, the ownership of the property rights, achievement motivation in terms of fear of sanctions, bonuses, and promotions based on the expected payoff from their ideas.[147] Mokyr (1990) documents that one of the critical components of economic growth is technological creativity from the social perspective, not the individual perspective.[148] He highlights, for instance, that technology investments generate economic growth based on human knowledge. In this dissertation, I highlight some definitions that, based on managers' work experience, suggest that creativity is a combination of expertise, creative thinking, and motivation, by which individuals with knowledge and skills improve the organizational competitiveness and creativeness though time and efforts.[149] Previous literature states that successful innovation and the process of technical improvement require freedom from rigid rules, breaking down departmental barriers, and flexibility concerning changing needs, threats and opportunities.[150] The company should avoid hierarchical operations because these slow decision-making and little individual freedom of action.

It sounds simple, but in the reality in the case of pulp and paper industry, it means first of all, whether best practice or average technologies are taken into use are available resources in terms of time (utilisation rate) and utilised capital

143 Dodgson et al. 2008, p. 99.
144 Williams et al. 1995, p. 25, Talonen and Hakkarainen 2008, p. 60.
145 Zahra and Covin 1993, p. 470, Gatignon and Xuereb 1995, p. 32.
146 Abernathy and Clark 1985, pp. 20–21, Silverberg et al. 1988, pp. 1049–1050.
147 Stiglitz 1987, p. 41, Mokyr 1990, p. 173, Gagné and Deci 2005, p. 356.
148 Mokyr 1990, p. 11.
149 Mathieu and Zajac 1990, p. 188, Metcalfe 1994, p. 941, Amabile 1998, pp. 78, 87, Steers et al. 2004, pp. 379–387, Korhonen 2006, p. 50.
150 Burns and Stalker 2015, p. 188. See Jaworski and Kohli 1993, p. 11, from the market-orientation perspective.

(costs of operations) and the level of the compromises on technology (time and quantity efficiency).[151] According to previous studies, innovation activities and a firm's profitability can be supported by external networking, strategic technology alliances, dynamic complementarities to secure needed assets on time to manage cooperation, and increasing managerial competence.[152]

I agree with Amabile's (1988) argument that the core element of the organizational innovation process is individual creativity, which enables the group to operate.[153] For instance, according to many scholars, investment in domain-specific skills and knowledge enhances creativity, and almost all inventions are accumulated continuously from gradual changes made by anonymous people or due to technological drift.[154] As individuals become committed to an organization based on trust and rewards to the extent that it provides for the growth and achievement needs, it is called perceived competence, which improves participatory decision-making and increases organizational commitment.[155] From the perspective of team functionality, the critical determinants are a supportive organization and work environment without political problems, the role and structure of the managers, the correct assignments of the employees with clear targets, available resources in terms of time and money, distribution of information, cooperation and respect to other team members.[156] At Tampella, the employees' development was a challenging issue due to several very different businesses and a large number of employees (8,967 in 1974).[157]

Different countries have different experiences in paper industry technologies.[158] For instance, in the North American pulp and paper industry, the core determinants of corporate growth were waves of radical technological innovations in the organizational context between 1860 and 1960. It enabled managers to create and develop new strategies, markets, and types of organization, including policies and technological learning.[159] Since the nineteenth century, a network of players was a critical determinant for the success of technological learning in the forest industry in America.[160] Sometimes the firms' capabilities to grow and increase profits were limited by the production's internal resources and the paper products' market demand. A firm's sig-

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151 Dess and Davis 1984, p. 484, Mokyr 1992, p. 277.

152 Miles and Snow 1986, pp. 64–65, Rothwell 1992, pp. 236–237, Hagedoorn and Schakenraad 1994, pp. 291–309, Möller and Halinen 1999, pp. 413–427, Magee 2003, p. 21, Wiersema and Bowen 2008, p. 128, Alajoutsijärvi et al. 2012, p. 293, Ojansivu et al. 2013, p. 1326.

153 Amabile 1988, p. 150.

154 Cowan and Foray 1997, pp. 595–622, Liebeskind 1997, pp. 625–627, Nonaka et al. 2000, pp. 1–20.

155 Bateman and Strasser 1984, pp. 109–110, Lämsä and Savolainen 2000, p. 8.

156 Amabile 1998, p. 87.

157 Tampella Annual Report 1974.

158 Kurosawa and Hashino 2012, pp. 135–166, Kurosawa and Hashino 2017, pp. 235–259, Särkkä et al. 2018, pp. 7–10.

159 Toivanen 2004, pp. 213, 301.

160 Wright 1999, pp. 317–320.

nificant incentives to develop and maintain technological change were the capability to increase profitability, reduce costs and increase production capacity by utilising scale economies, and to increase end products' prices by increasing market demand.[161] Demand for paper was mainly increased by improving the end products' quality and developing new products and services.[162] In the Western market environment, the rate and direction of the technical change depended, for instance, on expectations of improvements, sources of technology, the needs of the users, and the benefits of the successful innovators.[163] For example, between the years 1950 to 1970, new organizational innovation in terms of a diversified and multidivisional structure was the core determinant for improving managerial control and efficiency by means of technological knowledge, finances, scale and scope, innovations in machinery and paper products, and corporate strategies in terms of the expansion and diversification of operations in the North American pulp and paper industry.[164]

2.1.2 The path-dependent nature of strategy decisions and technological change

Many academics define innovativeness and business success or failure as a complicated development path of strategic decisions.[165] Tampella's top management did not focus extensively on financial performance by organizational innovativeness and by new product development, including process, identification, and improvement proposals. According to many scholars, innovation systems should focus on the relationship between actors such as companies and institutions. They define the antecedent determinants of the organizational innovativeness such as market- and learning-orientated organizational culture, specialisation, and professionalism among managers, managerial support for innovation, formal-centralised and complex organizational structure (negative), internal and external communication ability, and company size and industry maturity (negative).

The view that technological change depends primarily on its past is known as path dependence, which will later lead either to stagnation or success.[166] Some scholars have stated that the nature of the innovations is discrete rather than cumulative, but a firm's cumulative knowledge is path-dependent and endogenous and is based on its past experiences, culture, and human knowledge over several decades.[167] The technological progress depends on techniques and trajectories in use: more advantaged techniques and economies are available the more that

161 Cohen 1984, p. 798, Korhonen 2006, p. 47.
162 Cohen 1984, p. 795 and, p. 797.
163 Rosenberg 1976, p. 527 and, pp. 533–535, Pavitt 1984, p. 343.
164 Hoskisson 1987, pp. 625–644, Toivanen 2003, p. 5.
165 Nelson and Winter 1977, p. 73, Dosi 1988, pp. 1150, 1157, 1164, Cassis 1997, p. 190.
166 David 1985, p. 336.
167 Cohen and Levin 1989, p. 1098, Cohendet and Llerena 2003, p. 288.

profitability and technological knowledge improve. The managers are the principal agents to evaluate in advance the advantage technology, competencies and complementary capabilities, routines and objectives, and technology competencies in terms of a firm-specific product, as well as the process innovation, external relationships, and value of information.[168] Cognitive processes dominate the organization's dynamic learning to absorb technology with the circumstances, experienced skills and needed information within firms, industries and investment projects.[169] Rosenberg (1994) defines the essential item – a sequence of technological change or technological disequilibrium – as the economics of scale compensate for the high fixed costs.[170] For instance, between 1915 and 1940, the North American pulp and paper industry had gradual technological improvements, both in new and old paper mills.[171] As a consequence, labour productivity improved continually, and paper machines' production more than doubled.

Some scholars highlight the history-dependent variables, such as a combination of the high level of technological leadership and managers and employees' diversified skills, to maximise profitability in the pulp and paper industry.[172] It means more advantageous technology, for instance, in terms of machinery speed, width, automation and processes, than its competitors have. In Tampella's machinery workshop, positive feedback meant learning-by-using based on the cognitive process and external or internal economies of scale in use to attempts to reduce investment related costs. In general, the organization should be capable of learning from the past and utilising those experiences for innovations or gradual improvements of technology or related processes.[173] For instance, between 1860 and 1960 in North America, the core determinant for long-term structural changes and the co-evolution of the technology and the industrial organizations was waves of innovation due to technological learning among the other major dynamic forces, such as corporate strategies, industrial relocation and policy.[174] Mokyr (1990) defines technological change as a set of changes and ideas based on human knowledge.[175] These new ideas and suggestions occur in most cases blindly and are epistemological and unpredictable.[176]

In this dissertation, I follow the definition of path dependence: namely, a small change in the past can change the course of history, which can generate increasing returns, self-reinforcing, or positive (or negative) feedback processes.[177] The increasing returns are the source of path dependence or one form

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168 Becker et al. 2005, p. 782.
169 Magee 2003, p. 6.
170 Rosenberg 1994, p. 52.
171 Rosenberg 1982, pp. 67–68.
172 Lilja et al. 1992, p. 152, Alajoutsijärvi 1999, pp. 47–51, Skippari et al. 2005, pp. 50, 65, Lamberg et al. 2009, p. 58.
173 Abernathy and Clark 1985, p. 5, Mokyr 1990, p. 251, Senge 1990, p. 23, Kruger and Dunning 1999, pp. 1126, Danneels and Kleinschmidt 1999, p. 22, Wenger et al. 2002, pp. 1–10, Sirmon et al. 2007, pp. 276, 287.
174 Toivanen 2004, p. 303.
175 Mokyr 1990, p. 6.
176 Campbell 1960, pp. 397–398.
177 David 1985, p. 332, Arthur 1994, pp. 111–158, Pierson 2000, p. 254.

of path dependence with importance of the social, timing and sequence. Dynamics of the increasing returns show the cost difference between switching alternatives in specific social contexts within the temporal period.[178] Past activities and events influence outcomes and trajectories in a sequence, knowing or not knowing the further direction of the movement. Some studies highlight path-dependent development trajectories, which interact with exogenously changing environments via paths such as institutions and clusters of patterned behaviour.[179] For instance, Tampella's machinery workshop played an essential role in improving the expertise of the national forest industry in Finland. The requirements of technological patterns and the progress of technological trajectories include the availability of an elastic supply of inventions, the formation of a cluster of innovations, macroeconomic instability, and substitute technologies. It means that the technological pattern defines the technological variables, which are relevant in the process of the multi-dimensional trade-offs, such as economies of scale and increasing mechanisation of operations.[180]

Tampella's machinery workshop is an excellent example of the negative path dependence. Namely, the 'decreasing returns tradition' means that the negative feedback of the change may cause an offset reaction based on that specified change, which then stabilises the economic equilibrium. It is common in a complex and knowledge-intensive business when the selected technology is not the most effective in the long run, due to the more a technology is used the more costs it generates for each user to achieve increasing returns. This is a common phenomenon in a conservative forest industry. As the firm has gain-needed advantages, positive feedback may lock in this technology.[181] Capital intensive investment in current best practices or average technology might create negative path dependencies when the technology is further developed but cannot be taken into use due to past investments.[182]

In addition, the firm's existing and prior cumulative knowledge and skills may create constraints, which are framed by the size and patterns of technological diversification.[183] The self-reinforcing mechanisms, or positive – or negative – feedback processes can be created by the large set-up or fixed costs, learning and co-ordination effects, or self-reinforcing expectations in terms of best practices technology and related adoption time.[184] Sometimes, historic activity may cause later constraints on increased returns through unpredictability, inflexibility

178 North 1992, p. 15, Arthur 1994, pp. 152–153.
179 David 1994, p. 217–218, Crouch and Farrell 2004, pp. 34–35.
180 Dosi 1982, p. 154, Rosenberg 1994, p. 78.
181 David 1985, pp. 335–336, Arthur 1994, pp. 13–32.
182 Landes 1969, p. 2, David 1985, p. 332, Arthur 1989, pp. 116–131, Pierson 2000, p. 253.
183 Teece et al. 1997, p. 529, Adner and Levinthal 2001, pp. 617, 627.
184 Arrow 1962, p. 155, Rosenberg 1976, pp. 534–535, Arthur 1994, p. 152, Pierson 2000, p. 254.

and ineffectiveness.[185] In the long-term, the path-dependent inefficiency and lock-in phenomenon reduces profitability.[186]

Technological change can cause lock-in within one trajectory, and by that there may occur social obstacles and changes in the management practices, organizations, networks, regulations, and the firm's culture.[187] In the context of technological development, business scholars highlight that the natural technological trajectories of technical change are based on the endogenous dynamics of technical progress in the transition to oligopolistic maturity and technology-based oligopolistic competition.[188]

Inflexibility or lock-in means that the further into the process the technology or related commercial product is, the harder it will be to switch on later.[189] For instance, Brunninge and Melander (2011) state that initial conditions and self-reinforcing mechanisms created industry-level and organizational-level paths in the Swedish pulp and paper industry.[190] For instance, the self-reinforcing mechanisms in terms of investments, remaining specific technologies, and economies of scale were evident during specific periods in the Swedish pulp and paper industry between 1872 and 1990.[191] First, massive investments were made to maximise the economies of scale in Sweden. Secondly, the chemical business remained too long, for example, in MoDo's strategy portfolio due to the executives' tendency to avoid divestment decisions, which was opposite from the owner Carl Kempe's original strategy.[192]

The operating environment of the Scandinavian forest industry's business system was also prevalent during Tampella's existence between 1958 and 1995. Its characteristics were the geographical location of the natural resources, long distance from customers, small home markets, and strong societal and political support in terms of the available capital and related forest cluster by the governments of Sweden and Finland.[193]

2.1.3 The challenge of capital investments

In the pulp and paper industry, investments are capital-intensive, path-dependent and usually embedded in a complex social and political context.[194] The critical factors for new investment projects are the available capital and schedule, which need to be included in the company's business plan.[195] For instance, the Finnish

185 Arthur 1989, p. 128, Arthur 1994, pp. 111–158, Pierson 2000, p. 253, Page 2006, pp. 113–114, Sydow and Koch 2009, pp. 689–709.
186 Arthur 1994, pp. 13–32.
187 Arthur 1989, p. 126, Russo 1992, pp. 24–25, Arthur 1994, pp. 117–118, Pavitt 2003, p. 41, Spencer et al. 2008, p. 16.
188 Nelson and Winter 1977, pp. 71–73.
189 Arthur 1994, p. 46.
190 Brunninge and Melander 2011, p. 26.
191 See Blomström and Kokko 2001.
192 Brunninge and Melander 2011, pp. 21–22.
193 Romme 1994, p. 473, Karvonen 2000, p. 82, Järvinen et al. 2012a, pp. 31–32.
194 Alajoutsijärvi et al. 1999, pp. 26–27.
195 Bridges et al. 1991, p. 268.

forest industry companies have sought economies of scale through investments, experienced repeated over-investments, upgraded their products' portfolios, and sought advantageous production technologies.[196] The existing paper or board machine concept should allow the possibility to increase products' portfolio flexibility, to improve the production machinery's performance, and to expand the lifetime of the machinery. Consequently, the cost structure of the product and productivity improves by means of gradual and cumulative technological change.[197]

In the technology investment context, scholars focus, among other things, on managerial decision-making. They highlight that the dominating factors of technological change and a firm's success are the market culture and orientation, customer value, the export share based on the increased market power and customer needs, the diversity of knowledge and skills among the personnel, and the organization's size, which is based on the specific market's norms, values and beliefs.[198]

At Tampella, the paper and board producers' technological know-how was highly dependent on their internal machinery workshop's knowledge and skills in operating the newly built machinery. This dependency increased considerably over the years as Tampella's decision-making in the context of investments was centralised in the head office . This inter-dependency between the machinery workshop and the paper industry plant created a challenge for the organization's ability to understand and maintain the advantage of knowledge and technology within the company.[199]

One of the main arguments of this dissertation is that the top management of the company must receive sufficient and new information about market dynamics before making an investment decision. In Tampella, this did not happen; that is, the information obtained did not usually influence the top management's decision-making in the context of investments. According to Carter and Williams (1959), the firm's investment decisions around research and development were not based on market demand due to missing clear corporate objectives and a dominant focus on short-term development and survival.[200] Furthermore, some academics have stated that the structure of the technology itself dominates its development and market demand plays only a marginal role in its development.[201]

Decisions of investment or technology adoption should include information about benchmarking technologies and other alternatives to reduce costs and improve performance.[202] Uncertainty may exist due to the cost of labour, missing

196 Rohweder 1993, p. 184, Järvinen et al. 2012a, pp. 19–47.
197 Tushman and Anderson 1986, p. 441.
198 Kohli and Jaworski 1990, pp. 7–8, Damanpour 1992, p. 395, Hadjimanolis 2000, p. 278, Deshpande and Farley 2003, p. 18, Chandler 1994, pp. 34–36, Hansen et al. 2006, p. 217.
199 Vuori 1997, pp. 77–78.
200 Carter and Williams 1959, pp. 87–104.
201 Sahal 1983, p. 80.
202 Rosenberg 1982, pp. 112, 137, 218, Cohen 1984, p. 777.

holistic understanding of the cost structure, missing knowledge of the cross-functional effects and consequences of the new technologies, fragmented and slowly distributed information during the investment process, unavailable feedback from past experiences, and a lack of awareness of competitors' expansion plans.[203]

There were several capital-intensive projects in the pulp and paper industry even though there were no major technological innovations during the period from the 1950s to the 1990s.[204] Rather than acquiring new technologies, pulp and paper industries sought for economies of scale with more capital-intensive investments and by introducing more efficient and larger machinery. Technological development mainly means improving previous inventions, excluding small inventions, which improve production efficiency and product cost structure.[205] In the past, the interval of a significant machinery rebuild was twenty or thirty years before the machinery became exhausted. Nowadays, European forest companies invest more in small rebuilds for reasons of quality or capacity. From the decision-making perspective, investments in both new machine lines and rebuilds mean compromises in the technologies adopted. In the rebuild of existing technology, the amount of compromises is higher, because firms maximise the degree of the reuse of the existing machinery and related processes. A similar gradual development took place in the North American pulp and paper industry during the years 1915–1940, as the paper machines' technological changes improved productivity by means of gradual improvements.[206] For instance, Procter and Gamble created a sustained advantage in disposable diapers in the U.S.[207] In Finland, United Paper Mills maintained high profitability for decades through superior patented products, the managerial system, and cost reduction based on the evolving technological environment.[208]

In markets where competition creates constraints, strategic investment will only occur if the cost of the expansion's present value will be lower than the non-strategic alternative. Furthermore, the strategic investment may be established as a counteraction against competitors' actions.[209] In some cases it is more profitable to build an entirely new paper or board machine line than to modify an old one. In this kind of path-dependent process, past investment decisions affect the new investment's decision-making process. Due to this, the company should maximise the benefits of scale and scope to purchase the most comprehensive and fastest available paper or board machinery in the entry phase to be profitable for years or even decades to come. Based on my personal work experience in the paper and board business, usually the fact is that the purchaser with a deep understanding of the technology and related applications can create smarter machinery con-

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203 Smith 1981, p. 13.
204 Laurila 1998, p. 20.
205 Tushman and Anderson 1986, pp. 444, 450.
206 Cohen 1984, p. 785, Ghosal and Nair-Reichert 2008, pp. 536–547.
207 Lieberman and Montgomery 1988, p. 43.
208 Ojala and Lamberg 2006, p. 112.
209 Smith 1981, pp. 18–19.

cepts with lower capital and operations costs than their competitors. The investment cost increases and the cost of operations decreases due to the expanded dimensions of machine speed and width.

Based on the above considerations, corporate culture has a significant importance in the investment context. In many companies, the firm's culture means cost reduction to control performance uncertainties during the product design phase.[210] Consequently, this means making technological compromises by purchasing the cheapest possible device or prototype without real technological know-how. Making capital goods decisions without a deep technological understanding may lead to the situation that the equipment life cycle is too short or the devices do not function as expected. In deciding on purchasing forestry industry equipment, the most important thing is to understand the long lifecycle of the equipment due to its high fixed costs and large, immobile and interrelated types of equipment.

2.2 Exogenous market dynamics

2.2.1 Market-driven technological change

A firm's capabilities are based on the structure of the opportunities that evolve by means of technical development and alternative technologies, which are driven by external activities, internal capabilities, and a combination of market demand.[211] The market environment is a complex entity due to the effect of institutional actions, the diversification of markets, and the organizations' enforcement mechanisms.[212] Therefore, as mentioned earlier, it is essential to follow market dynamics and end customers purchasing behaviour to secure the future of their businesses.[213] The determinants of the market dynamics also include the technology allocation system for significant machinery investments. The basic premise is that the final decisions of the investment, technology adoption or portfolio change of the business needed to include information about market dynamics, benchmarking technologies and other alternatives to reduce costs.[214] The technological changes are defined in the time context of both investment decisions and operational performance activity. For instance, manufacturing flexibility supports market orientation by volume changes, customer specifications,

210 Rosenberg 1994, p. 14, Jantunen et al. 2009, p. 322.
211 Abernathy and Utterback 1978, p. 45, Mowery and Rosenberg 1979, p. 145, Christensen 1997, p. 3, Dosi 1982, p. 149, Gatignon and Xuereb 1995, p. 32, Adner and Levinthal 2001, p. 623, Stendahl and Roos 2008, p. 664.
212 Teubal 1997, p. 1184, Dess and Davis 1984, p. 477.
213 Lamberg and Laurila 2005, pp. 1815, 1817.
214 Dess and Davis 1984, p. 477, DeBresson and Lampel 1985, p. 185, Rosenberg 1994, pp. 12, 248.

and new products.[215] There exists a correlation between the business unit performance and technology protection, and between both capacity utilisation and breadth of product line and performance. Based on the above considerations, the basic premise was that also Tampella's executives should understand the connection between market demand and technological change, as presented in Picture 3. It means the connection between market demand and technology change by focusing on sensing the competition environment, demand-pull, technology push, cooperation with end customers and suppliers, and product differentiation

Picture 3 A conceptual model of the connection between market demand and technological change.

		Demand
		Demand-pull
		Technology push
		Cooperation with end customers and suppliers
		Product differentiation
		Price
		Understand pricing dynamics and mechanisms
		Consumers buying habits changes
		End product cost efficiency
		Multiproduct production
Market factors		
Demand		**Financial crises**
Price		Understand the local markets sensitivity
Financial crises		Strong market position
Production quantity		Diversification of the sales areas
Production quality		Timing of business cycles to adopt new technology
		Production quantity and quality
		Capacity expansion by technological development
		Manufacturing flexibility
		Scale and scope management
		Product cost structure
		Continuous quality improvements

Sources: Abernathy and Utterback 1978, Mowery and Rosenberg 1979, Dosi 1982, Cohen 1984, Cohen and Levin 1989, Cohen and Levinthal 1989, Mokyr 1990, Rothwell 1992, Teubal 1996, Christensen 1997, Cooper et al. 1999, Adner and Levinthal 2001, Hansen et al. 2007, Lamberg et al. 2019.

According to Cohen (1984), a firm's major incentives to develop and maintain technological change are to increase profitability and production capacity by scale economies and to increase end product prices by increasing market demand.[216] One of the most important features of the company's top management is to understand how customers respond to product requirements that meet their demands. Thus, delivering products to customers is a worthwhile business for both parties. That is the reason why top management should also commit to the end customers in the technology development process through co-operation.

215 Milgrom and Roberts 1990, pp. 526–527, Davis et al. 1992, p. 358, Ngo and O'Cass 2012, p. 873.

216 Cohen 1984, p. 789 and, p. 797.

This co-operation with customers might, however, create both positive and negative path dependencies.[217] In Tampella's paper and board production units, intermediate customers were printing houses, which were assumed to know the needs of their end users. Earlier research on the forest industry's historical development has shown, for instance, that the pulp and paper company Swedish MoDo's executives received no relevant feedback from their market network and that was a reason to maintain the chemical business in their strategy portfolio, which proved to be a mistake.[218] For instance, with Nokia, large operators sold phones connected to network agreements, and in that regard, Nokia was dependent on the operators' understanding of the market. However, as the operators did not understand the breakthrough of the smartphone (Apple sold devices outside the operators), that was one of the main reasons for the failure of Nokia's smartphone business.[219] As a consequence of the end users' cooperation, product flexibility increases and resistance to innovation or technological change is reduced.[220]

A market-orientated approach for technological change highlights the firm's portfolio management in terms of the end products and needed technologies as a whole.[221] It is based on the argument that top management needs to sense potential markets and react to significant changes in the competitive environment. However, the connection of the technology to portfolio management is not always as clearly understood.[222] The lack of understanding of this holistic portfolio management-technology combination is one aspect that generates a major barrier for the market-orientation culture. From the investment perspective, sometimes the final technological solutions are limited by available capital or a lack of knowledge, which in turn generate technological compromises. These compromises reduce the cost of the investment project to a minimum, but many times increase the operational costs significantly in the short and long term. Thus, later on, in the production operations' perspective, it can be a challenge to control profitability based on the high-cost structure of the products due to the existing technology of the machinery. In general, a firm's major incentives to develop and maintain technological change are the capability to increase profitability and production capacity by scale economies and to increase end products' prices by increasing market demand and improving cost structure.[223]

The demand-based view of technological evolution focuses on the interaction between technology development and the heterogeneity logic of the market environment and demand.[224] Dosi (1982) suggests that market forces are the major determinant of technological change based on demand-pull theories, and

217 Rothwell 1992, p. 236, Hansen et al. 2007, pp. 1333–1334, Lamberg et al. 2019, p. 15.
218 Brunninge and Melander 2011, p. 22.
219 Lamberg et al. 2019, p. 15.
220 Urban and Von Hippel 1988, p. 21.
221 Cooper et al. 1999, pp. 334–335.
222 Brown and Duguid 1991, p. 54, Cooper et al. 1999, p. 349.
223 Cohen 1984, p. 793.
224 Adner and Levinthal 2001, p. 612.

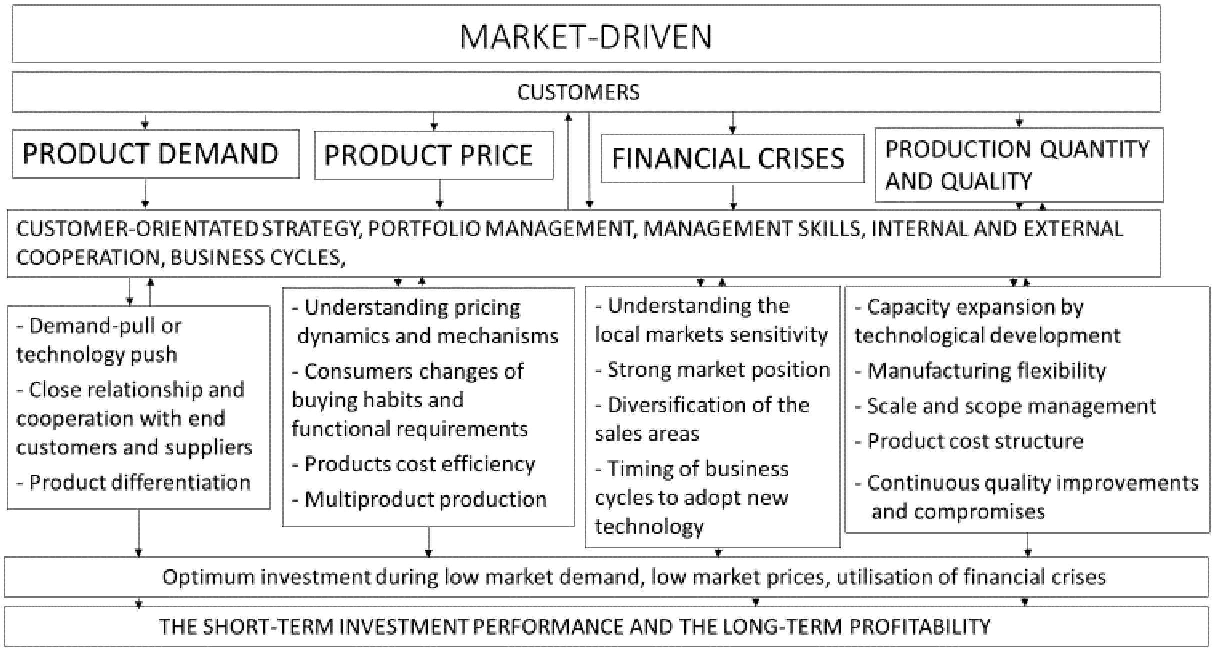
technology is an autonomous factor based on push theories, at least in the short run.[225] Both technology push and demand-pull are necessary for any successful innovation based on the 'recognition of needs' in the markets. Previous studies highlight the importance of scientific knowledge, together with managerial and economic factors, for substantial investment in commercial production. Some scholars state that production-quantity expansion should be based on cost competitiveness and existing market size, including future growth potential.[226] For instance, in 1921, newsprint producers developed their machines' speed due to the high price of newsprint.[227]

In the mature pulp and paper industry, the co-evolution between technological development and market fluctuations plays a key role in the success of companies. This includes a response to dynamic market demand and international competition by gradual technological changes, product differentiation, the availability of critical raw materials (such as wood fibre and energy), and having close relationships with end customers and between corporations.[228] The critical factors in new investments in paper machines are organization, logistics and geographical location. Some scholars document that the dominant decision-making factors for new technology investments are the existing production capacity, the price of paper and the agglomeration effect by the installed capacity.[229]

In my analysis, I highlight Tampella's top management's customer-orientated culture in the decision-making context. Therefore, I focus on exogenous market dynamics and the end customers' purchasing behaviours, which normally secure the future of businesses by means of technological change.[230] The selected market factors are product demand, product price, financial crises, production volumes, and production quality, as presented in Picture 4. In the case of Tampella, it is important to note that the company's forest industry unit was the machinery workshop's endogenous customer; that is, the company was multidisciplinary and unique.[231] In the context of technological change, this academic analysis defines the firm's market-orientation culture in terms of demand-pull, technology push, cooperation with end customers and suppliers, and product differentiation.[232]

225 Dosi 1982, p. 150.
226 Porter 1979, p. 138, Schmalensee 1988, p. 78, Diesen 1998, p. 128.
227 Cohen 1984, p. 795.
228 Alajoutsijärvi et al. 1999, pp. 26–29, Blomström and Kokko 2001, p. 68, Lundmark 2003, p. 33, Järvinen et al. 2009, p. 43.
229 Bergman and Johansson 2000, p. 22.
230 Cohen and Levin 1989, pp. 1081–1083.
231 Chandler Jr. 1982, pp. 3–23, Chandler 1990, pp. 65–73, Conduit and Mavondo 2001, p. 17. See also Chandler, Alfred D. Jr., 1990b, Chandler, Alfred D. Jr., 1994.
232 Chandler Jr. 1991, pp. 32–33.

Picture 4 The firm's customer-orientated strategy based on market dynamics.



Sources: Abernathy and Utterback 1978, Mowery and Rosenberg 1979, Dosi 1982, Cohen 1984, Cohen and Levin 1989, Rothwell 1992, Romme 1994, Teubal 1996, Christensen 1997, Alajoutsijärvi et al. 1999, Cooper et al. 1999, Bergman and Johansson 2000, Karvonen 2000, Adner and Levinthal 2001, Lundmark 2003, Hansen et al. 2007, Järvinen et al. 2009, Atkinson and Morelli 2011, pp. 1–70, Lamberg et al. 2019.

2.2.2 Timing of the investments

From the perspective of economic downturns, the challenging issue is how management takes into account and observes the local economies' cycles and the possibilities they might bring. At the same time, economic changes reflect the sensitivity of the local market, which a company has to take into account in their business strategy and for capital investment timing. According to previous studies, in the capital-intensive paper industry, cyclicality and profitability are an effect, for instance, of market overcapacity and demand fluctuations based on economics of scale, with long delays (two to five years) from investment decisions to saleable production and exchange rates. The consequence of production overcapacity is declining market prices. In this analysis, I focus on the connection between market crises and technological investment activities based on the following determinants: understanding local market sensitivity, strong market position, diversification of sales areas, and timing of business cycles to adopt technology.[233] From the pulp and paper industry's perspective, for a bulk product such as newsprint and wrapping and packaging board, the sales price is the most important competitive factor.[234] Tampella's forest units also focused on these types of products. Therefore, the cyclical price changes in the market that were

233 Alajoutsijärvi et al. 2001, pp. 495–496.
234 Diesen 1998, pp. 61–64.

typical in the paper industry in a short period were also determinant for the success of Tampella. Low prices can be caused, for example, by an overcapacity (supply) in the market or global recession (demand). The forest industry companies strive to meet these constraints by improving their production and thereby improving their products' cost efficiency. In an extended period, the global decrease of individual paper or board prices indicates transformation, which is caused by a change in the consumers' buying habits. From the investors' point of view, the market price factor is important because it gives realistic and minimum calculated values of the payback and returns on investment based on the lowest possible sales price at the moment. For instance, during the last decades of the 20th century, relative price changes stimulated wastepaper usage in Sweden.[235] Furthermore, the essential determinants of technical change in the Swedish newsprint industry were capacity utilisation, output price, and regulatory intensity during the years 1974 – 1994.[236]

One particular characteristic of the pulp and paper business is that the industry itself causes business cycles either by increasing or reducing production capacity in the market. Generally, increasing capacity reduces the market prices of products, while capacity reduction, in turn, increases them. Global economic downturns and overcapacity in production lower the market prices of the products. From the exogenous market perspective, the period from the investment decision to the moment when production with new invested machinery starts further increases this cyclicality.[237] The firm's top managers have a critical role in estimating the turning points of the business cycles and in understanding the consequences and the variations of the prices, demand and excess capacity.[238] In practice, the investments' implementation should be ready when the business cycle increases, and decisions should be made during the good demand of the cycle.

Globally operating companies may respond better to market fluctuations by having a strong market position and skilful co-ordination in the investment projects.[239] The end products' market demand and especially seasonal fluctuations determine the company's potential for profitable business operation. The management needs constant information on variables affecting market demand to secure business predictability and a continuous profit. In my analysis from Tampella's machinery workshop's perspective, I highlight the importance of the available market information in terms of the speed and width of paper and board machines in the context of the global competitive environment. From Tampella's forest industry perspective, in turn, I highlight the importance of the available market information in terms of demand for newsprint and board grades, prices, financial crises, and quantity and quality in the global competitive environment. I focus on the connection between market prices and investment activities based on understanding pricing dynamics and mechanisms, consumer changes in

235 Lundmark and Söderholm 2004, p. 33.
236 Melander 1997, pp. 152, 258, Lundmark 2005, pp. 572–575.
237 Berends and Romme 2001, p. 549.
238 Senge 1990, p. 23.
239 Alajoutsijärvi et al. 2001, pp. 495–496.

terms of the buying habits, end products' cost efficiency, and multi-product production.

Market competition and changes of the customer's functional requirements may force firms to improve their products in all markets, which are segmented according to functionality and price. As a consequence, they need to consider multi-product production instead of a single one.[240] In the market-orientated context, the horizontal technology policy reduces uncertainties and adopts new organization's routines. The management supports related activities in the processes of learning, locating, identifying, and screening new opportunities.[241]

From the implementation timing of the perspective of technological change, market dynamics should account in the technology allocation system for significant machinery investments as well.[242] It is worth noting that in the pulp and paper industry, as in many other industries, significant investments are allocated with maintenance shutdowns together in advance from one year to three years due to limited own and supplier resources (time and employees), timely delivery of equipment, funding arrangements, and the process of the environment and operation licenses. The significant machinery purchasing process and funding set time limits for an investment project. The investments are related to the technological development of the virgin fibre, mechanisation, rationalisation, automation, and scale of the machinery. Cheap energy supplies, constant growth in demand, durable raw material supplies, modern production machinery and favourable economic policies of the forest cluster increase the firm's profitability.[243]

From the competitors' perspective, the timing is difficult to estimate. From a firm's internal perspective, optimum timing of investments is vital due to high initial sunk costs and continuous competition.[244] For example, additional capacity announcements did not disturb market prices and capacity utilisation significantly in the North American pulp and paper industry from the ex post point of view. However, from the ex-ante point of view, additional capacity announcements impacted so that the abandonment increased as capacity utilisation rose.[245]

By analysing these dynamic market factors, I also determine the company's optimum investment in relation to the timing perspective. The variables are reviewed in the context of profitability, time horizon, and global competition.[246] From the pulp and paper mills' perspective, the optimum investment activity exists when market demand is negative. It means that during strong demand, the company designs investments and maximises profitability by having a full-capacity utilisation rate of production. Immediately when the market declines, the company should implement investments. It is only possible to gain market information by having a market orientation strategy, for instance, about demand,

240 Adner and Levinthal 2001, p. 626.
241 Teubal 1997, p. 1184.
242 Farzin et al. 1998, pp. 19–20.
243 Ojala et al. 2018, p. 100.
244 Barzel 1968, p. 354, Schmalensee 1988, pp. 37–38.
245 Christensen and Caves 1997, p. 47.
246 David 1985, p. 336, Murto 2003, p. 19, Lamberg et al. 2012, p. 335.

to generate new possibilities when needed.[247] Management needs to be skilful for effective decision-making in time and profitability contexts. A close relationship with global machine suppliers is needed for successful long-term investments in paper and board machines, including flexible delivery times and purchasing contracts.[248] Typically the delivery times of machinery types of equipment are very long. The delivery times of the individual components such as a headbox or single online calender unit is much faster. In the Tampella case, flexible cooperation with the machinery supplier should not have been an issue, as they had their workshop in-house.

2.3 Top management capability

2.3.1 The critical role of top management

Optimally, top management's leadership would mean a clear capability for decision-making and a strategic way of thinking, understanding path dependence in technology and organization culture, and specific skills to integrate technological know-how into business transactions in order to maximise profitability.[249] As a consequence, normative expectations for what good strategic leadership should be are enormous: top management should create their firm's competitive advantages and control the implementation of these advantages by developing and utilising available technology in the best possible way – while taking into account the continuous flow of information it receives from the exogenous markets and endogenous organization as presented in Picture 5.[250]

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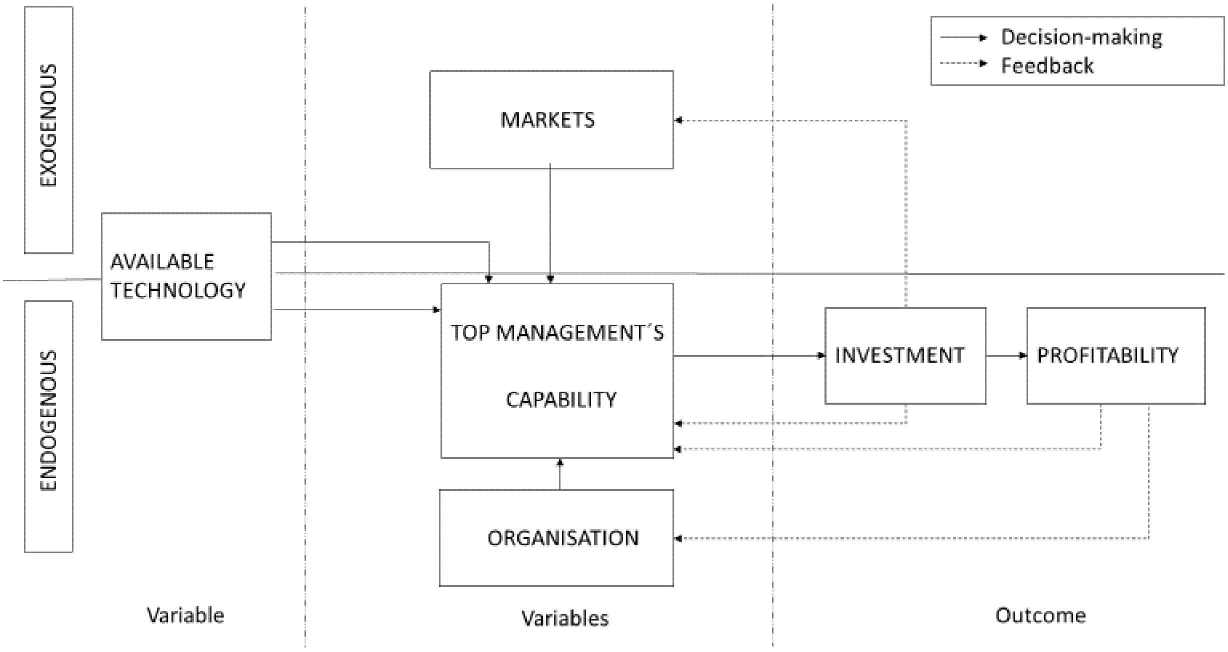
247 Diesen 1998, p. 65.
248 Alajoutsijärvi 1996, p. 211.
249 Hellgren and Melin 1993, p. 65, Teece et al. 1997, p. 529, Chandler 1994, p. 42.
250 Hansen and Wernerfelt 1989, p. 403, Porter 1991, p. 111, Chandler Jr. 1991, pp. 33–34, Zollo and Winter 2002, p. 340, Sirmon et al. 2007, p. 288.

Picture 5 A conceptual model of the decision-making and feedback processes of the top management's capability.



Sources: Mowery and Rosenberg 1979, Hansen and Wernerfelt 1989, Porter 1991, Hellgren and Melin 1993, Teece et al. 1997, Zollo and Winter 2002, Cohendet and Llerena 2003, Chandler 1994, Sirmon et al. 2007, Teece 2007, and Lamberg et al. 2012.

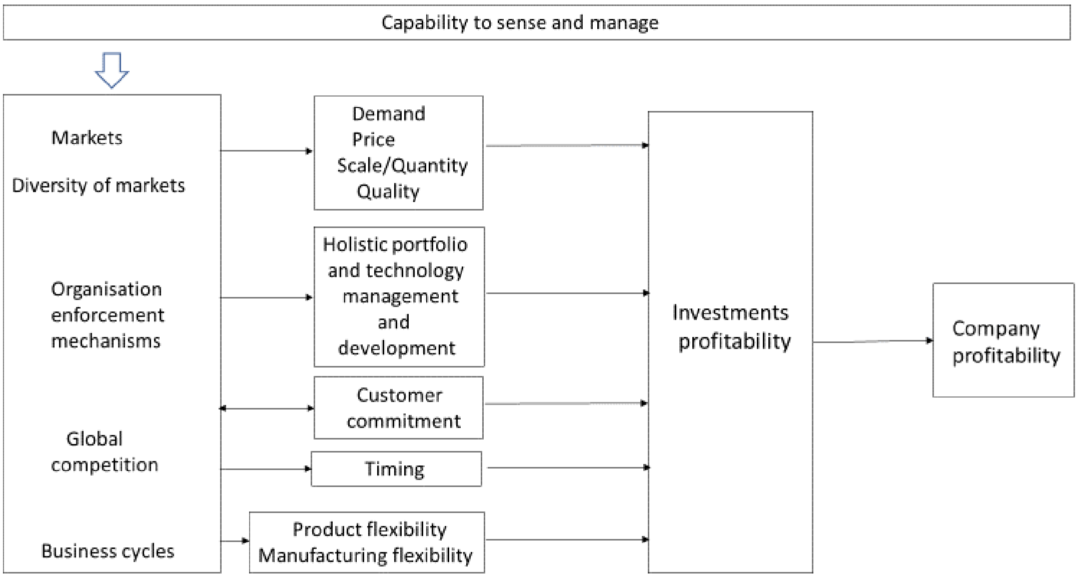
From the market perspective, as management's capability determines the fate of the company, executives and top management also need to possess a customer-orientated attitude for sensing business opportunities and changes in the entire business environment as early as possible.[251] In mature industries, Bush and Sinclair (1992) highlight that integrated customer-orientated transactions, a well-defined competitive strategy, and cost-effective operations are more difficult for competitors to imitate, more resistant to the markets' changes, and create pricing flexibility for the end products.[252] On the other hand, it is important to note in a customer-orientated corporate culture that the fulfilment of customer requirements without the top management's understanding of the business transactions can lead to a failure of the company. That happened at Tampella's machinery workshop, as their management withdrew from the development of paper machines by signing the TVW agreement at the end of the 1960s. The same happened with the mobile phone manufacturer Nokia when the company's top management rejected advanced in technology and continued to concentrate on conservative technology.[253]

251 Teece 2007, pp. 1322–1323, Lamberg et al. 2012, p. 11.
252 Bush and Sinclair 1992, p. 69.
253 Christensen 1997, p. 13, Lamberg et al. 2019, p. 9.

From the technology perspective, executives need the capability to make decisions on capital-intensive investments, seek quality and production efficiencies in the long term, secure new technology adoption and implementation, take care of portfolios, select correct start-up timing and make sense of the market situation, and at the same time secure co-operation between the top management and the mill managers.[254] For instance, Procter and Gamble maintained their high market position in disposable diapers through managerial innovations and organizational learning in manufacturing.[255] In the context of technological change, dynamic capabilities create core determinants for organizational and managerial competencies and cognitions to increase and maintain a company's competitiveness, for instance, by product diversification.[256] There are also opposite examples in the business economy (i.e. the company's profitability weakens with diversification).[257] This means technological competence or knowledge in the strategic context, which has been created by the firm's individuals, who can utilise the information produced through various networks.[258] Therefore, Tampella's top management also needed to understand and sense the new opportunities (for instance, from the portfolio point of view),[259] reshape organization structures, make decisions and actions without delay, and support continuous learning and knowledge absorption,[260] as presented in Picture 6.[261]

254 Laurila 1998, p. 23.
255 Lieberman and Montgomery 1988, p. 49.
256 Davis et al. 1992, p. 358, Chandler 1994, p. 594, Lee and Lee 2007, pp. 500–502, Wiersema and Bowen 2008, p. 119.
257 Fukui and Ushijima 2006.
258 Zahra et al. 1999a, p. 185, Boal and Hooijberg 2001, p. 534, Dodgson et al. 2008, p. 72.
259 Teece 2007, p. 1346.
260 Chandler Jr. 1991, p. 48, Zollo and Winter 2002, pp. 348–349, Thywissen et al. 2018, pp. 278–279.
261 Sirmon et al. 2007, p. 287, Teece 2007, pp. 1334–1340, Lee and Lee 2007, p. 500.

Picture 6 A conceptual model of the top management's capability to sense and manage.



Sources: Dess and Davis 1984, Porter 1985a, David 1985, Narver and Slater 1990, Lilja et al. 1992, Christensen 1997, Diesen 1998, Alajoutsijärvi et al. 1999 and 2001, Lee et al. 1999, Zollo and Winter 1999, Cohen and Kozak 2001, Berends and Romme 2001, Magee 2003, Crespell et al. 2006, Teece 2007, Lamberg et al. 2009 and 2012, Mansikkasalo et al. 2013, Ojala et al. 2018, Särkkä et al. 2018.

From the organization perspective, top management needs to allocate between productive and unproductive activities with available different types of characteristics, such as exchangeability, extended competencies, and valuable complementary resources.[262] From the perspective of constraints, researchers typically focus on cognitive limitations and bounded rationality in the organizational decision-making context.[263] It means that the company is unable to maximise its profit by maintaining specific standard procedures and does not have enough adaptive routines until a specified rate of the return is achieved.[264] The firm's creativity can be limited by the top management's lack of capability to commit employees, the company culture, daily routines, knowledge, or a conservative status quo. It means that limited capabilities and incomplete important information may guide the decision-makers' attention to secondary topics. The information includes time and capabilities, and memory means the capabilities of individuals and organizations, understanding and communication. The organization's internal inertia is created by inflexible and formal organization, a lack of compatibility between old and new technologies, change projects dominating another integrated project or technological trajectories dominating in a specific firm

262 Baumol 1990, p. 894, Winter 2003, p. 2, Sirmon et al. 2007, p. 287, Danneels 2010, p. 3.
263 Kuran 1988, pp. 153–156, Simon 1989, pp. 1–14, Cohen and Levinthal 1990, pp. 149–150.
264 Simon 1989, pp. 12–13.

or industry, and repeating the same product design innovations.[265] The constraints of the routines may include decay, changes in the content of routines, reaction speed and duration, time lags and delays, the frequency of repetition, and managerial and employee turnover.[266] For instance, from the perspective of rational behaviour, the firm does not develop further its absorptive capacity due to the management being unable to recognise, create or establish innovative changes to respond to the initial shifts in the competitive environment over time.[267] The reason for the bounded rationality may be the manager's behaviour to maximise some specific personal objectives, such as revenue, the employees, growth or managerial perquisites, which may create intra-managerial boundaries and unexpected consequences. This pattern of inertia is called the 'lockout' phenomenon, the 'not-invented-here' syndrome, or 'self-reinforcing behaviour'.[268] Organizational inactivity and a lack of individual commitment and motivation can lead to organizational chaos or routines which cause the firm's stagnation.[269] A lack of internal expertise, the absorption capacity, and the potential technical environment limit the technological opportunities. The management's incapability to respond to the changes mentioned above generates the need for more costly investments in the future. On the other hand, the informal managerial internal or external networking included in feedback communication may be a useful tool for managers to expand their knowledge.[270]

Capability, co-ordination and motivational routines have different organizational and economic and behavioural consequences due to the power of replication, degree of inertia, and search potential.[271] The routines may improve organizational capabilities by controlling, by reduction of uncertainties, by increasing stability, and by absorption and binding explicit and tacit knowledge.[272] I focus on the flexible patterns created by the organizational interactions of the top management.[273] The pattern is the collective nature of the routines and repetitive behaviour, which may change if the conditions change. The patterns include action, activity, behaviour and interaction.[274]

265 Rothwell and Gardiner 1985, p. 185, Tyre and Orlikowski 1991, p. 38, Patel and Pavitt 1997, p. 154, Becker et al. 2005, p. 781, Hambrick and Mason 1984, p. 198, Cooper and Schendel 1976, p. 68, Hannan and Freeman 1984, p. 162, Kelly and Amburgey 1991, pp. 591–612, Ajzen 1991, p. 182, Hannan and Freeman 1993, p. 201, Nelson and Winter 1997, pp. 51–52, Armitage and Conner 2001, pp. 486–488, Cohendet and Llerena 2003, p. 275, Becker 2004, pp. 643–677, Becker et al. 2005, p. 781.

266 Cohen 1991, p. 138, Grant 1996, pp. 379, 384.

267 Pavitt 1991, pp. 42, 48–49.

268 Cohen and Levinthal 1990, pp. 135–138, Arthur 1994, pp. 111–158, Sydow and Koch 2009, pp. 689–709.

269 Dooley and Van de Ven 1999, pp. 358–372. For different components of commitment, see Metcalfe 1994, p. 941.

270 Tversky and Kahneman 1986, p. 36, Laurila 1998, p. 18.

271 Cohen et al. 1996, pp. 25–27, Adler et al. 1999, p. 50, Feldman 2000, p. 620, Cohendet and Llerena 2003, p. 289.

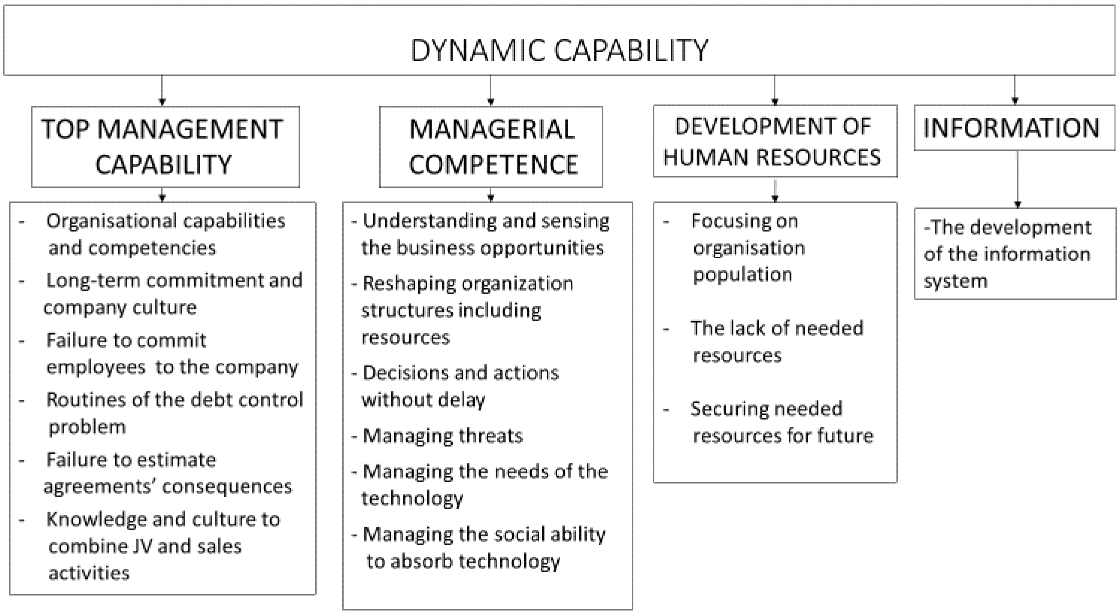
272 Dosi et al. 2000, pp. 202–204, Winter 2003, pp. 991–995.

273 Sydow and Koch 2009, pp. 689–709.

274 Teece and Pisano 1994, pp. 6–9, Cohen et al. 1996, pp. 16–19, Zollo and Winter 1999, p. 10, Dosi et al. 2000, pp. 65, 375, Zollo and Winter 2002, pp. 340–341.

In this dissertation, I define the top management's capability as an essential decision-making function for business success based on the top management capability, managerial competence, diversity of the population and available information, as presented in Picture 7. In Tampella's operations from 1958 to 1995, the opportunities, constraints, and behaviour of the directors and shareholders were different in the different periods. In the context of the performance of the company, the dominant changes took place in terms of international competition, the purchasing habits of customers, the liberalisation of the banking system, national laws, and institutional regulations. Based on the above-mentioned dynamic factors of the competitive environment, Tampella's top management played a critical role to secure the firm's capabilities, which were in many instances based on the structure of the opportunities allowed by technical development, alternative technologies, and the available information about the firm's market and competitive environment.[275] The middle management acted as a transfer agent to implement the top executives' decisions. For this reason, I focus on analysing the success of senior management decision-making from the perspective of organization capability, not individual capability.[276]

Picture 7 The dynamic capability determinants.



Sources: Mowery and Rosenberg 1979, Pettigrew 1979, Dosi 1982, Hambrick and Mason 1984, Harrison and March 1984, Rothwell and Gardiner 1985, Amabile 1988, Barney 1986ab, Jackson and Dutton 1988, Kuran 1988, Cohen and Levinthal 1989, Simon 1989, Mathieu and Zajac 1990, Mokyr 1990, Prahalad and Hamel 1990, Brown and Duguid 1991, Porter 1991, Tyre and Orlikowski 1991, Hannan and Freeman 1993, Collis 1994, Denzau and North 1994, Burgelman 1996, Magee 1997 and 2003, Patel and Pavitt 1997, Laurila 1998, Kruger and Dunning 1999, Zollo and Winter 1999 and 2002, Zahra et al. 1999, Eisenhard and Martin 2000, Barney and Arikan 2001, Calantone et al. 2002, Zollo and Winter 2002, Nelson 2003,

275 Dosi 1982, pp. 151, 159, Cohen and Levinthal 1989, p. 593.
276 Miles and Snow 1986, pp. 62–73.

Chandler 1994, Hult et al. 2004, Becker et al. 2005, Sirmon et al. 2007, Teece 2007, Sydow and Koch 2009, Alajoutsijärvi et al. 2012, Honig et al. 2014, and Lamberg et al. 2019.

The first determinant of the dynamic capability is the top management's organization capability, which focuses on the board and executives' activities or their absence.[277] I approach the top management's ability primarily from whether they were able to create the necessary operating conditions for the other organization. I analyse first the role and the decisions of the top executives and management, whereby the main variables of the organizational behaviour are the leadership capability, the know-how and the personal commitment to the company, the commitment of employees to the enterprise, and the enterprise culture. Mathieu and Zajac (1990) highlight the importance of attitudinal and calculated types of organizational commitment based on the work environment to improve organizational performance.[278] The first means an individual's acceptance of the organization's goals and values, to work on behalf of the organization and have a strong desire to maintain membership in the organization.[279] Becker (1960) defines the calculated commitment as *'a structural phenomenon, which occurs as a result of the individual-organizational transactions and the alterations in the side-bets or the investments the overtime'*.[280] Highly skilled employees can have the ability to generate value for the organization and, as a consequence, they may be rewarded, which thereby increases their calculative commitment.[281] In the following paragraphs, I highlight the variables that affect the operational level at each level of the organization, and especially the decision-making process.

Analysing the conglomerate Tampella's management decisions in the past is exceptionally challenging due to final decisions being the sum of several variables of different industries and a continuous process in nature. The factors that affect rational decision-making include past decisions, personal and actors' preferences, collective and personal conservatism, uncertainty, risk-taking willingness in decisions, knowledge, and incomplete and inconsistent goals.[282] Decision-making uncertainties, for instance, can occur due to a bureaucratic company culture and organization, the dominant parent organization, required excessive efficiency, a lack of autonomous and independent organization functions, unclear strategies by the firm, closed and passive top management, no reward or compensation systems, minimised slack resources, challenges in resource allocation, and failures in internal and external communication systems.[283]

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277 Burgelman 1996, p. 208, Zollo and Winter 1999, p. 10.
278 Mathieu and Zajac 1990, p. 188.
279 Mowday et al. 1978, pp. 26–29, Meyer and Allen 1991, pp. 82–83.
280 Becker 1960, pp. 35–37.
281 Stevens et al. 1978, p. 393.
282 Harrison and March 1984, p. 39, Hellgren and Melin 1993, p. 47, Magee 1997, p. 239, Kruger and Dunning 1999, p. 1132.
283 Cooper and Schendel 1976, p. 68, Hannan and Freeman 1984, p. 162, Kelly and Amburgey 1991, pp. 591–612, Ajzen 1991, p. 182, Hannan and Freeman 1993, p. 201, Armitage and Conner 2001, pp. 486–488, Becker 2004, pp. 643–677, Becker et al. 2005, p. 781, Honig et al. 2014, pp. 9–10, 50, 291–292.

2.3.2 Managerial competence

The second determinant, managerial competence, highlights the individual investments or the technology performance activities by the middle management. Their working environment was framed and guided by the strategies and decisions of the board and executives, and their organizational activities are based on the managerial authority, the individual's education, past work experience, organizational culture, organizational politics, absorptive capacity and the variety of the expertise within an organization. The managerial activities secure the company's long-term survival in a dynamic environment with the competition based on organizational and individual behaviour, capabilities to learn, and skills to adopt technology.[284] Technology-orientated senior managers are the principal agents to avoid the organizational constraints, make and monitor decisions (including the consequences resulting from the technologies chosen), define the goals and policies aligned with the firm's capabilities and top management's past decisions, and highlight the interrelation between technology and society in the context of needed socio-technical change.[285] An excellent example of middle management's critical role is the fate of the mobile phone manufacturer Nokia, where the decision-making process between the top and middle management was unstable. As a consequence, the top management's decisions in terms of technology and organization failed.[286]

I primarily investigate management's ability to understand the business environment combined with the market and technological investments, particularly in the context of the company's long-term development and profitability.[287] Second, I study management's capability to perform daily operational issues. Such decision-making emphasises the ability to successfully respond to the organizational, business and technological requirements. Managerial capabilities have an impact on technological change and the introduction of new technology with the approach of social and political management processes.[288] From the pulp and paper industry perspective, managers need to understand paper industry transactions in terms of capital and service businesses, related economics, and possessing the nature of mental strength and flexibility.[289] Forest industry mills often need immediate managerial decisions to solve acute production line problems related to operations or product quality. Individual creativity depends on one's own ideas and on external stimuli to solve the problem. Personal learning

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284 Barr and Stimpert 1992, pp. 15–36, Eisenhard and Martin 2000, pp. 1110–1114, Calantone et al. 2002, p. 522, Hult et al. 2004, p. 436, Ojala and Karonen 2006, pp. 106, Teece 2007, pp. 1344–1345.

285 Porter 1991, pp. 115–116, Jaworski and Kohli 1993, pp. 7–9, 15, Denzau and North 1994, p. 8, Wenger et al. 2002, p. 9.

286 Lamberg et al. 2019, p. 23.

287 Abernathy and Clark 1985, pp. 20–21, Ngo and O'Cass 2012, p. 873.

288 Pettigrew 1979, pp. 576–577.

289 Ojansivu et al. 2013, p. 1326.

experience improves an individual's knowledge and capability to solve these issues.[290] The firm's tacit and widely dispersed knowledge is due to its knowledge regime, absorptive capacity, capabilities and competitive environment. To maintain the benefits of its knowledge, the firm needs to transfer tacit knowledge to codified knowledge, protect trade secrets by patents, own optimal timing, and exploit the economies of scale and scope.[291] For these reasons, I examine the role and decisions of management in the context of operational decisions and activities.

There exist plenty of constraints created by managerial choices. The hiring of external resources may create further friction and inertia within the management and by managers. Managerial action may be political or informal, including various internal divisions and micro-political or organizational conflicts, and having different interpretations and goals.[292] Managers may have capability and informal behavioural constraints, such as emotions, personal feelings, and values, which can create intra-managerial boundaries and unexpected consequences.[293] For instance, production managers are keen to increase line efficiency, while sales representatives like to change the portfolio.

I share a personal opinion about the present trend of the firms' technology development in the forest industry, which is based on my over thirty-year national and international career in this particular industry. In general, I argue that the forest companies' top management outsources their innovative technology development to suppliers due to a lack of professional resources in-house. The approach of outsourcing technological innovation entails a high-risk factor for the long-term profitability of the company.[294] Due to this, the firm is incapable of demanding advantage technology and knowledge from external global suppliers, so they have to rely on the offered technology and its process applications. Also, the firm's own employees do not learn by doing, which further decreases the company's learning culture, the individual's know-how, the technology decision-making capability, and the absorption capability of the innovative information.

On the other hand, managerial knowledge increases through informal internal or external networking.[295] Managers have little influence on short-term corporate performance based on the most standardised products, imbalances in supply and demand, the price volatility of the products, foreign exchange fluctuations, and unpredictable variations of manufacturing costs in terms of fibre, energy and chemicals.[296]

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290 Simon 1989, pp. 9–10, Magee 2003, p. 27.
291 Lee and Lee 2007, p. 501, Kyläheiko et al. 2011, pp. 285–286.
292 Pettigrew 1979, pp. 576–577, Laurila 1998, p. 39, 86, 133.
293 Hambrick and Mason 1984, p. 198.
294 Bidwell 2012, pp. 1622–1642.
295 Laurila 1998, pp. 18–19.
296 Laurila 1998, p. 15.

2.3.3 The development of human resources

The amount and the quality of resources, along with internal and external circumstances, define the interpretation of technological change as either an opportunity or threat.[297] Based on my personal work experience, in some companies the top management generalises the critical information which they do not understand or which they want to understand but do not confess that they do not understand. The consequence is that the technology and investment decisions take place without the necessary professional knowledge.[298] Unfortunately, firms too often underinvest in innovative capabilities, reducing efforts to acquire and use innovative knowledge. Consequently, the firm's culture, the employees' daily routines, knowledge, and technical or financial resources limit its absorptive capacity too much.[299] In the organization context, decision-making uncertainties can be created by the inability to predict performance and cost structures, by the planning and centralisation of the decision-making, and by the employees' different skills, capabilities and orientations.[300] In the technology context, the firm may have a lack of ability to skilfully allocate resources in terms of time and money.[301]

I analyse the importance of the employees' professional skills for the company in the development of human resources and rational decision-making, which are the key factors in responding to the changing conditions of a path-dependent organization.[302] Formal and informal behaviour create the firm's culture of decision-making and organization. That is why reductions in organizational diversity imply losses of the related information in a particular environment.[303] The firm's internal, valuable and immobile resources or competence create a competitive advantage.[304] These intangible assets can be accumulated skills, routines and reputation.[305] Some scholars define these resources and competencies as a resource-based view to control changes in the environment.[306] Resources, such as managerial choices, should be nurtured and maintained by the firm's continuous activities.[307] Some firms define their internal resources as the sales force or R&D organizations, and external assets as reputation and relationships.

At the firm level, Tampella's top management's capabilities and skills were also necessary for making changes to the organization with intelligent choices.[308]

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297 Jackson and Dutton 1988, pp. 384–385, Mokyr 1992, pp. 333–335, Hannan and Freeman 1993, p. 201.
298 Kyläheiko et al. 2011, p. 276, Cousins et al. 2011, p. 939, Särkkä et al. 2018, p. 8, Gutierrez-Poch 2018, p. 161.
299 Cohen and Levinthal 1990, p. 135, Honig et al. 2014, pp. 9–10.
300 Rosenberg and Birdzell 1986, p. 12.
301 Danneels 2007, p. 530.
302 Hannan and Freeman 1993, pp. 7–10, Sydow and Koch 2009, p. 696.
303 Barney 1986b, p. 658.
304 Korhonen and Niemelä 2005, p. 28, Korhonen 2006, p. 47.
305 Abramovitz 1993, pp. 217–243.
306 Porter 1991, pp. 107–109, Collis 1994, p. 151, Barney and Arikan 2001, pp. 141–142.
307 Prahalad and Hamel 1990, p. 81.
308 Harrison and March 1984, p. 40.

According to scholars, the differences of business systems between firms include the managerial hierarchy of the business activities' co-ordination, the specialisation of the managerial capabilities and activities, and the degree of discontinuous growth with the changed fundamental skills and activities.[309] Failure results from the established competencies, which become rigidities in the context of organizational change rather than technological incompetence.[310] This is the reason why it is important to analyse both the technological and organizational cultures of a firm. If the firm is incapable of absorption technology by learning, the organization and individuals are not motivated to learn and do not learn from past projects or past managerial experiences and capabilities.[311] The individuals' previous work experience, knowledge and necessary skills, the recent scientific or technological developments, and the company's organizational culture have an impact on human behaviour, subjective norms and attitudes, and intentions.[312]

Tampella had all the possibilities to create a learning culture and have an impact on the adoption of advantage technology from private and public institutions, sources outside the forest industry, and abroad.[313] Two of the most critical factors for a firm's long-term survival are the quality and quantity of its explicit and tacit knowledge based on continuous learning and accumulated knowledge adoption in terms of articulation and codification, based on past experiences.[314] In-house knowledge was critical also for Tampella's technological development in the long term. In addition, it meant the firm's ability and willingness to codify its internal knowledge, the nature of internal mechanisms, the rules and standards to keep secrets, and the rate of the labour turnover.[315] Based on previous literature, the firm's internal knowledge equalled the existing competencies, and changes in knowledge took place according to human behaviour.[316] The learning mentioned above either promoted or hindered future technological transactions.

The forest industry is characterised by the fact that the more experienced and authorised a person in management is, the more an individual can increase the firm's productivity, especially technological decision-making, in terms of capital investment and related compromises. One dominant decision regarding compromises in a specific function should not create negative consequences for other functions. The specified knowledge means that the individual is capable of duplicating and bringing new knowledge of the technology to solve daily problems of the machinery and related processes; the most critical issue is that he will be a tutor for other employees.[317] The experienced senior professionals act as the

309 Adler et al. 1999, p. 45.
310 Pavitt 1998, pp. 15, 21.
311 Dosi 1982, p. 158, Laurila 1997, p. 221, Cohendet and Llerena 2003, p. 273.
312 Armitage and Conner 2001, p. 472, Ajzen 1991, p. 206, Magee 2003, p. 12.
313 On similar processes in Southern Europe, see Gutierrez-Poch 2018, pp. 168–171.
314 Brown and Duguid 1991, p. 55, Zahra et al. 1999a, p. 172, Zollo and Winter 2002, p. 340, Nelson 2003, p. 915, Wenger et al. 2002, p. 9, Yang 2012, p. 44.
315 DeBresson and Amesse 1991, p. 373.
316 Nelson and Winter 1997, pp. 51–52, Zollo and Winter 1999, p. 30.
317 Nelson 2003, p. 914.

firm's internal mentors, who share their tacit knowledge of the markets, technology and the organization. The individuals and teams need to understand the nature of the equipment, such as the path dependence, high fixed cost and long lifetime of massive, immobile and interrelated types of equipment.[318] The traditional firm's core competencies can function as bases for new product innovations, which can be multidimensional in terms of the organization, technology or marketing.[319]

In this sense, I agree with Magee's (2003) statement in the paper and board industry context that unit costs decrease and the efficiency of performance increases in proportion to the accumulated experiences due to learning by doing.[320] In the manufacturing industry context, I prefer Zollo and Winter's (1999) statement on combining both the capability of top management to sense the firm's learning needs and an organization's learning capability.[321] The managers' learning by doing is based on the assumption that thinking and acting are separate things.[322] The different existing work tasks and conditions improve the learning capabilities but do not create the diversification needed for innovation. In the development of the organizational absorptive capacity and innovative performance, the process of learning by doing should be utilised in the process of learning to learn.[323] In the Finnish pulp and paper industry, according to scholars, technology-orientated firms had a highly bureaucratic way to operate culture, but the machines' operators had tacit knowledge through the learning-by-using and fast problem-solving culture.[324]

From the technology absorption perspective, the technological level of paper machines demands such a large body of knowledge that without professional experience and the presence of mentors, the process to learn needed technology and problem-solving techniques is too long.[325] Performance is best when the object of the learning is somehow known beforehand and the knowledge is diversified. At Tampella, there existed two significant characteristics of the learning process. The knowledge was cumulative, and wrong decisions of technology change and organization were costly to fix. Tampella's middle management faced these two challenges daily. The production unit's profitability was reduced substantially if the equipment life cycle was too short, the devices did not work as intended, and professional decisions were missing.[326] The firm's executives and top management faced the most critical challenge – debt control. To avoid these concerns, a firm's technology adoption and learning culture should be proactive and continuously updated according to the dynamic needs of the technol-

318 Cohen 1984, p. 789.
319 Leonard-Barton 1992, p. 123, Danneels 2002, p. 21.
320 Magee 2003, pp. 16–19.
321 Zollo and Winter 1999, p. 28, Magee 2003, p. 18.
322 Arrow 1962, pp. 155–173, Hellgren and Melin 1993, p. 50, Wenger et al. 2002, pp. 3–5.
323 Zollo and Winter 1999, p. 28.
324 Schienstock 2007, p. 97.
325 Gutierrez-Poch 2018, p. 183.
326 Babbage 1833, pp. 171, 285.

ogy and organization. This means, according to some scholars, that the organization takes care of the technology absorption capability or learning ability at all levels, produces new knowledge in the company, and creates the conditions for learning new things and understanding the available information on the basis of related expertise.[327]

2.3.4 Importance of the information

The company needs top professional management with key technology understanding and experienced human resources in-house to secure absorption capacity and understanding of the related business information and its importance.[328] The available internal and external information comprise the core determinant for decision-making in terms of markets, the organization and the development of technology.[329] The critical determinants are lifetime learning and cross-sharing communication cultures, which are needed to motivate the employees to stay in the company and, accordingly, secure tacit knowledge-sharing based on their experiences.[330] Furthermore, a firm needs to have close interaction between the other relevant parties, such as customers, suppliers, universities, independent research institutions, the infrastructure and the social environment for advantage technology adoption, portfolio innovations and profitability improvements.[331] The importance of technology absorption based on professional individuals' information is evident in the example of the disk drive business, in which the best firms of the disk drive industry succeeded or failed by blindly listening to their customers and investing aggressively in the technology, products, and manufacturing capabilities that satisfied their customer's next-generation needs.[332] A similar example is documented in the forest industry, where too-strong customer orientation can stifle innovation and only produce gradual improvement of the existing products.[333] These two examples indicate the management's inability to properly understand and interpret received information in terms of technology and organization.

The fundamental prerequisite for Tampella's profitable operations was whether it was capable of implementing successful investment projects with its machinery workshop's customers and internal forest units. Usually, this requires good and open-minded internal and external communication based on project planning and scientific and technological know-how. Based on my work experience, the firm's successful development requires the ability to exploit the past investment projects' feedback information in terms of cash flow, organizational resources, technological knowledge and skills, and the impact on market dynamics.

327 Child 1997, pp. 52, 69.
328 Karonen 2004, p. 263, Korhonen 2006, p. 50.
329 Porter Alan et al. 1991, pp. 114–132, Woldendorp 2005, pp. 1–5.
330 Detert and Edmondson 2011, pp. 481–482.
331 Mokyr 1990, p. 12, Brown and Duguid 1991, pp. 48–49, Porter et al. 1991, p. 114, Sirmon et al. 2007, p. 288, Bapuji et al. 2011, p. 229, Alajoutsijärvi et al. 2012, p. 84.
332 Christensen 1997, pp. 13–14.
333 Korhonen and Niemelä 2005, p. 31.

Sometimes the decision-makers may be constrained by incomplete feedback information in terms of organization or technology, uncertain business environment, and labour turnover.[334] The storing and understanding of information in terms of quality and frequency are based on experiences within particular contexts rather than the facts.[335] From the network perspective, technology standards and organizational considerations affect the received information, so that, for instance, the power struggles and the rivalries take place within the network.[336] The factors above may cause firms to discount the value of the information and ideas coming from other firms, reducing willingness to invest in their internal capabilities and effectively utilise the network experience.[337]

Based on personal work experience, for a professional capital investment project in the forest industry, it is a practice that the company's new main equipment choices are first based on the available information of the supplier's references (external references) and, second, the equipment and experience (internal references) in the company's production. The external references include vendor-built machines that are used by competitors. Utilising external technology references is very important in the forestry sector due to the costs of technological mistakes, which are very significant and take place over many years. For instance, in the 1980s, one WFC[338] mill in Finland had seven years of negative results after a new paper machine start-up due to the top management's wrong decision-making on the technology. The external references also mean years of global collaboration, whereby the company develops and examines the equipment and their applications through research and development projects with other companies, alliance and strategic vendors, industry clusters, and institutions.[339] It mainly involves received information from the utilisation of pilot machines, internal network information, primary research and funding possibilities.

The internal references include the company's production equipment and machines, patents, intellectual property rights, own experiences, and the learning culture. Every company needs real knowledge based on experience, especially about the new technologies of competitors and related types of equipment. In the innovation context, according to scholars, successful interfirm cooperation also requires essential tacit knowledge.[340] This was one of the most important things at Tampella, because their forest industry technology was dependent mainly on the transfer of technology from their machinery workshop. The machinery workshop's advantage technology development depended on the tacit knowledge and skills of their employees, as well as on their knowledge of competitors.

334 Kuran 1988, pp. 167–168.
335 Cohen and Levinthal 1989, p. 593, Denzau and North 1994, p. 8, Lamberg et al. 2019, p. 23.
336 DeBresson and Amesse 1991, p. 373, Lamberg et al. 2019, p. 31.
337 Cohen and Levinthal 1990, p. 133, Tripsas 1997, p. 139.
338 Wood-Free Coated, M-Real internal information.
339 Järvinen et al. 2012c, pp. 229–232.
340 Cavusgil et al. 2003, p. 15.

3 THE CASE: TAMPELLA – FROM SUCCESS TO FAILURE

In particular, Part III of the dissertation deterministically describes the path-dependent processes that led to the failure of Tampella. I have chosen seven partly overlapping processes that might explain this path from success to failure. First, the early developments of Tampella laid the foundation for the following decades, over a century. Second, the decisions made in the early 1980s were especially fatal in terms of the firm's capital turnover and future portfolio of the paper and board businesses. Third, the ownership and intervention of the Finnish state and national banks in Tampella led to the bankruptcy of the company. Fourth, the CEO's turnover changed the firm's operational practices, which created organizational uncertainties from time to time. Fifth, the executives' organizational capability affected some of their decisions and had drastic consequences for the company's survival. Sixth, the top management's strategic decisions significantly restricted the technology development of the machinery workshop. Consequently, until the early 1980s, the paper and board units' technological development was significantly limited. Seventh, Tampella's diversified structure created a corporation that was challenging to manage in terms of decision-making and debt. The descriptive narrative of the path of Tampella is based on the company archives, annual reports, previous literature and articles published in international and Finnish industry and business journals (especially *Paper and Timber Journal* and *Talouselämä Journal*).

3.1 The early years of the company

In 1844, the lawspeaker N.J. Idman, laird Carl August Ramsay and Gustaf Idestam established ironworks in Tampere, which already had a tradition in iron trading with Russia.[341] Gustaf August Wasastjerna established a diversified company Tampella in 1856 by combining Idman's blast furnace, foundry, and sawmill.[342] The new chairman of the board was a pastor and teacher, Alfred Kihlman, who further expanded the machinery workshop products from ships to water turbines and wood-grinding equipment. Tampella gained benefits from the state's subsidies, its geographical location of Tampere, and other industry development.[343] The city gave a permit to import raw materials and machinery as a duty-free business until the end of the 1890s.

Tampella's development path followed other Finnish companies both chronologically and strategically. In particular, the investments of the restructuring process and war reparations to the Soviet Union after the Second World War supported the development of Tampella and other heavy industry firms. The Finnish metal industry products included products such as machines, cables and ships.[344] In the pulp and paper industry, the first Finnish Fourdrinier paper machines were introduced in Tampere in 1842 and in Tervakoski in 1853. Furthermore, many Finnish inland pulp and paper mills were established between 1866 and 1873.[345] Utilising the knowledge and cooperation of its national network, Tampella established new products, such as grinding machines, in 1873. In 1880, the first Finnish sulfate pulp mill started its production in Valkeakoski, and one year later, the first sulfite pulp mill opened in Kuusankoski.[346] Tampella's interest in forestry operations can be considered as starting in 1874, when it established a mechanical pulp board association with Papermill Oy. In the early 1880s, the Tampere Puuhiomo integrated into the Tammerfors Linne- och Jern-Manufaktur Aktiebolaget, which established the cardboard and kraft board mills already in 1872.[347] Since 1886, the company purchased groundwood machines and established Papermill Oy and forest areas for raw materials in Inkeroinen, where over time the company's board knowledge was centralised. In 1897, Tampella invested in the first 'continuously running' board machine at Inkeroinen. Tampella was not the first entrant into the market in Finland, yet it was among the pioneering companies.

Under the leadership of Managing Director Wolter Ramsay, the company focused increasingly on forest machinery and related equipment. When new custom tariffs reduced the Soviet Union exports, the machinery workshop learned to be flexible towards changes in the market and society.[348] In the mid-1930s, the

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341 Pihkala 1964, p. 123, Sainio 2003, p. 7. In 1848, the firm was renamed Tammerfors Linne- och Jern Manufaktur Aktiebolaget. See Seppälä 1981.
342 Skippari 2005, p. 109. Tammerfors Mekaniska Werkstad started operations in 1857. The early years of the company are documented in a three-volume book by von Bonsdorff 1956.
343 Toivanen 2005, p. 71.
344 Kaukiainen 2006, p. 18.
345 Sihvonen 2008, p. 8, Ojala et al. 2018, p. 41, Särkkä et al. 2018, p. 41.
346 Hjerppe 1989, p. 77.
347 Seppälä 1981, p. 50.
348 Oksanen and Pihkala 1975, pp. 14–15.

machinery workshops of Tampella, Maskin & Bro, Varkaus and Karhula established a joint venture named TAMAVAKA, which took place over four years.[349] During the same decade, its technological development was affected by international development, as it adopted the available technology through joint ventures with the American machinery workshop Black-Clawson.[350]

An example of organization and manufacturing flexibility was in 1933, when the company received an order of 40 locomotives and signed a preliminary aeroplane motor agreement with the Defense Forces of Finland. Correspondingly, the technology of hydroelectric power was developed and implemented in Inkeroinen due to the increased internal and public energy demand. In the 1930s, the volume of orders required an extension to the workshop, as the company exported plywood presses, recovery boilers, and shell drums, among other products. Already in 1938, the company had 4,400 employees and its production value was FIM 366.9 million.[351] It was the fourth-largest company in Finland, based on the number of employees. Most of its functions located in the city of Tampere, such as the machinery workshop and linen production, and Lapinniemi's cotton factories.[352]

During the 1930s, many companies' representatives, including those of Tampella, travelled abroad for technology adoption.[353] In 1935, Tampella's management travelled to Germany to visit the machinery supplier Voith Heidenheim and to Switzerland for technology adoption.[354] The reason was that since the late 1800s, Tampella's machinery workshop faced intense international competition by overseas competitors, such as German J.M. Voith and Maschinenbauanstalt Golzern, American Pusey & Jones and Beloit IronWorks, and Swedish A.B. Karlstads Mekaniska Werkstad and Nydqvist & Holm. The domestic competitors included Warkaus Mekaniska Werkstadt, Karhula workshop, and the Aktiebolaget Wiborgs Mekaniska Verkstad.[355] In the late 1950s, there existed seven large paper machine manufacturers in the world: Tampella, Valmet Oy, Wärtsilä Oy Kone and Silta, Black Clawson, Beloit, Voith, and KMW.[356]

Throughout the company's life cycle, the Finnish or international general economic situation influenced the company's performance, as the company was operating in international business and the company's financing was based on external debt. In 1938, the company responded to the growing market demand by starting newspaper production, and in 1952 the company established a semi-pulp production plant in Anjalankoski.[357] The company expanded its different businesses further in 1953, when it started to produce drilling equipment for the

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349 Nykänen 2005, pp. 58–61.
350 *Paper and Timber Journal* 1958, 1963, Hjerppe 1989, p. 78, Särkkä et al. 2018, p. 44.
351 Sainio 2003, pp. 9–10, Paranko 2012, p. 178. In 1938, the company name was Tampereen Pellava- ja Rauta-Teollisuus Osake-Yhtiö.
352 Sainio 2003, p. 10.
353 From a historical environmental perspective, see Pehr Kalm's travel diary by Hollsten 2015.
354 Tampella Direktiones Protokoll 1935, No. 1 §8, Elka archives, Mikkeli.
355 Gutierrez-Poch 2018, p. 165.
356 See Nykänen and Paulapuro 2005.
357 Tampella Direktiones Protokoll 1938 Vol. 2 §25 and §36, Elka archives, Mikkeli.

mining industry. In 1956, a general strike and financial slowdown took place in Finland. In turn, according to Hjerppe (1989), the post-1956 period was good for exports due to devaluation in Finland, but already in 1958, the company faced a tense economic situation due to the recession (0.5 per cent growth), import regulation and tight monetary policy. Between 1961 and 1963, there existed financial challenges due to several simultaneous cost-increasing processes: significant investment in Heinola Fluting, the metal workshop's long-term customer loans for paper machines, employee wage increases, new social burdens, and the increased costs of wood fibre.[358] The Bank of Finland and Finnish Export Credit Ltd. provided investment funds for long-term credit, but, for example, the financing of the new Inkeroinen's board mill was significantly supported by the United States.[359]

In general, the Bank of Finland was responsible for overseeing foreign capital movement, and already in the 1950s, several financial institutions were established to secure access to corporate finance.[360] For instance, Mortgage Bank of Finland and Finnish Export Credit Ltd. were established in 1956,[361] Finnish Export Guarantee Agency in 1962,[362] Industrialisation Fund Ltd. in 1963,[363] Sponsor Oy in 1967, and Development Regional Fund Ltd in 1971.[364]

In the 1960s, the three major industries of Tampella were the forest, metals, and textiles.[365] Between 1946 and 1960, the strategic focus of the company was on the liberalisation of trade, new technological innovations (sulfite), integrated production processes by mechanisation, and a significant focus on newsprint and board production. In addition to new investments, such as Heinola Fluting's board machine in 1961 and Inkeroinen's cardboard machine in 1965, management understood that an essential source of Tampella's competitive advantage was its internal collaboration between the machinery workshop and paper, pulp and board production units. Cooperation between Tampella's machinery workshop and forest production units could develop a competitive advantage for both, due to increased employee efficiency, the available technology, reduced cost structure, improved resource allocation and communication, and increased in-house knowledge and skills. Based on this internal cooperation in the 1960s, Tampella was able to produce newsprint and special paper qualities according to customers' requirements despite newspaper overcapacity in the market and the agreed-upon sales restrictions. Furthermore, as a result of internal cooperation between the machinery workshop and Anjalankoski's paper mill, the latter

358 Tampella Annual Reports 1961, 1963.
359 Tampella Annual Report 1963.
360 Hjerppe 1989, pp. 83–84.
361 Paavonen 1998, p. 137, Suomen Vientiluotto Oy.
362 Suomen Vientitakuulaitos.
363 Teollistamisrahasto.
364 Kuusterä 2019, pp. 61–62, Kehitysaluerahasto Oy.
365 *Paper and Timber Journal* 1960, No. 8, p. 454. Tampereen Pellava- ja Rauta-Teollisuus Osakeyhtiö (Tammerfors
Linne- och Jern-Manufaktur Aktiebolag) was renamed Oy Tampella AB, dated 23 August 1960.

(PM 1) achieved a good production volume and energy savings related to steam. In 1965, the Inkeroinen's new board mill investment secured the employment of the machinery workshop.[366] Tampella's organizations continued to co-operate across their different business units. Tampella's top management commanded its machinery workshop to participate in significant foreign investment projects, such as Eurocan Pulp and Paper in Canada and Pineville Kraft Corporation in North America. In Finland, the Anjalankoski newsprint PM1 was rebuilt, including a renewal of the press section, machine calender and electric drives; all these were done by the firm's machinery workshop in 1973.[367] As a consequence, the level of in-house knowledge and skills increased at both the paper mill and machinery workshop, reflecting a similar co-evolutionary process as seen at Kymi and Valmet at the same time.[368]

The internal co-operation did not always bring good results. Between 1965 and 1976, Espanola's board mill achieved an average satisfactory performance with annual fluctuations of ± 100 MESP, as presented in Figure 1. The original machine supplier was Tampella's machinery workshop in 1965.[369] Between 1977 and 1989, the mill's result was negative, excluding the year 1987.[370] The intermittent reasons were market-based economic variables such as Spain's economic downturn, 16 per cent inflation, appreciation of the peseta, 70 per cent increase in recycled fibre and 30 per cent lower prices.[371] In 1990, the EBITDA rose to 17.1 per cent, and the net profit was 380 MESP. During the first eight months in 1991, the EBITDA accounted for 23.7 per cent, and net profit accounted for almost 700 MESP.[372]

In 1992, Espanola did a major rebuild and its supplier was Tampella Carcano, which earlier was Tampella's subsidiary company.[373] As a consequence, the gross margin fell 30 per cent and the net result from net sales fell 71.5 per cent.[374] Furthermore, in 1992, customer claims increased from 0.7 to 2.5 per cent calculated from turnover. The primary reasons for the negative performance were problems with the pulp processing, fibre raw material, coating compositions, the logistics of machinery equipment and the operators' knowledge of the new technology.[375] In summary, Espanola's profitability was negatively affected by the board machine's low design speed of 430 m/min, the

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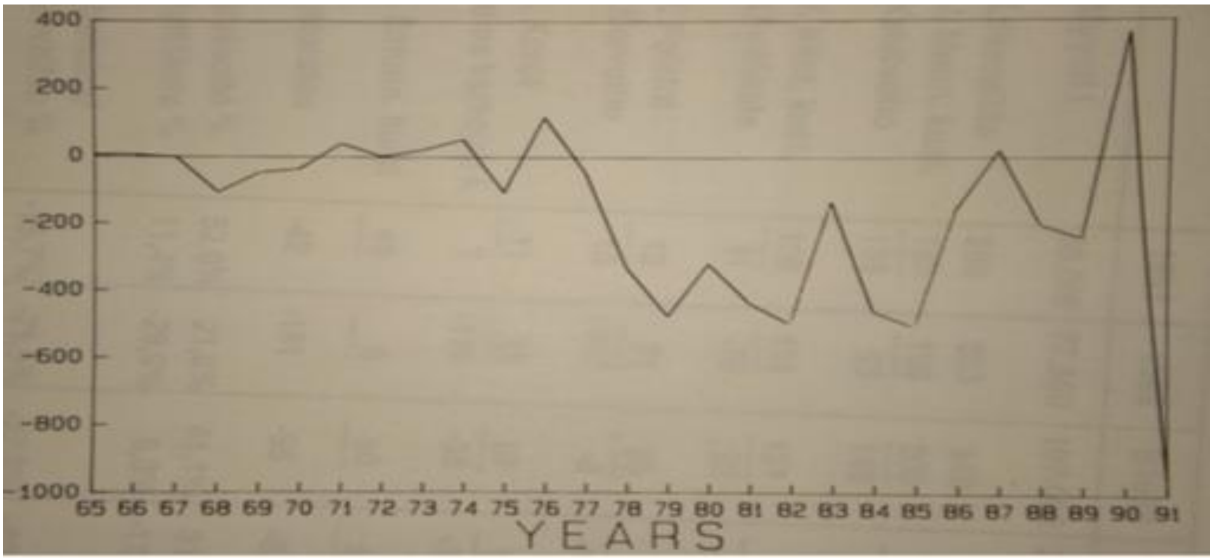
366 Tampella Annual Report 1965, *Paper and Timber Journal* 1966, No. 11.
367 Tampella Annual Report 1973.
368 Alajoutsijärvi 1996, pp. 101–174.
369 *Paper and Timber Journal* 1965, No 8.
370 Hiltunen 27.4.1993, Enso-Gutzeit internal due diligence report, Elka archives, Mikkeli.
371 Tampella Annual Reports, 1977–1989.
372 Hiltunen 27.4.1993, Enso-Gutzeit internal due diligence report, Elka archives, Mikkeli.
373 Tampella Annual Report 1992.
374 Hiltunen 27.4.1993, Enso-Gutzeit internal due diligence report, Elka archives, Mikkeli.
375 Tampella Annual Report 1992, Hiltunen 27.4.1993, Enso-Gutzeit internal due diligence report, Elka archives Mikkeli.

narrow width of 3.9 m, selected raw materials, technological problems of the modification in 1991, and market and economic downturns.[376]

Figure 1 Espanola net result in 1965–1991.



Source: Hiltunen 27.4.1993, internal due diligence report, Elka archives.

In 1965, Tampella signed a significant joint venture agreement with Enso-Gutzeit and the American Bodcaw Company. The established company in North America was named Pineville Kraft Corporation, where years later Tampella delivered BM 3.[377] Enso-Gutzeit, Kymi Oy and Canadian shareholders agreed on another co-investment. They established a company called Eurocan Pulp and Paper, whose location is Canadian Kitimat.[378] Tampella provided a substantial part of the machinery for this project, which started up in 1969.[379] The Eurocan Kitimat's brand name of kraft paper was Kidkraft and the test-liner's KitLiner.[380]

The top management's aforementioned activity indicates that Tampella's management had a market-orientated attitude to improve the machinery workshop's sales in Canada and North America. Unfortunately, these decisions manifested a short-term approach: financial arrangements should dominate a single investment with both production capacity and high value-adding products, with

376 *Paper and Timber Journal* 1965, No 8. The Tampella machinery workshop delivered the board machine and most of the other process equipment. In 1991, the machine's width was increased from 3.9 m to 4.3 m, but the speed remained the same.

377 Tampella Annual Report 1965. In 1973, Tampella divested from Pineville Kraft Corporation based on three reasons: good board machine reference was achieved, participation as a minority shareholder was no longer considered appropriate, and the investment had already given a good return on invested capital.

378 Näsi et al. 2001, p. 41, Tampella Annual Report 1965 and 1976, Oy Tampella AB Board meeting memo 8.1.1976 §3A. Kymi Oy purchased all Tampella shares of Eurocan Pulp and Paper (25 per cent of company shares) on 8 January 1976.

379 Tampella Annual Report 1969, *Talouselämä Journal* 1969, Vol. 39. See Ahvenainen, Jorma 1992, *Enso-Gutzeit Oy 1872–1992: 2, 1924–1992*, Enso-Gutzeit. Ahvenainen, Jorma 2006, *Suomalainen metsäteollisuus Pohjois-Amerikassa*, Elka, Mikkeli.

380 *Paper and Timber Journal 1970*, No. 11.

the essential requirement for new investment being the potential purchasing power of the market. Eurocan Kitimat needed to operate in a mature market with tight competition. Also, the price trend of related end products was downward. The Eurocan Kitimat project was under the special protection of the Finnish government, so the motivations of Tampella's management were both commercial (with the hope of new sales preferences) and political (with a hope for the utilisation of the government support).[381] Joint operations such as Eurocan and Pineville were typical for Finnish forest industry companies. Furthermore, most of the Finnish forest industry companies had participated in centralised wood-purchasing operations to co-ordinate prices since 1927.[382]

In 1967, Tampella's forest business unit generated 55 per cent of the invoicing and had 2,946 employees. In the same year, its machinery workshop unit employed 2,383 people and accounted for 27 per cent of the company's invoices. The textile business unit employed 1,638 people, and they generated 16 per cent of the company's billing. Furthermore, participation in several international joint ventures underlined the importance of the pulp and paper industry for Tampella.[383]

During the years 1965 to 1983, simultaneously with Tampella's direct investments in the pulp and paper businesses, acquisitions and mergers were carried out in large numbers as companies such as Espanola S.A., Syrjänen Oy, Latexteollisuus Oy, Oy Aug. Eklöf Ab, and Lainapeite Oy were acquired. Furthermore, the company made acquisitions of the plastic manufacturers Eralki Oy and Kalvotuote Oy in 1969, wherein the function was to support both the plastic and forest industries.[384] As a result of regular expansion, the top management was concerned about the company's growing debt burden due to the workshop's financing of machinery customer's and the company's capital investments.

In the beginning of the 1970s, Tampella's metal industry had many different production units. They had a shipyard and workshop at Tolkkinen (Porvoo), a machinery workshop of forest and power machines in mid-Tampere region, production facilities of thermal and process equipment in Messukylä, and production of compressed air and drilling rigs by the Tamrock business unit.[385] In 1974, the number of employees totalled 8,967.[386] Between the years 1961 and 1980, the company focused on intensive diversification, environmental issues, technology change from sulfite pulp to sulfate pulp, and production of recycled newsprint and boards.[387]

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381 Näsi 2001, p. 17, Ojala and Karonen 2006, pp. 103–104, for further reading on the relationship between large Finnish forest industry companies and power ownership groups (for instance, state-owned companies, banks and elite families).

382 Pakkanen 2011, pp. 110–112, Jensen-Eriksen and Ojala 2015, p. 533. On the wood cartel in Finland in 1997–2004, see also Koski and Pajarinen 2013.

383 Tampella Annual Report 1967.

384 Tampella Annual Report 1966.

385 Tampella Annual Report 1969, *Talouselämä Journal* 1997, No. 38: '*Sandvik nielee Tamrockin*' (Sandvik acquired Tamrock in 1997).

386 Tampella Annual Report 1974.

387 Tampella Annual Reports from 1961 to 1980.

3.2 The 1980s as the beginning of the end

During the 1980s, the primary concern was Tampella's capital turnover, which was ineffective throughout the analysis period due to the massive debt from loans for the new investments and the machinery workshop's customers.[388] The firm's weakest debt ratio was between 1981 and 1990, and a weak equity ratio took place between 1983 and 1987.[389] Still, in 1982–1983, the top management invested significantly more in turnover, compared, for instance, to Enso-Gutzeit and Kymi Oy.[390] Overall, between 1981 and 1995, Tampella's significant interactions focused on centralisation, improved productivity, the performance of the integrated mill units, environmental issues, development of new raw materials, wood-free papers and coated papers.[391]

In 1980–1984, the forest industry's competitive landscape was characterised by international competition, increased national protectionism, and competitors' currency devaluations.[392] In 1982, Sweden devaluated the Crown by 16 per cent, while the Finnish mark devaluated only by 4 per cent.[393] Due to the above reasons, many managerial activities focused on increasing Tampella's competitiveness, for instance, in board business units of Inkeroinen, Espanola and Heinola Fluting.[394] The board mills created new board grades and produced several records, which secured the forest unit's profitable businesses. For instance, Inkeroinen performed well, as its BM 4 produced record-high production based on past investments in 1981.[395]

Tampella's management had a good sense of business understanding. The machinery workshop's management focused on the development of the automation, production flexibility, standardisation, and engineering of the computer programs. Also, they focused on the spare parts business, thus moving partly into the service business.[396] Top management had a market-orientated attitude, as the board mill won an international marketing competition in 1984.[397] The same argument is proven by the following public announcement[398] of Tampella's vice president and industry leader Jaakko Mattila about Tampella's strategy planning:

> Tampella's strategic planning is not based on cyclical scenarios, as it's much more intense. The design period is approximately the same as the order backlog of products,

388 Tampella internal meeting minutes, 16.9.1976, §84a.
389 See Figure 9.
390 See Figure 4.
391 Tampella Annual Reports from 1981 to 1995.
392 Sajasalo 2006, p. 214.
393 Tampella Annual Report 1982.
394 Tampella Annual Report 1984.
395 Tampella Annual Report 1981.
396 Tampella Annual Report 1985.
397 Tampella Annual Report 1984.
398 *Talouselämä Journal* 1984, No. 20.

> from eight weeks to 30 months. The most important thing is that the business units respond to the changes, such as order backlog fluctuations.

Of course, one can always speculate on the correctness of the strategy. In my opinion, from the previous statement, it can be critically considered that first, in the same sentence, the Tampella executive defined the production cycle of a continuous process-based pulp and paper industry and a production cycle of the machinery workshop. This is impossible, due to the cost structure of the operations and the cash flow control being different. The company's industries need their own and specified short- and long-term strategies. Secondly, one can ask if a substantial and diversified company such as Tampella really implemented its strategic planning according to the company's existing order backlog of its products. Thirdly, even though Tampella's management stressed the change of capability, they did not change the strategic functions before it was too late. Jaakko Mattila's statement reflects the uncertainty about the strategy, which can be said to be proven, as the company sold its textile industry to Finlayson due to the weak equity ratio in the mid-1980s, but left 49 per cent of the shares for itself.[399] The sale of the power generation, distribution and related shares of FIM 484 million in the following year was strategically a short-term decision by the management.[400] Even if the deal was geared toward reducing debt and financing costs, in the long term the sale of energy companies did not make sense. This is because energy ownership is one of the most important profitability factors of production units, and its availability has to be ensured. It is evident, for instance, that Enso Oy announced a further increase in its energy self-sufficiency from 95 per cent in 1997.[401]

In 1985, Tampella announced that they would continue to focus on the forest and metal industries, including the metal unit's equipment and processes, power generation equipment and rock drilling.[402] Two years later, in 1987, the Chief Financial Officer Ingmar Olsson defined the strategy above to focus on the company's endogenous core competencies that supported the firm's other transactions.[403]

> The clear line in recent years at Tampella has been the abandonment of capital-intensive and non-industrial core activities. The guideline releases better resources to develop actual industrial operations. 'Feet' are helpful in balancing finances and earnings. Simplified and clear combinations also support each other in many ways, but they also provide a good environment for innovations, often better than when acting separately. When engaged in the forest industry and manufacturing forest machines, they can and are capable of benefiting from both.

During the years 1987 to 1989, the company's organization, operating methods and strategy-planning system were streamlined to improve efficiency. For the

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399 See Figure 9.

400 Tampella Board meeting memo 1939, Direktiones Protocol No. 9, §83 and §98, Elka Archives, Mikkeli. Already in 1939, Tampella participated in the IVO Oulujoki power plant project with Ahlström and the United Papermills (Yhtyneet Paperitehtaat).

401 Enso Oy Annual Report 1997.

402 Tampella Annual Report 1985.

403 *Talouselämä Journal* 1987, No. 5, p. 33.

company's future economic growth and survival, the most critical decisions and actions were related to reducing debt, increasing the end products' value, and improving profitability and organizational efficiency.[404] In 1987, the management established a new organization, which focused on acquisitions. The top management received additional education for the internationalisation strategies, and all employees were educated to understand the company's norms and culture, as well as the importance of profitability.[405] Many activities took place to improve individuals' motivation and commitment: a bonus system was created on all organizational levels, information sharing was increased, the company's goals and values were clarified, and two employees were nominated to the management team. The aforementioned organizational changes and individual activities were successful, as profit improved, the costs of the debt were reduced and, according to the employees' work environment study,

> Personnel have internalised the company's goals, and understand and accept the needs of the changes. Personnel also have a strong desire to adopt and innovate new organizational ways to operate, which creates the company's profitable businesses.[406]

Furthermore, this was evident in 1989, as all employees were rewarded due to the profits of the year before and shareholders once again earned annual dividends.[407]

In 1988, Tampella's top management decided to transform Anjalankoski's PM 2 to produce coated magazine grades. Moreover, they also decided to proceed with improved newsprint grades in PM 3, even though the newsprint market price was weak already in 1987.[408] That same year, a leading business company named Maxwell Communications Corporation and Finnpap signed FIM 1.2 billion three-year contracts for the delivery of paper, worth around FIM 400 million a year.[409] It is evident that in the 1980s, the decisions to expand newsprint production were strange.[410] The market was unattractive due to newspaper's overcapacity, and newsprint prices had declined already since 1958, excluding some single years of weak growth. Furthermore, additional newsprint capacity was already under construction by Tampella's competitors. Besides, there was no specific reason why the company had to implement investments in both PM 2 and PM 3 at the same time. Two years later, an extensive rationalisation program took place due to weak newsprint demand. The turnover accounted for FIM 4,902 million (def. 1995) in 1989. During the years 1990 to 1991, the market

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404 Tampella Annual Report 1986.
405 Tampella Annual Report 1987.
406 Tampella Annual Report 1989.
407 Tampella Annual Report 1989.
408 *Paper and Timber Journal* 1988, No. 10.
409 *Paper and Timber Journal* 1988, No. 6.
410 E. Kivimäki, memo, 11.3.1980, Tampella AB paper and board industry. The statement of the new paper machine 3 future portfolio done by Anjala's papermill, Finnpap and the central government (K. Hakalehto). K. Hakalehto, internal meeting memo, 10.11.1978, Oy Tambella AB central government, on the future of printing and writing paper.

demand was so weak that Tampella Forest started the rationalisation activities, which meant a reduction of 360 employees.[411] Furthermore, since 1990, under Tampella's command, the company's board for the second time made a historic decision to not distribute dividends to the shareholders (the first such decision took place in 1976).[412]

3.3 Institutional interventions

Institutional interventions supported the export activities of the national companies, but occasional extra charges, such as the state's export duties and the Finnish cyclical reservation system, also burdened the companies' earning capacity. Tampella's preservation fund payment accounted for between 5 and 11.34 million FMK (def. 1995) during the years 1969 to 1971.[413] In turn, from the company's point of view there were also several positive events, in which the government was either a regulator or functionally involved. For instance, the Finnish forest company's profitability improved due to devaluations of the Finnish mark in the years 1957 and 1967, and in 1977–1978, 1982, 1986 and 1991.[414] During years 1973, 1979, 1980 and 1989, revaluations weakened the competition's capability but restrained inflation, which secured operational liquidity. Furthermore, in the 1950s, the Finnish government established the bill of export guarantee, the system to credit export, the license commission and the trade liberalisation agreement with OECD.[415] In the 1960s, the international integration activities included EFTA[416] membership, the reorganised Export Credit Ltd. and the establishment of the Export Advisory Board.[417] The significant associations and memberships were the Finnish Foreign Trade Association,[418] EEC,[419] European Union,[420] CAFFI,[421] and FFI.[422]

411 Tampella Annual Report 1991.
412 Skippari 2005, p. 109, Tampella Annual Report 1990.
413 Tampella Annual Reports from 1969 to 1971.
414 The devaluation after the day floating.
415 Hoffman 2019, p. 150, Paavonen 2019, p. 90. Note that 'bill of export guarantee' is translated from the original 'Vientitakuulaki', 'license commission' translated from the original 'Lisenssitoimikunta', and OECD means Organization for Economic Cooperation and Development.
416 European Free Trade Association, 'Euroopan vapaakauppajärjestö'.
417 Translated from the original 'Vientineuvottelukunta'.
418 Translated from the original 'Suomen vientiyhdistys', later on renamed Finpro.
419 Widgrén 2001, p. 386, Free Trade Agreement between the European Economic Community in 1974.
420 Membership in the European Union in 1995.
421 The Central Association of Finnish Forest Industry, 'Suomen Puunjalostusteollisuuden Keskusliitto'.
422 Paavonen 1998, pp. 271–294, Sajasalo 2006, p. 214, Jensen-Eriksen and Ojala 2015, pp. 526–527, Paavonen 2019, pp. 87–112. The Federation of Finnish Industries, 'Suomen Teollisuusliitto'.

Through associations and the agreements mentioned above, Tampella increased its competitive capability, which was supported by the Finnish government's subsidies and reduction of the extra funding charges, which promoted export businesses.[423] During the post-war period, the members of the Finnish forest cluster gained business benefits through the Finnish state's intervention, which made political arrangements with the Soviet Union.[424] Over many decades, Tampella's forest business units centralised sales by Finnpap, which expanded sales opportunities. Finland's membership in the EFTA in 1961 and EEC in 1974 removed European trade barriers, including some to Eastern European countries, which supported Tampella's access to the European markets.[425]

The Bank of Finland was established in 1811 to support domestic investments and business based on the fact that most of the national firms funded themselves.[426] The role of the Bank of Finland, which is comparable to the Bundesbank of the Federal Republic of Germany, can be characterised as a state-controlled political institution, which focused on exchange rates, inflation, economic promotion and integration at an international level, and participation in international monetary systems.[427] Tampella's collaboration with banks, politicians and influential families was an important issue, as they drew up regulations, participated in financing arrangements and established associations to support export activities. For instance, already in the 1860s, the conglomerate Tampella went bankrupt, but the company's creditor Finland Central Bank rescued the company.[428] Four decades after World War II, the deposit banks mainly financed the Finnish businesses. A financial market was stable due to tight regulation, but the continuing risk of banking activity was the magnitude of the loan portfolio relative to the banks' liquidity. The political control of the bank system was necessary due to the lack of available capital. In 1970, new legislation focused on maximising both lending opportunities and reducing the solvency requirements of commercial banks, savings banks, and cooperative banks to achieve their competitive neutrality.

Between 1983 and 1986 in Finland, the banks' expansion built on the rapid liberalisation of the financial and foreign exchange markets for industry and capital movements, the diversification of financial instruments, the Finnish banks' expansion abroad, and growing loan demand.[429] The liberalisation of the financial markets started after the Bank of Finland dismantled regulatory mechanisms.[430] It made it possible to get international funding for Finnish companies and the public sector, as it diminished the importance of the national central

423 Skippari 2005, pp. 78, 157, Sajasalo 2006, p. 215.
424 Schienstock 2007, p. 97, Wuokko 2017, pp. 13–14. See Jensen-Eriksen 2007.
425 Skippari 2005, p. 77–78.
426 Kuusterä and Tarkka 2011, p. 112.
427 Kuusterä and Tarkka 2002, p. 16, Ojala and Karonen 2006, pp. 110–112.
428 Sainio 2003, p. 7, Paranko 2012, p. 174.
429 Koskenkylä et al. 1994, p. 14, Lehtiö 2004, p. 174.
430 Hyytinen and Pajarinen 2003, pp. 22–25.

bank's refinancing.[431] The national banks moved to a daily rate, and as a consequence, the interest and exchange rate risks returned to banks. Since the mid-1980s, the bank's internal constraints were its weak and short-sighted risk-bearing capacity in both national and foreign investments and foreign operations, weak control over its management, and the increase in corporate financing.[432] The change and the escalation of out-of-control growth took place in the second half of 1987. The growth engine was driven by an increase in foreign currency loans, except all capital restrictions on private individuals were removed. Since 1987, the loans' quantity posed significant concerns as Finnish mark, and currency-based loans accounted for nearly FIM 400 billion in 1990.[433] It is noteworthy that the central bank did not react to this in time, which is evident by the credit losses in Finland between 1988 and 1992, as presented in Table 1. Due to the bad economic situation in Finland, the mark had to be devalued in 1991 and, on the 8th of September in the following year, the Finnish mark's fixed exchange rate was floated.[434]

Table 1 The credit losses in Finland from 1988 to 1992.

Year	1988	1990	1991	1992
Credit losses (billion FMK)	> 1	> 2	7.7	> 22

Source: Kuusterä 2019, pp. 73–74.

Tampella had close relationships with the influential Finnish families and bankers during its entire lifetime. For instance, in 1953, a member of the Executive Board of Banking Members, deputy general manager Mr Göran Ehrnrooth, represented himself and his family at Tampella – not a bank.[435] The same kind of relationship took place in 1987 when Tampella's ownership's rearrangement changed Tampella's top management. The members in terms of the bank people among the industry leaders were the new chairman of the board, Säästöpankkien Keskus-Osake-Pankki's (SKOP) CEO Christopher Wegelius, Tampereen Alue-Säästöpankki's CEO Paavo Prepula, Deputy SKOP's CEO Juhani Riikonen, SKOP's board member Eljas Sukselainen, CEO of Interpolator[436] Timo Summa and Tampella's CEO Leo Vatanen.[437] This reflects that Tampella was taken over

431 Heikkinen and Kuusterä 2001, p. 65.
432 Lehtiö 2004, p. 175.
433 Kuusterä 2019, pp. 69–71.
434 See Vihola 2000.
435 Ojala and Karonen 2006, p. 112 for same kind of the elite's cooperation: *'Jaakko Lassila was a member of the board of directors of almost twenty large Finnish companies, and in six of them he was the chairman of the board.'*
436 Skippari 2005, p. 122. The development company Interpolator Oy was close to the Savings Bank Group. Both the SP investment and the SKOP retained about 10 per cent of the shares. Thus, the Savings Bank Group became the largest shareholder in the Tampella Group with more than 50 per cent share.
437 Koskenkylä and Vesala 1994, p. 8. Säästöpankkien Keskus-Osake-Pankki, SKOP, was the central financial institution of savings banks in Finland.

by the Finnish banks based on the nominations of the above executives. As Tampella's major shareholder, SKOP not only encouraged but pushed Tampella's management to expand the corporation by mergers and acquisitions.[438] A series of international acquisitions took place in North America, Italy, and Finland, according to the company's strategy in 1989.[439] In 1990, Tampella owed about FIM 5 billion to SKOP due to the past debts and new acquisitions.[440] The result improved due to the subsidies of FMK 1.5 billion issued by the bank of SKOP, and the competitiveness improved due to the devaluation of the Finnish mark. The new strategy and SKOP's regime ended when the Bank of Finland took over SKOP in 1991. The leading cause was SKOP's failed banking risk management in the mid-1980s and excessive lending.[441]

In the early 1990s, Nordic banking crises took place due to external factors, such as the international economic downturn in OECD countries, bank credit losses, high interest rates, rapid fluctuations in exchange rates, corporate credit customers' payment difficulties, and the collapse of the national real estate market.[442] In Finland, the recession accelerated due to the collapse of trade with the Soviet Union, and competitiveness weakened due to revaluation and the increased interest rates in the Western industrial countries.[443] Based on the events mentioned above, the banking crisis of the 1990s was the result of the past events of the previous decade.

Tampella became a victim of the Finnish bank spheres, as they aimed to expand their ownership in Finnish industrial companies at the end of the 1980s.[444] The aggressive strategic moves by the banks changed the ownership of several Finnish companies, including Tampella. At the end of the 1970s, Union Bank owned more than 10 per cent of the share capital of Oy Tampella Ab, Kymi Kymmene Oy, Oy Nokia Ab, Oy Finlayson, and Ovako Oy Ab. In 1985, Union Bank owned already 20 per cent of Tampella's shares, as it changed its attitude towards equity investments from passive to active in the mid-1980s.[445] Suddenly, Union Bank sold all its shares to SKOP in 1987 and booked FMK 400 million in profits.[446] Through these transactions, Tampella became a gaming piece for Union Bank's strategy changes. Tampella's owners and management did the most significant organizational changes in the company's history as SKOP transferred 81 per cent

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438 Skippari 2005, p. 143.
439 Tampella Annual Report 1989.
440 Kuisma and Keskisarja 2012, p. 59.
441 Koskenkylä 1992, p. 187, Kuusterä and Tarkka 2002, p. 176.
442 See Massoc 2020, pp. 135–160 for structural banking reforms in France, Germany and the UK.
443 Koskenkylä 1994, p. 15, Jännäri and Koskenkylä 1995, p. 40, Lehtiö 2004, p. 174, Ojala 2008, pp. 193–229, Gulan et al. 2014, pp. 9–10.
444 Ojala 2008, pp. 193—229.
445 Union Bank's name was Pohjoismaiden Yhdyspankki from 1919 to 1975 and Suomen Yhdyspankki (SYP) from 1975 to 1995. From 1990 to 1992, the group established Unitas to act as its parent company, and banking activities were transferred to its subsidiary. In 1995, Unitas Oy and the National Bank of Finland (KOP) established Merita Bank.
446 Laurila 1997, p. 224, Skippari 2005, p. 105. See Vihola 2000.

of its shares and the ownership of its related corporations to Solidium Oy. The owner of Solidium Oy was the Bank of Finland, and it intended to sell Tampella's received assets and liabilities. In 1992, Valmet Oy bought 91 per cent of Tampella Papertech's shares, including the entire machinery workshop.[447]

Furthermore, Enso-Gutzeit acquired Tampella Forest Oy, including the entire paper and board businesses, Tampella Papertech Oy's remaining shares, and Tambox Europe Oy's shares and some land areas.[448] The production of the water turbines, the non-woven fabrication businesses and 27.5 per cent of the Sunila pulp mill's shares were sold off. After 1992, Tampella had only the Tamrock and Tampella Power business units left, as the paper and board industry, the production of water turbines and the non-woven fabrication business had been divested.[449] In 1995, Tampella bought the Detec and Roxon companies to support the Tamrock businesses.[450] At the end of the same year, Solidium, SYP, and KOP remained significant owners of Tampella, but the foreign ownership was 51.1 per cent. The following year, the Norwegian company Kvaerner bought Tampella Power Oy. In 1997, the Swedish company Sandvik acquired all of Tampella's shares, and after two years renamed it Sandvik Tamrock Oy. These transactions ended Tampella's development as an independent corporation in 1999.[451]

Kuusterä's following interpretation of the collapse of SKOP and Tampella is perfectly illustrated:

> SKOP had been successful in aggressive investment. With the acquisition of a majority stake in Tampella Oy in the winter of 1987, the Savings Bank Group[452] had begun to consolidate its industrial complex. A more active investment policy also challenged the Cooperative Bank.[453] The sale of the healthy business of the Finnish Savings Bank[454] to the equitable Union Bank, National Bank of Finland,[455] PSP[456] and Cooperative Banks was announced on 22nd of October 1993, after which the largest reorganization of the Finnish Bank history began in the receiving banks. The problem property transferred to the state's responsibility by the asset management company Arsenal.[457]

3.4 Executive changes

In 1960, the long-term managing director Arno Solin was replaced by Åke Kihlman, who continued to work until 1968. The chairman of the board, physicist Jarl Axel Wasastjerna, remained until 1969. In 1962, the next reorganization took place when Johan Nykopp was nominated to act as new managing director and

447 Tampella Annual Report 1992.
448 Tampella Annual Report 1993.
449 Tampella Annual Report 1993.
450 Tampella Annual Report 1994.
451 Hoffman 2019, p. 173.
452 The Finnish name is Säästöpankkiryhmä.
453 Osuuspankki.
454 Suomen Säästöpankki, SSP.
455 Kansallis-Osakepankki, KOP.
456 Postipankki, Postisäästöpankki.
457 Kuusterä 2002, p. 62.

Kihlman started to act as full-time chairman of the executive board.[458] Personified in relation to the above persons, the regime represented an important era and one of the causes for Tampella's success in the 1960s. Under their command, the target of the organization changes was to decentralise the management. After all, the top management power increased, and the operations in the headquarters remained as before reorganization.

Johan Nykopp served as CEO between years 1969 to 1972 after his long diplomatic career and four years among STK's executives between 1958 and 1961.[459] This designation reflects the spirit of the time when corporate management appointments sought to influence more both national political relations and public opinion than the professional leadership of a large multi-disciplinary company.[460] Under his command in 1969, the company management hired an external business consultant to develop and modernise the management's leadership methods. As a result, the management established a new organization, budget and diversified business functions, such as new non-woven factory and rock drills.[461] Tampella changed CEOs in 1973, as N.G. Grotenfelt, Master of Laws, took a position after serving at Finnpap.[462] He remained until 1982, as did the Chairman of the Board, G. Ehrnrooth, Master of Law, from 1970 to 1982. Between the years 1970 and 1974, the company's top management faced various internal and external difficulties, primarily due to the workshop's increased debt and its interest rates, the further weakening rates of the dollar and pound, and tight accounting law.

Especially during the 1970s, the management made a lot of efforts to commit employees to the company, avoid strikes, secure the needed resources for the future, and improve the absorptive capability of the organizations. The organizational activities focused on internal information and communication, occupational health care, preventive work safety, employees' organization policies and employees' housing and loans.[463] Despite the management's actions, during the 1970s there existed growing agitation and operational inertia in the labour market, especially in the business unit of the machinery workshop. The turbulence culminated in a metal union strike for three weeks in 1971.[464] From the perspective of the production unit, the machinery workshop's output was disrupted by several strikes and, as a result, the management outsourced some of the production and engineering operations in 1980.[465] According to the management's calculations, over 63,000 working hours were lost due to illegal work disruptions in 1981.[466]

458 Möttönen 2014, p. 139. See Uola 2008, p. 672.
459 *Talouselämä Journal* 1977, No. 12. STK stands for Suomen Työnantajain Keskusliitto, or the Confederation of Finnish Industries. See Mansner 2007, *Suurlakosta Euroopan unioniin: vuosisata työnantajatoimintaa.*
460 Wuokko 2017, pp. 28–29.
461 *Talouselämä Journal* 1969, No. 39.
462 *Talouselämä Journal* 1977, No. 12.
463 Tampella Annual Report 1971.
464 Tampella Annual Report 1971.
465 Tampella Annual Report 1980.
466 Tampella Annual Report 1981.

In 1973, the new CEO N.G. Grotenfelt decided to reorganise the top management and establish a central organization to improve the co-ordination and planning of activities.[467] As a result, different organizational departments were modified or established, such as the central management division of finance and general administration, and functions for planning, co-ordination and supervising. The following year, the executive board expanded with the various industrial groups' leaders and the central government's representatives. The nominations noted above indicate that the administration and bureaucracy further increased in the head office. Despite the above-mentioned organizational activities in 1974, the company's debt was 41 million FMK; the company had a lack of capital and complained about the lack of professional employees, due to the previous emigration to Sweden and shrinking age groups.[468]

Throughout the 1970s, Tampella had challenges, such as taking care of finances with national creditors and politics, committing employees to the company and managing threats. When the business cycle went dramatically worse in 1975, the management repeated their decision routines by a cost reduction project and reorganization.[469] They implemented a recruitment ban until 1978, employees' retirements and layoffs from 8,354 to 7,755 persons, and sales reorganization in the machinery workshop.[470] A year before, there existed a lack of skilled labour in an industry, and then suddenly a recruitment ban took place. In 1976, the top management met growing organizational challenges, such as increased debt, higher property and electricity taxes, and increased domestic costs of wages, raw wood material, and human resources.[471]

The same year, the company's management reorganised the forest unit into three business units: the paper and board industry, the saw industry and the forest industry. In 1977, the devaluations of the Finnish mark and the amount of managerial activities helped the firm to achieve a minor positive profit. The managerial activities included a 10-day restriction on production shutdowns and the temporal layoff of employees at the Heinola Fluting mill, driving people to retire, reduction of the cost of birch fibre, increasing short-term financial credits, postponed investments, and the selling of Eurocan Kitimat's and Strömberg's shares.[472] The economic upturn took place during the end of 1979, which increased the demand for machinery services, spare parts, and paper and board products. The management decided to transform uninterrupted 3-shift to 5-shift systems in Tampella's forest unit.[473] This allowed employees, after the night shift, to sleep for one day and take five days off. This change in human resources added 152 new jobs and thus increased the company's employment costs. On the other hand, the change in working time secured better availability of human resources.

467 Tampella Annual Report 1973.
468 Tampella Annual Report 1974.
469 Tampella Annual Report 1975.
470 Tampella Annual Reports 1977 and 1978.
471 Tampella Annual Report 1976.
472 Tampella Annual Report 1977.
473 Tampella Annual Report 1979.

Furthermore, the free health care system and the activities of housing increased the employees' commitment at the expense of profitability.

Tampella's financial results were weak in the 1970s and 1980s.[474] During the financial downturns between 1975 and 1979, the diversified business structure and as high as 90 per cent export levels of Tamrock and paper and board machines contributed positive performance, which maintained the company's survival. At the beginning of the 1980s, the management performed an organizational change and reduced the operating units' quantity from ten to three.[475] The established business units were forest, metals, and combined textiles and packaging. Leo Vatanen was the firm's CEO between 1983 and 1987, and Pekka Salo between 1988 and 1990. N.G Grotenfelt chaired the Board of Directors between 1983 and 1984, Helge Haavisto between 1985 and 1986, and C. Wegelius between 1987 and 1991.[476]

After the 1988 reorganization, Tampella's five business units were Tampella Forest, Tamrock, Tampella Papertech, Tambox Europe and Tampella Power. Tampella Papertech was divided into six business functions: board machines, paper machines, rolls and components, air ventilation, chemical pulp machines, and mechanical pulp machines.[477] Tammertool's manufacturing facilities for the speciality tools and Sandy Hill's machinery and service workshop integrated into Tampella Papertech. Tambox Europe focused on the packaging products, Tampella Power focused on energy supply, and Tamrock focused on rock drilling and mining equipment. Tampella Forest included paper, board, and sawmill units, which focused on capacity expansions and rebuilds such as grade-change modifications from newsprint to special newsprint and improvements in board-grade quality.

The 1990s was a decade of organizational and ownership changes. Timo Summa was the CEO of the company between 1991 and 1995, until Kai Miesmäki had a position in summer 1995. Veli Korpi chaired the Board of Directors from the year 1992 to 1994, and Leo Vatanen in 1995.[478]

3.5 Executives' organizational capability

I may argue that executives did self-reinforcing decisions of capital investments and were incapable of managing the quantity of debt. The behaviour mentioned above indicates limitations of the capability in terms of interpreting external market information and technological possibilities. An example is CEO Grotenfelt's public announcement,[479] in which he explained about a new AP-83 newspaper investment project:

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474 See Figure 11.
475 Tampella Annual Report 1980.
476 Tampella Annual Reports from 1983 to 1991.
477 Tampella Annual Report 1988.
478 Tampella Annual Reports from 1990 to 1995.
479 *Talouselämä Journal* 1980, Vol. 27, p. 26.

> The market can be found for the world's top-quality newspaper. We only wish to have a good cycle for a business. We can produce a newspaper and our customer relationships are in good shape. The newsprint is a product of the spruce trees' promised land, so it is possible to maximise the benefits of the fibres. In the newspaper market, it is possible to reach a steady market without collapsing and heated demand. Competing paper products will hardly be found in the near future. In Canada, quality competition is similar as in Finland. Sweden has a burdening raw material situation. The production facilities need to be in Finland, because internationalisation ties up so much power and capital that long establishment process is very difficult to manage.

The announcement above indicates that the top management did not interpret or utilise the paper or board market's information professionally. In the early 1980s, the value of newsprint concerning other types of paper was low, and the market price decreased annually, excluding a few individual years.[480] From the customer's point of view, customers primarily prioritise paper functionality and sales price, not the customer relationship.[481] Furthermore, the forest unit of Tampella prioritised its sales operations with Finnpap, which served the Finnish paper makers as a collective sales organization and cartel.[482] Secondly, as the forest business is a dynamic industry due to the fluctuations of its business cycles, the changes in the markets and prices should always be a fundamental determinant for the decision-making.[483] Grotenfelt simplified this vital matter by stating that the business cycles are due to good or bad luck. The same kind of the approach to an existing lock-in portfolio took place in Sweden, as Holmen AB delayed their divestment from chemicals between 1872 and 1990. The decision was based on expectations of future growth, market leadership, and scale and scope benefits, but also influenced by the executives' personalities, past experiences, and interpretations of the competitive environment.[484]

A further example of the management's capability limitation was the investment project of Eurocan Kitimat[485], in which Tampella's organization ignored external market information and repeated the management routines in terms of available technology and decision-making. Eurocan Kitimat's investment became so expensive that investment failure increased the executives' barrier to implementing foreign direct investments in the future. Executives preferred to centralise production to Finland. Typically, the location of the production unit is not the dominant determinant for an investment project's success or failure. However, especially in the pulp and paper industry, the mill's location is a critical determinant to secure the availability and lowest possible costs of raw materials. In other industries, labour availability, quality, and cost may become a critical cost factor. The reasons for Eurocan Kitimat's failure was the incapability to sense the threats of the business and competitive environment, to under-

480 See Figure 15.
481 Diesen 1998, pp. 62, 65.
482 Pakkanen 2011, pp. 65–66. See Heikkinen 2000.
483 Diesen 1998, pp. 9–17.
484 Hellgren and Melin 1993, p. 61.
485 Oy Tampella Ab management meeting memo 8.1.1976, § 3A/Eurocan. Tampella Annual Report 1976.

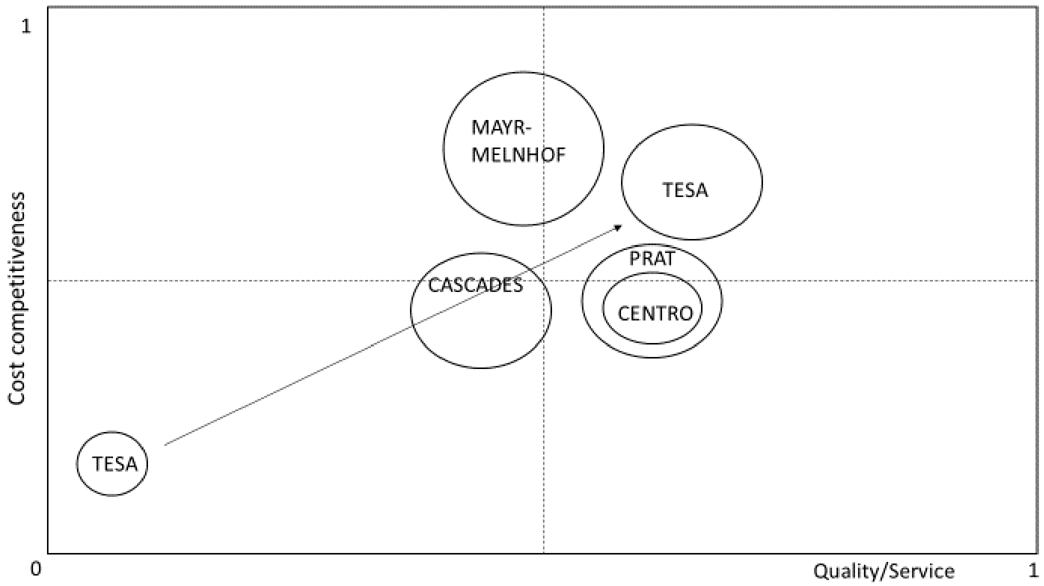
stand the available market information, to manage national politics, and to manage technological threads due to the capability limits of the executives. There would have been available skills and knowledge in-house as well. In 1980, Vice-President Pelkonen highlighted strong concerns about the lack of liquidity due to the new investment project of PM 3 in Anjalankoski.[486] His opinion was ignored by the dominant individuals in the executive group.[487]

The top management's capability to manage financials and create a continuously profitable business was weak, due to both their organization's cognitive limitations and the inability to learn from the past in terms of economic downturns and the fluctuations of the business. They did not take into account the company's financial situation before they were forced to face it. Already in 1972, 10 per cent of Tampella's turnover went to meet the expenses of the loan interest rates. Despite the amount of debt and annual net profit, the top management continued to invest further. Tampella's total investment costs accounted for FMK 1,470 million, and the forest units share was FMK 480 million in 1990. Between 1986 and 1990, Tampella's net results were positive. In 1991, the management responded to the company's bad financial situation by means of a substantial rationalisation program; as a consequence, they laid off 1,473 employees.[488] In 1991, total investment costs accounted for FMK 828 million, and the forest units share was FMK 392.5 million.[489] In 1992, total investment costs accounted for FMK 233 million, and the forest units share was FMK 25 million.[490] Between 1991 and 1995, the firm's catastrophic net results forced executives to act.

The Espanola mill unit worked like a natural experiment for the inferiority of Tampella's management system. Enso-Gutzeit's takeover improved performance almost immediately. Cost competitiveness did not improve under Tampella's command, and the performance of the rebuilt unit was weak still in 1992.[491] Performance was improved by the new owner of Enso-Gutzeit, reaching a new production record in 1994.[492] Furthermore, under the new owner's leadership, the cost competitiveness of WLC and FBB grades improved to be as good as or better than their primary local competitors, as is indicated in Pictures 8 and 9.[493] The competitiveness of the Tesa products was created by using recycled fibre-based raw material.

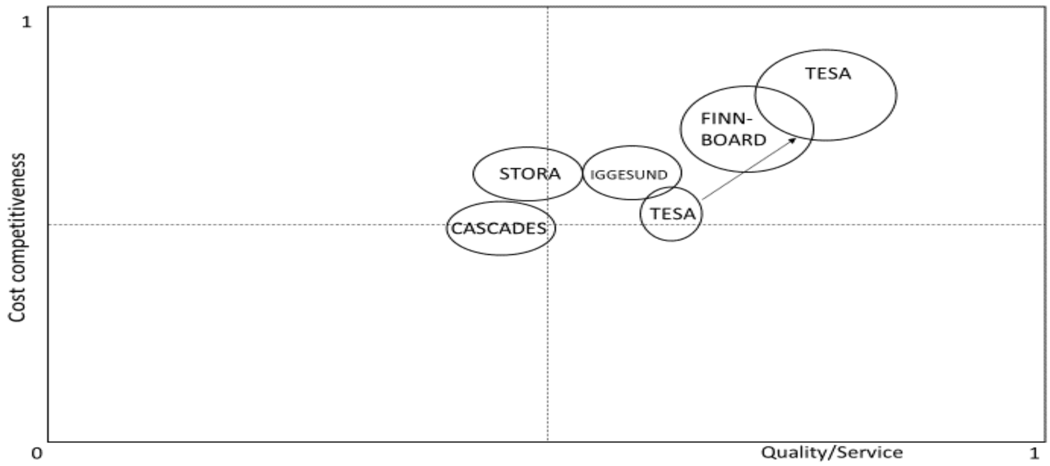
486 Tampella internal memo 1980, No. 6, Direktiones Protokoll §67, Elka archives, Mikkeli.
487 Tampella internal memo 1980, Direktiones Protokoll No. 6, §67, Elka archives, Mikkeli.
488 Tampella Annual Report 1991.
489 Tampella Annual Report 1991.
490 Tampella Annual Report 1991.
491 Tampella Annual Report 1992.
492 Enso-Gutzeit Annual Report 1994.
493 The new brand name was Tesa, which means white-lined chipboard (WLC) or folding boxboard (FBB) grades.

Picture 8 Espanola's WLC cost competitiveness compared to their major competitors.[494]



Source: Enso-Gutzeit, internal due diligence report 18.4.1993.

Picture 9 Espanola's FBB cost competitiveness compared to its major competitors.[495]



Source: Enso-Gutzeit, internal due diligence report on Espanola's board mill, dated 18.4.1993.

494 White-lined chipboard (WLC) is used for packages whose quality requirements in terms of printability and strength are lower than folding boxboard. End uses are, for instance, packages for toys, household goods and detergents. It means that white-lined chipboard's sales price is lower than that of folding boxboard.

495 Folding boxboard is used for packaging applications with high-quality requirements in terms of printability and strength. End uses are, for instance, pharmaceutical, perfume and food packages. The end product's quality requirements are higher than end products made by white-lined chipboard. It means that folding boxboard's sales price is higher than that of white-lined chipboard.

3.6 The curse of past strategic agreements

After the Second World War, Tampella also adopted new technologies through numerous joint ventures. In 1947, for instance, having already on-going co-operation with Bagley and Sewall, Tampella signed partnership agreements with several other American workshops, such as Improved Paper Machines, Pusey & Jones, Gates Engineer, and Black Clawson. As a consequence, Black Clawson delivered one tissue machine to Czechoslovakia in 1953. Tampella and Black Clawson further expanded their agreement to stock preparation types of equipment in 1964.[496]

Although Tampella already had numerous references for its newspaper machines, it made an effort to increase machinery sales through a new marketing strategy of Madden Machine Co. The activities for a joint sales office started in 1965. The new company, Madden Machine Co., was established for marketing purposes by Tampella's Karl af Hällström, Valmet's Henrik Solin and Madden Co.'s Carl-Erik Flander in 1966. By 1967, Tampella had already become profiled as a reliable supplier of board machines.

Since the 1930s, the TAMAKAVA agreement, and after the Second World War, the SOTEVA framed the Finnish manufacturing firms' product development in the agreed industry-based sectors.[497] In 1969, Tampella signed a joint venture TVW agreement with other Finnish machinery workshop companies Valmet and Wärtsilä.[498] This agreement ended competition between them and distributed the forest industry-specific machinery concepts between their machinery workshops and joint sales activities.[499] Tampella's top management signed the TVW agreement without understanding that it was a fatal decision in the firm's history, whose effects continued throughout its existence. This means that, as a rule, board producers did not demand as high production capability in terms of machines' width and speed as did printing and writing producers. As a result, the speed and width development of Tampella machines, for instance, lagged more and more significantly behind Valmet.[500] The basic principle of the breakdown was based on their customers' quality of the end products. Since then, the agreement in question defined the development paths of these machinery workshops from the business and technology points of view. The previous conclusion was based on the fact that the machinery companies' technology development was dominated by the new requirements of the paper and board machines' speed and width. Besides, the machinery workshops' technological development was dominated by the new quality requirements of the paper and board producers' end products. It can be said that the machinery workshops needed to have continuous product development according to the required

496 *Paper and Timber Journal* 1964, No 8.
497 Nykänen 2018, p. 49. The TAMAKAVA agreement steered the Finnish machinery workshop's portfolio, and SOTEVA was the Finnish war reparations administration.
498 Toivanen 2005, p. 91, Skippari 2005, pp. 130, 260, Paranko 2012, p. 175.
499 Hoffman 2019, p. 169.
500 Diesen 1998, p. 145.

changes of their customers, due to increased paper and board quality standards and the ever-tightening competition in the pulp and paper industry.

According to the TVW agreement, the forest industry-specific machinery concepts were distributed among the machinery workshops of Tampella, Valmet, and Wärtsilä.[501] Consequently, Tampella continued to be profiled as a manufacturer of the board machines. Valmet had the paper machines for mechanical printing and writing grades, MF newsprint and SC-grades, and kraft paper.[502] Wärtsilä had all the finishing types of equipment, such as winders, calenders, and coaters. Besides, Wärtsilä delivered fine paper- and pulp-drying machines, until its removal to Järvenpää was completed. According to Alajoutsijärvi (1996), in the 1950s and 1960s, the major machinery suppliers assumed the entire responsibility of the paper machine delivery, and during the 1960s and 1970s, the related responsibility included equipment and related processes' functional testing, production start-up and needed production test runs.[503] The TVW agreement expired in 1987.[504]

For instance, Kymi Oy's customer Rank Xerox recognised improved copy paper quality based on a new PM 8 copy paper machine in the early 1980s. As a consequence, Rank Xerox also required better copy paper quality from its other copy paper suppliers.[505] Even today, the changes in the competitive environment are prevailing characteristics in the mentioned industry, but the new requirements of the paper industry do not dominate the technology development of the machinery workshop as much as before. Similarly, for instance, in North America in 1921, newspaper producers demanded better technology from machinery workshops due to increased newsprint demand.[506]

The international co-operation and joint ventures between the machinery workshops were common even later on. In 1976, the Japanese firm Sumitomo Heavy Industries signed an agreement with the TVW group to obtain a license for paper and board machines, their finishing machines, and auxiliary equipment for use in Japan.[507] In 1978, Tampella, Valmet, and Wärtsilä signed a deal with Brazilian Pilao and Brazilinvest.[508] TVW's share was just under half, and the turnover estimate was initially about FIM 100 million. In 1986, the machinery workshop companies Valmet[509] and KMW,[510] owned by Nordsgrund in Sweden, established a joint venture to secure the market position.[511] Later, in 1989, Tampella continued to adopt machinery technology in the company by the acquisition of the Italian Officine Fonderie Carcano Spa, which had the technology for narrow multiformers, fine paper, and pulp-drying.[512]

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501 Toivanen 2005, p. 91
502 See Nykänen and Paulapuro 2005.
503 Alajoutsijärvi 1996, p. 247.
504 Toivanen 2005, p. 91. See Nykänen and Paulapuro 2005.
505 Alajoutsijärvi 1996, p. 227.
506 Cohen 1984, p. 795.
507 Toivanen 2005, p. 115.
508 Tampella Annual Report 1980.
509 Valmet's holding was 75 per cent.
510 KMW's holding was 25 per cent.
511 Toivanen 2005, p. 100. See Jokinen and Freeman 1988.
512 Tampella Annual Reports 1988 and 1989.

It is evident that the TVW agreement constrained the development of the other paper grades than kraft- and test-liner and cartonboard in Tampella's machinery workshop. With the grades mentioned earlier, the company continued to be a reliable machine supplier in terms of the Fourdrinier, corrugated liner and cord board machines. From the perspective of technology development, the machinery workshop continued to manufacture the concepts of the single- and hybrid-formers, but it was not developing advantage gap former technology, namely, higher machine speed with lower basis weight. In other words, as the Tampella workshop's customers did not concentrate on increasing the production capacity through speed development as a priority, Tampella's machinery workshop also did not develop faster machines for their customers in the kraft and paperboard grades. This also meant that Tampella's forest industry did not get other paper grade's advantage technology from their machinery workshop, compared to the available technology from Tampella's machinery workshop's competitors.

Despite this disadvantage, Tampella's top management had the desire to develop the company's technology and, accordingly, significant continuous investments were made in technological development. Under Erik Nykopp's command, they established a separate development organization, which had the power to decide on machine concepts, ignoring the views of the people in production and at the headquarters. In 1970, Inkeroinen invested in a new pilot plant due to the poor board quality at the mill.[513] Board machines 1 and 2 had shutdowns due to a shortage of orders, the secondary market not buying, and challenges of demand that forced production to have better quality control of end products. New investments were also made in Inkeroinen's pilot plant in 1984, 1986, 1988 and 1990.[514]

It is noteworthy that the technological development of Tampella's machinery workshop could have been similar to that of Valmet without the aforementioned agreement. As a result of the TVW agreement, Valmet focused mainly on the development of fast and wide newsprint machines with great success. The technological development of Valmet's concepts in the printing and writing grades was based on the fact that the producers of the newspaper and lightweight coated grades required continually more effective machines. This was due to paper producers' increasingly tight competition, indicated already since 1958, as the sales price of newsprint paper started to weaken continuously. As a consequence, the newspaper producers had to improve their cost structure of newsprint paper compared to their competitors. The alternatives were either to increase production capacity by the machine's speed or to improve the quality of the products. In greenfield investments, the machines' speed and width generate the production capacity. From the cost perspective of machinery investment, it is important to understand that newspaper's low grammage does not increase the length of the drying section unreasonably. The board grades, excluding liner and some special grades, have a vice versa situation, as the higher grammages require

513 Tampella Annual Report 1970.
514 Tampella Annual Reports 1984, 1986, 1988 and 1990.

a more extended drying section, which increases investment costs. The second significant reason for Valmet's success was their customers' increased quality requirements of paper and the technological development of the printing machines. The increased speed and volume of printing machines required better paper properties than earlier. Essential then, and still prevailing, were the setting of the colour, drying of the ink and internal strength of the paper. The items above forced machinery suppliers to develop the entire paper machine technology based on the holistic understanding of the conceptual requirements in the end users' point of view on paper quality.

I assume that Tampella's executives did not understand the consequences of the agreement. This raises one of the most critical research questions: *Did the TVW agreement in question constrain the technological development path of both Tampella's machinery workshop and its paper and board production units?*

3.7 Failure to manage cash flow since 1963

Tampella's most significant long-term challenge was to ensure sufficient cash flow and control the debt since 1958.[515] Only between 1958 and 1962 was the gearing ratio satisfactory, being less than 120 per cent.[516] In 1958–1968, the turnover rate of capital was at the best level in Tampella's history, even though the company's indebtedness continued.[517] Subsequently, the turnover rate of capital declined until 1972. Between the years 1973 and 1991, it ranged from 37 to 73.2 per cent. After 1991, the turnover rate of capital collapsed due to the sales of the company's business units. The equity ratio was good or excellent from 1958 to 1961, and also in 1994. In 1972, and between 1983 and 1987, it was weak. In other years, the equity ratio was satisfactory or weak. Between 1973 and 1981, indebtedness increased, but the turnover rate of capital improved at the same time.[518]

The challenges of maintaining considerable cash flow increased due to the long-term customer loans of the machinery workshop. In the 1970s, the financial situation got tighter, and at the same time it was more challenging to get credit from abroad. In 1973, the workshop's customer loans and related interests were a cost burden.[519] The next year, the economic situation remained the same as, for instance, the company granted housing loans to employees with a total value of 14.6 million FMK.[520] Between 1970 and 1974, the company's top executives and management were concerned about the strong deterioration in the gearing ratio. It was evident that Tampella had a severe lack of capital; at the same time, the value of the dollar and the pound fell, and the cost of raw materials and wages

515 Laamanen et al. 2014, pp. 4, 32.
516 See Figure 9. See Näsi 1990 for the development of accounting.
517 See Figure 2.
518 See Figure 9.
519 Tampella Annual Report 1970, p. 23.
520 Tampella Annual Report 1971.

increased.[521] In 1974, the company's debt burden was increased by 41 million FMK due to real and accounting losses, and new accounting law with tightened regulations.[522]

The business cycle got dramatically worse in 1975. The company's top management reacted with a cost reduction project to secure the operational cash flow. Despite the company's efforts to keep costs under control, auditors drew attention to the increasing amount of debt and its impact on liquidity.[523] The economic situation was not relieved in the following years, when the domestic costs of wages, raw wood materials, human resources, property taxes and the price of electricity rose. The debt remained about the same level during the economic crisis from 1975 until 1979. In 1977, the situation improved from the previous few bad years, as the gearing was 159 per cent, capital turnover 63 per cent and equity ratio 28.5 per cent.[524] The Central Bank of Finland supported the Finnish export industry with two devaluations.[525] The company's ability to pay improved significantly in 1978 after a significant cost-saving program.[526]

Between the years 1981 and 1987, there existed three significant reasons for the bad financial situation. In 1979, the revaluation of the Finnish mark took place.[527] Two years later, forest owners and the related industry agreed on new recommendations for raw wood materials, which increased the wood log prices and, later, labour costs in the range of the 10 per cent to 15 per cent, depending on the industry.[528] Furthermore, OPEC's price agreements and coal supply problems from Poland increased energy prices.[529] In 1982, the substantial devaluation of the Swedish crown and increased national protectionism disturbed the volume of the export. The company was forced to sell its energy businesses for 419 million FMK due to the negative profit and far too high cost of the financials in 1986.[530] During the following years, the cash flow situation improved, as the company sold 14,200 ha of forest and two issues of shares. This increased the company's share assets 260.4 million FMK. Furthermore, the company's debt increased due to high investment costs in its forest business unit, which was based on an aggressive growth strategy.[531] The investment rate was particularly high in the 1960s, and at the beginning and end of the 1980s. In the 1970s, the investments were characterised by fluctuating five-year intervals.[532] Tampella invested significantly more than, for instance, Enso-Gutzeit and Kymi Oy concerning their net sales in years 1960–61, 1982–83 and 1988–90.[533] This meant that Tampella mainly

521 Tampella Annual Report 1974.
522 Tampella Annual Report 1974.
523 Tampella Annual Reports 1975 and 1976.
524 See Figure 9.
525 Tampella Annual Report 1977.
526 Tampella Annual Report 1978.
527 Tampella Annual Report 1979.
528 Tampella Annual Reports 1981 and 1982.
529 Tampella Annual Report 1980.
530 Tampella Annual Report 1982.
531 Diesen 1998, p. 136, Clarkson et al. 2004.
532 Skippari 2005, p. 104.
533 See Figure 4.

focused on developing forest unit operations, excluding the year 1978 and the years between 1984 and 1987, when most of the investments were directed to the metal unit.[534] The machinery workshop was Tampella's secondmost important function from the perspective of investment activities. Investments in the other business units were distributed evenly throughout the analysis period.[535]

The firm's financial situation was also weakened by the company's diversified structure, which bound considerable operational assets as top management strived to grow and develop, in particular, the forest and metal industries.[536] In the early years of the company, the textile industry also played a significant role. The forest industry is characterised as generating profits by maximising production capacity with the lowest possible costs. The aim is to maintain the needed quality of the entire portfolio as long as possible without additional costly investments. The aforementioned industrial practice means minor quality improvements. It is essential to have long customer relationships and maintain them. In contrast, the profitable business of the machinery workshop is based both on single deliveries of the main types of equipment and the related businesses of spare parts and services. It is evident that the company's strong focus on the forest and metal industries formed one of Tampella's tragedies; these industries were too different from the point of view of the management and operations. Both businesses required a large amount of capital based on the forest industry's technology investments and the workshop's customer loans. In the case of Tampella, the business scholar's argument – that debt constitutes major critical risks for a company's long-term survival and longevity – was realised.[537]

534 See Figure 5.
535 See Figure 5.
536 *Talouselämä Journal* 1973, No. 36, pp. 44–45: Oy Tampella Ab CEO Nils G. Grotenfelt interview.
537 Napolitano et al. 2015, pp. 955–969. Cf. Nokia's case for the firm's long–term survival in Aspara et al. 2015, pp. 1–48.

4 ANALYSIS

Part IV of the dissertation analyses XY-determinants for the development path of Tampella more closely. First, I will study the role of technology in this path by focusing on the speed and width of the machinery. Second, I will analyse whether the management of the company took into account market dynamics and fluctuations of economic cycles in the context of capital investments. Third, I analyse the basis on which different levels of the organization, both at the headquarters and factory units, made significant investment decisions. Fourth, I analyse what variables of organizational capability were based on Tampella's organizational decision-making.

4.1 Business performance

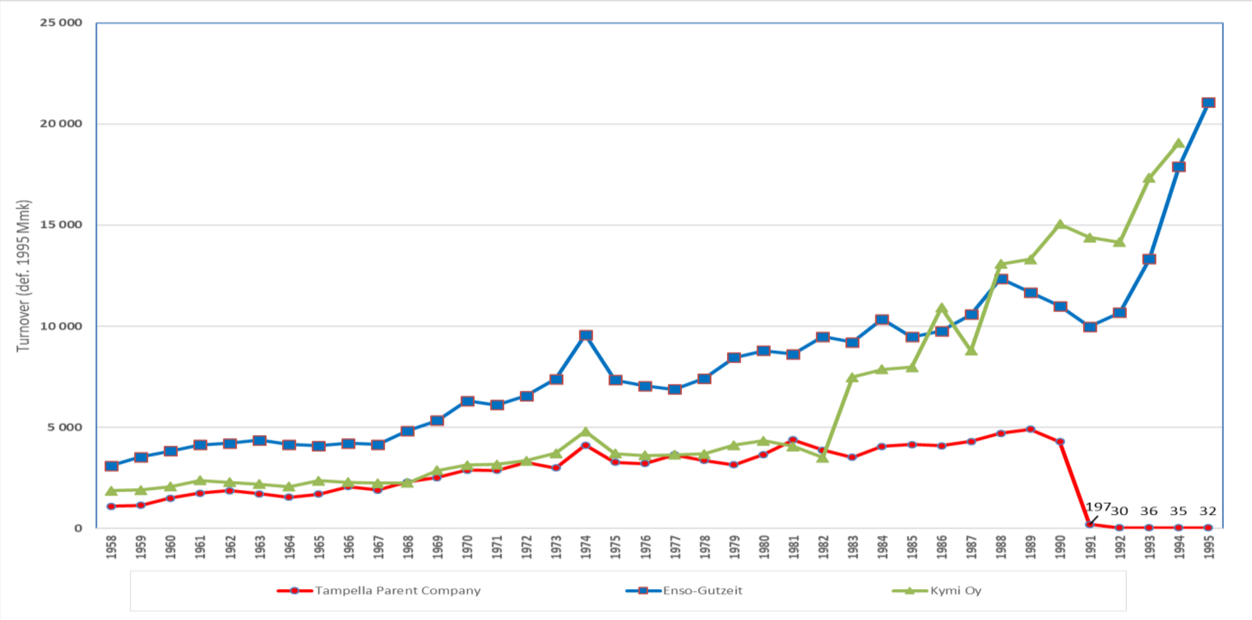
4.1.1 Profitability

In this dissertation, the decision-making capability of the company's management is defined by the ability of the operations to create profit. Other key economic indicators are the investments per turnover, the investment ratio to the earnings, the gearing and equity ratios, the calculated return on investments and equity, and productivity. These financial results are compared to Kymi Oy and Enso-Gutzeit's corresponding economic indicators to contextualise Tampella's development.[538] These companies have been chosen because they had many similarities with Tampella. Both had early internationalisation and a diversified business structure, both represented the Finnish forest industry, and both were large-scale enterprises with significant turnover, as presented in Figure 2.[539]

538 Lamberg 2001, pp. 56–69, Ojala 2001, pp. 27–55, Tampella Annual Reports from 1958 to 1995.

539 Ojala 2001, pp. 27–55, Lamberg 2001, pp. 56–69, Lamberg 2005, pp. 93–122, Lamberg 2006, pp. 45–63, Ojala and Lamberg 2006, pp. 107–139. Further readings: Ahvenainen 1972 and 1992, Ojala et al. 2008.

Figure 2 Turnover of Tampella's parent company, Enso-Gutzeit, and Kymi Oy (Def. 1995) between 1958 and 1995.

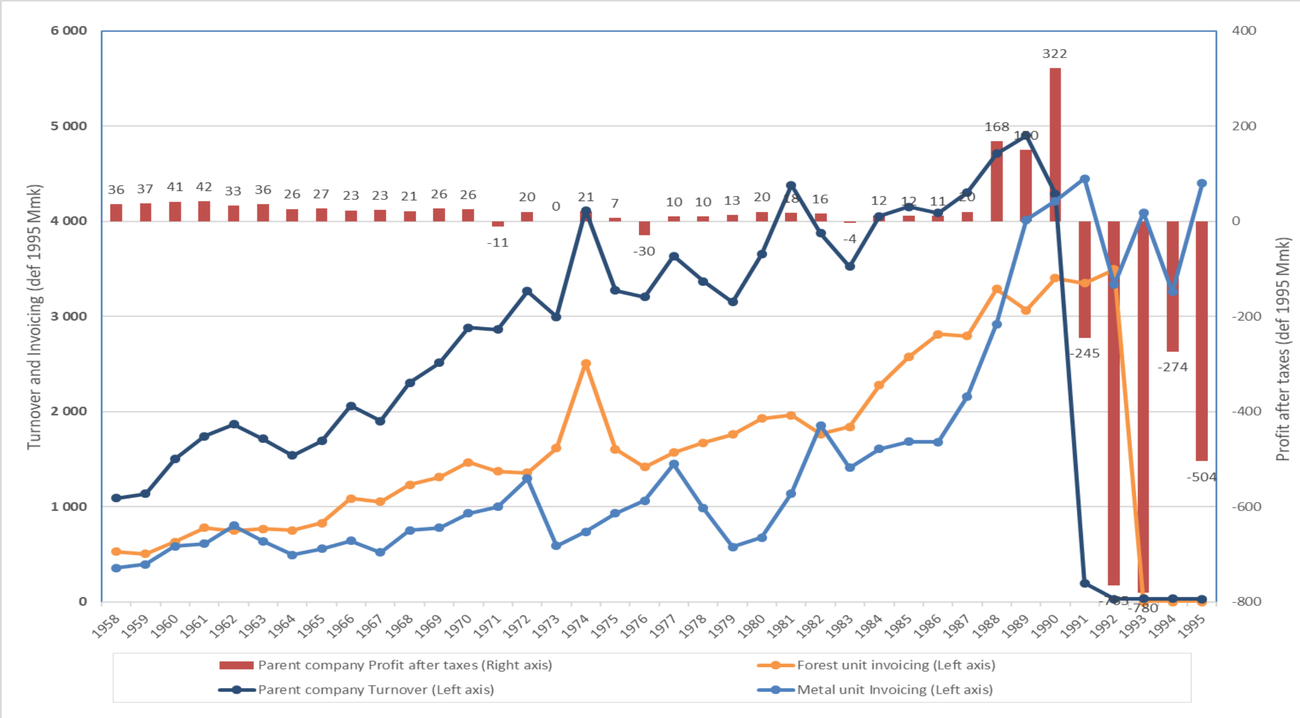


Sources: Tampella, Enso-Gutzeit and Kymi Oy's Annual Reports from 1958 to 1995. Note: From 1987, invoicing figures mean turnover.

The significant difference between Tampella and the selected companies is that in Tampella, the forest industry and the machinery workshop formed the two most significant lines of business. This is evident in that the machinery workshop's billing was the same as the forest unit in 1962, 1972 and 1982, and it was even better between 1989 and 1991, as seen in Figure 3.[540] Enso-Gutzeit and Kymi Oy were profiled more as forest industry companies.

540 Tampella Annual Reports from 1958 to 1995.

Figure 3 The invoicing of Tampella's forest and metal units, with turnover and profit after taxes of Tampella's parent company between 1958 and 1995 (Def. 1995).



Source: Tampella Annual Reports from 1958 to 1995. Note: From 1987, invoicing figures mean turnover.

During the period under review, Kymi Oy was strongly controlled by Union Bank.[541] Besides forest industries, the company's diversified business areas also included petrochemical production, brick making, Högfors Karkkila's foundry (since 1933), the gear manufacturer E. Santasalo Oy (since 1971), electrical equipment Strömberg (since 1983), and a major stake in the energy company Pohjolan Voima. At the beginning of the business, Enso-Gutzeit invested in the sawmill industry but later focused on manufacturing pulp and included the chemical industry and power plants, as well as paper, board, kraft paper and packaging industries.[542] Furthermore, the company operated as a shipowner and had a machinery workshop function. The company's activities were strongly guided by its owner, the Finnish state, after 1918.[543]

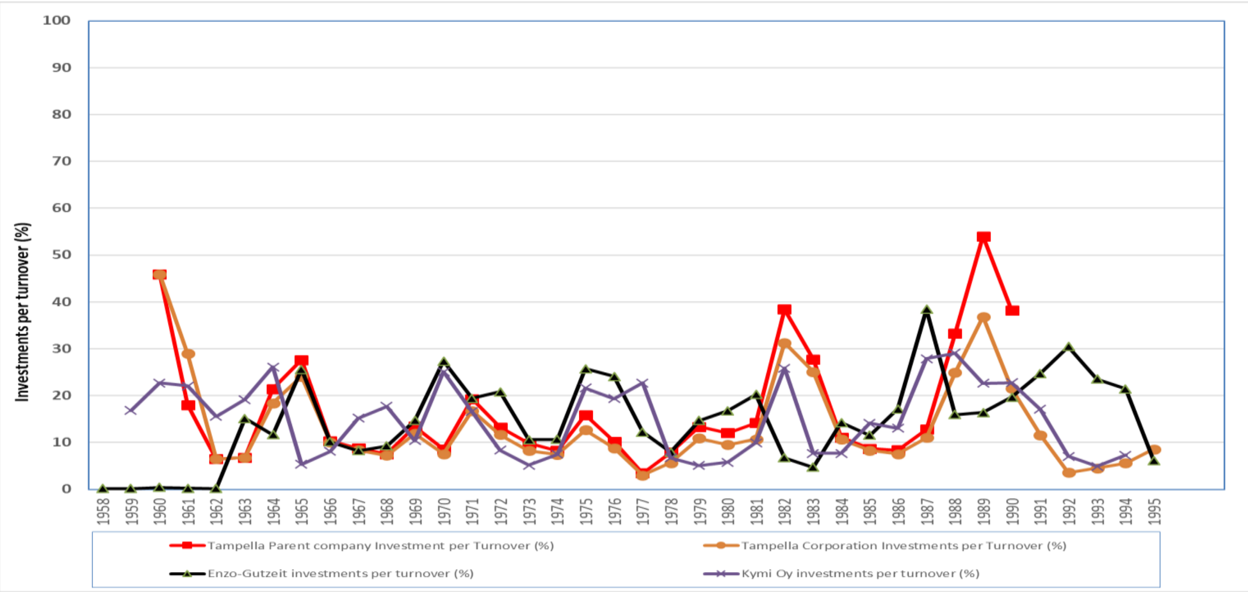
4.1.2 Significant investment

As presented in Figure 4, Tampella invested significantly more in the turnover over the years 1960–61, 1982–83 and 1988–90, compared to Enso-Gutzeit and Kymi Oy. Enso-Gutzeit's investments accounted for more than 10 per cent per turnover, took place between 1963 and 1965, in 1966, and in 1969–77, 1979–81,

541 Ojala 2001, pp. 27–55. For Union Bank, see Hjerppe 1989, p. 83.
542 Lamberg 2001, pp. 56–69.
543 See Ahvenainen and Kuisma 2006.

1984–95.[544] Kymi Oy's investments accounted for more than 10 per cent per turnover, and took place between 1958 and 1964, between 1967 and 1969, in 1971, between 1975 and 1977, in 1981–82, and between 1985 and 1991.[545]

Figure 4 Tampella, Enso-Gutzeit and Kymi Oy's investments per turnover between 1958 and 1995.



Sources: Tampella, Enso-Gutzeit and Kymi Oy Annual Reports from 1958 to 1995. Note: Tampella Corporation's investment data equals the parent company since 1982 based on its annual reports. Tampella's values exclude the years between 1958 to 1959 and 1991 to 1995 due to the data not being relevant.

From an investment timing perspective, Enso-Gutzeit utilised the best global economic recessions in 1970–72, 1975–76, 1981 and 1991–93. Kymi Oy had similar performance in 1970, 1975–77 and 1982. In contrast to those of Enso-Gutzeit and Kymi Oy, Tampella's investments were in 1970, 1976–77, 1983, 1986–87 and 1989. Until the early 1980s, it is evident that Tampella's machinery workshop secured first its external customers' deliveries in a time context, and afterwards its machinery and process types of equipment deliveries to its own forest industry production units. For this reason, Tampella's forest industry units were not able to take advantage of the international economic recessions in the best possible way. Thus, Tampella was a victim of its diversified structure and centralised organization in the context of major investment.[546]

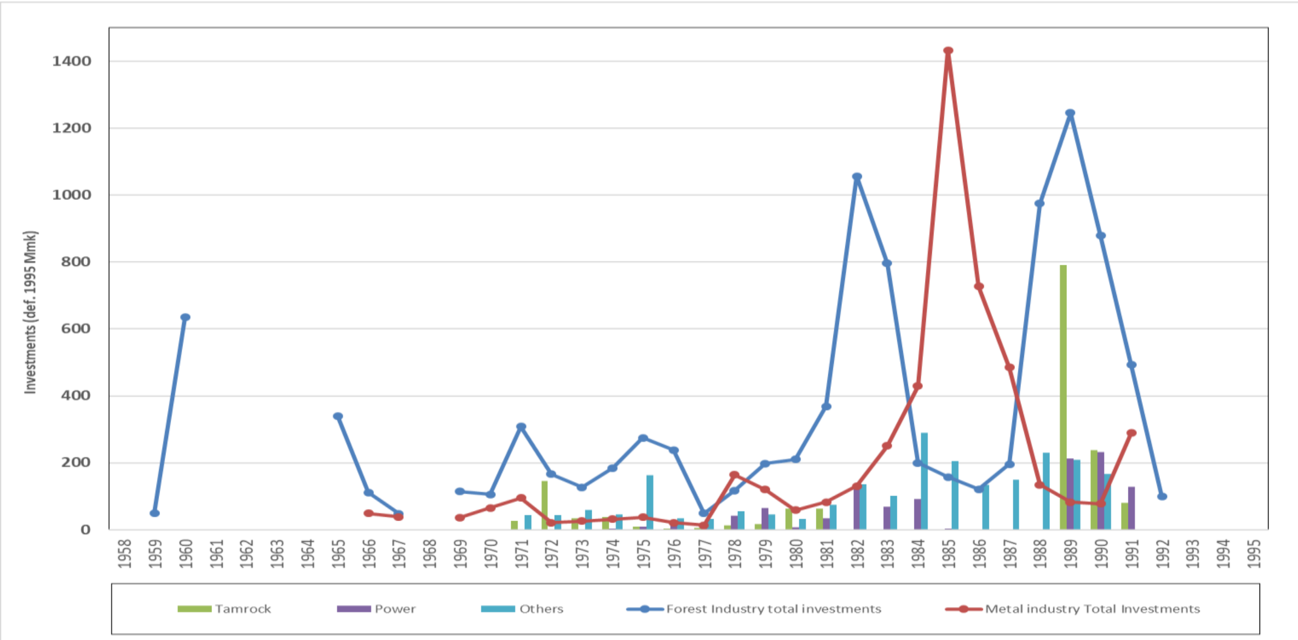
It is evident that Tampella focused on developing its forest unit operations (i.e. pulp, paper and board business operations), excluding the years 1978 and 1984–87, as presented in Figure 5. In those years, most of the investments were

544 Enso-Gutzeit Annual Reports from 1958 to 1995.
545 Kymi Oy Annual Reports from 1958 to 1995.
546 Hoskisson 1987, p. 629.

directed to the machinery workshop, which was the second most important function. This is also evident in the similarity between Tampella's forestry and metal industry's invoicing during the years 1958 to 1995, as presented in Figure 3.

In other Tampella units, the investments were distributed evenly throughout the period between 1958 and 1995. Tamrock invested steadily throughout the period, though its most intensive investment periods were in 1972 and between 1989 and 1991. As Tampella's multi-industry business units required continuous investments, cash flow management became a challenge.[547]

Figure 5 The Tampella parent company's investments (Def. 1995) between 1958 and 1995.



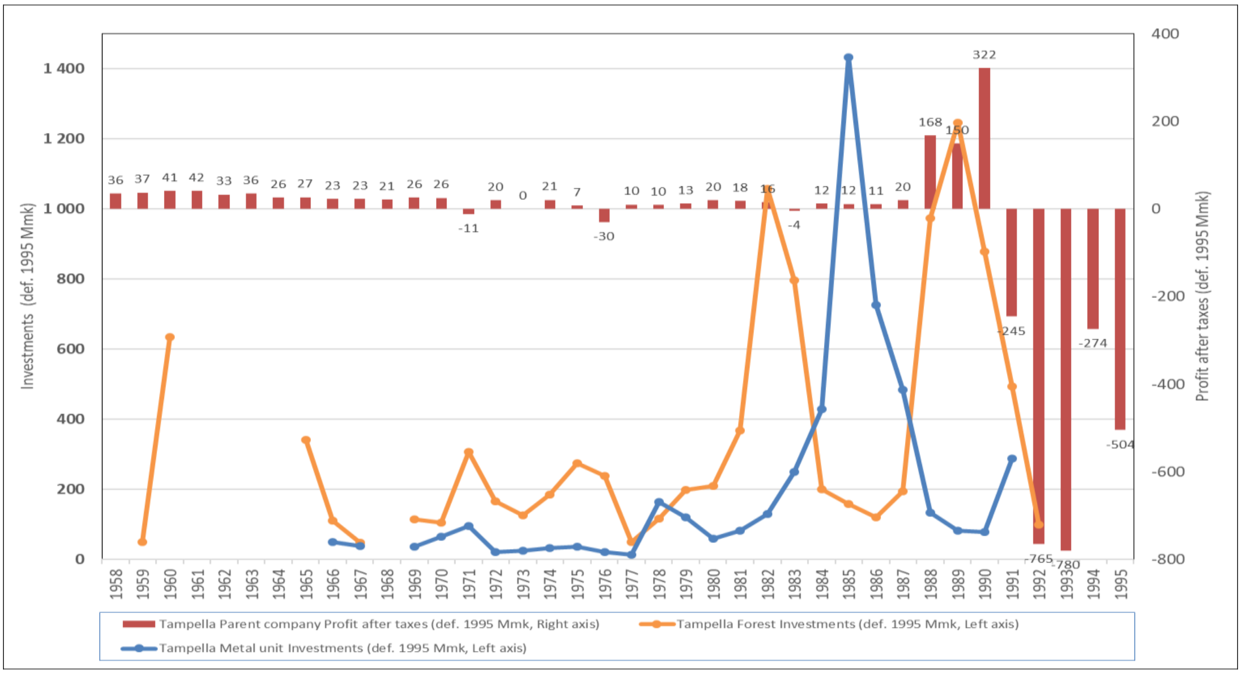
Source: Tampella Annual Reports from 1958 to 1995. Note: Tampella sold its forest units in 1992, and only the Tamrock and Tampella Power business units remained.

An interesting fact is that even though the top management's financial focus was on the forest and metal industries, these operations also caused the most significant financial problems over the decades. Furthermore, Tampella invested continuously, despite the weak performance of the company, as presented in Figure 6.[548] The continuing debt burden became the decisive factor in Tampella's operations.

547 Tampella Annual Reports 1962, 1963, 1966, 1968 and 1969. See Chapter 7 for the firm's cash flow management between 1958 and 1995.

548 See Tampella's forest business unit's major technology investments and costs from 1856 to 1995 in Annex 2.

Figure 6 Figure 6. Tampella's forest and metal units' investments, and the parent company's profit (Def. 1995) after taxes between 1958 and 1995.



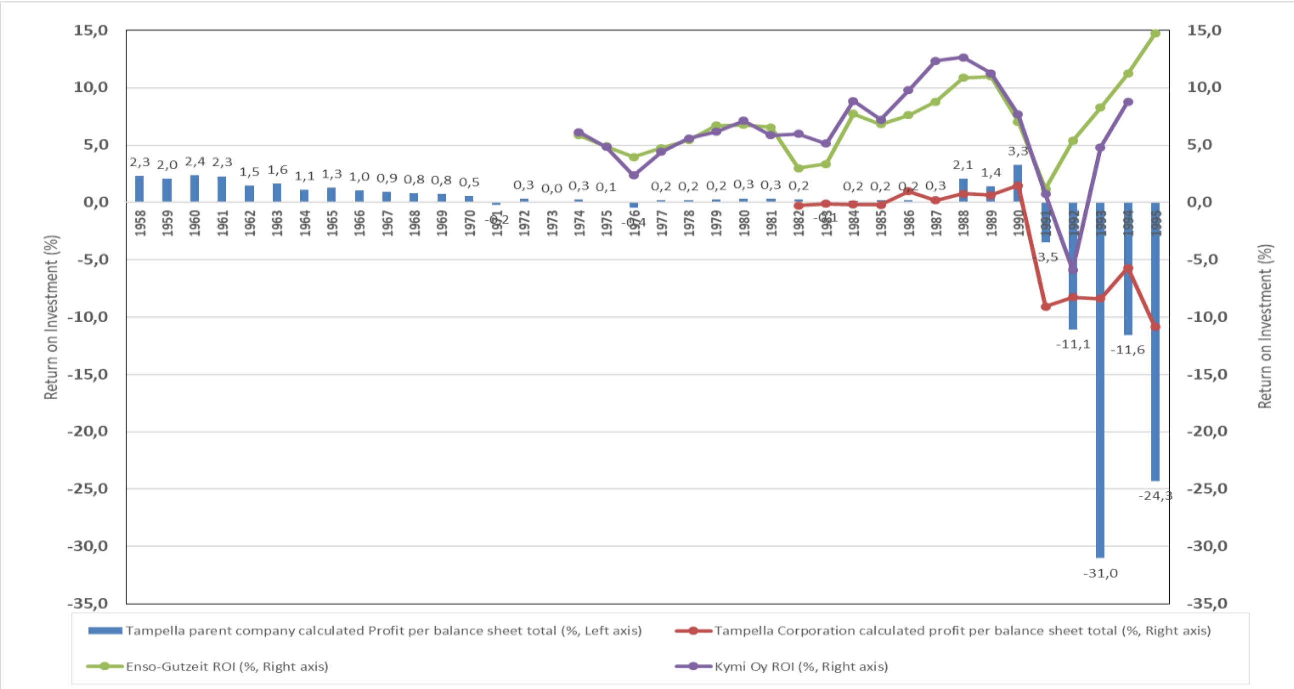
Source: Tampella Annual Reports from 1958 to 1995. Note: Tampella sold its forest units in 1992, and only the Tamrock and Tampella Power business units remained.

4.1.3 Return on investments

As presented in Figure 7, Tampella's return on capital invested was very poor throughout the period under review, and since 1991, the return on investments was negative. Why was the company incapable of generating profit, even though it consistently implemented technological investments, organizational changes, cost reduction projects and executive changes?[549]

549 Maceda et al. 2003, pp. 36–40.

Figure 7 The Tampella parent company and corporation, Enso-Gutzeit and Kymi Oy’s calculated return on investments between 1958 and 1995.

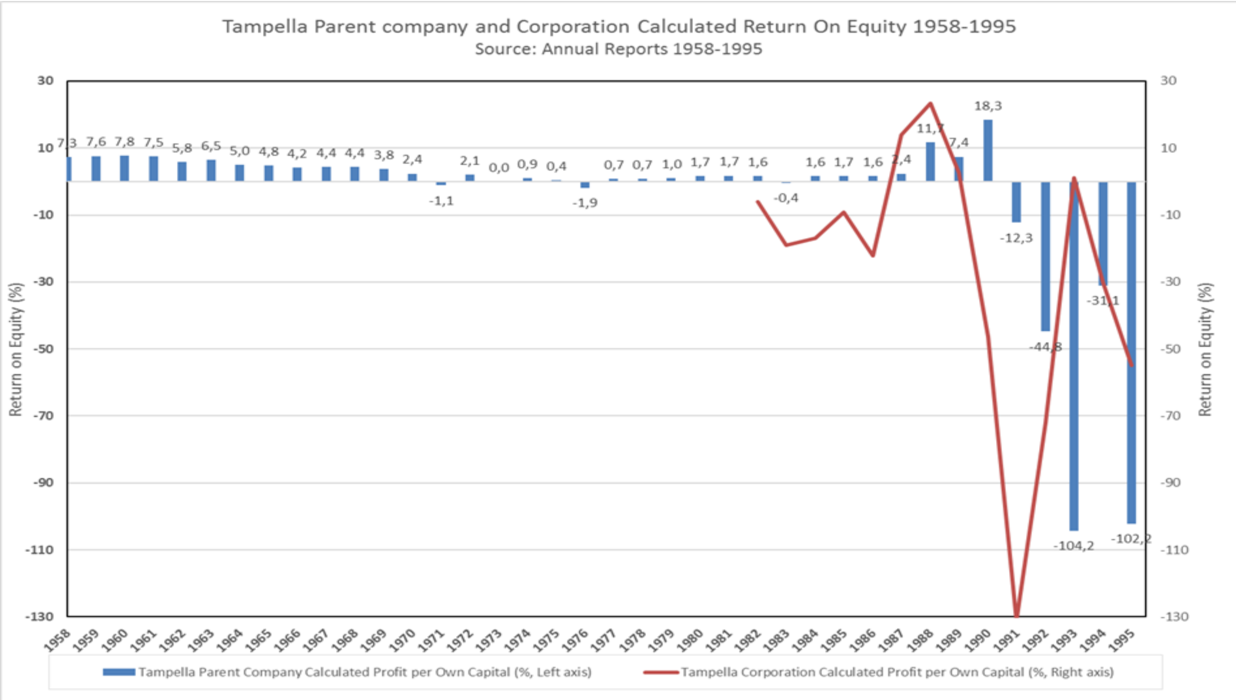


Source: Tampella, Enso-Gutzeit and Kymi Oy Annual Reports from 1958 to 1995.

Furthermore, Tampella’s calculated return on equity was also very poor throughout the period under review, except between 1987 and 1989, as presented in Figure 8.[550] Enso-Gutzeit[551] and Kymi Oy[552] had a weak return on investments in the 1970s and 1980s. Since 1984, both companies improved until the 1991 recession. Since 1994, both companies had excellent results due to the good economics, the improved production efficiency and the improved competitiveness of the production machinery.[553]

550 See Paranko 2012, p. 199 for benchmarking ROI values of other Finnish metal companies.
551 Lamberg 2001, p. 63, Lamberg 2005, pp. 109–110.
552 Ojala 2001, p. 48.
553 Ojala 2001, pp. 47–48, Lamberg 2001, pp. 62–63.

Figure 8 Tampella parent company and corporation calculated Return on Equity in 1958–1995.



Source: Tampella Annual Reports from 1958 to 1995.

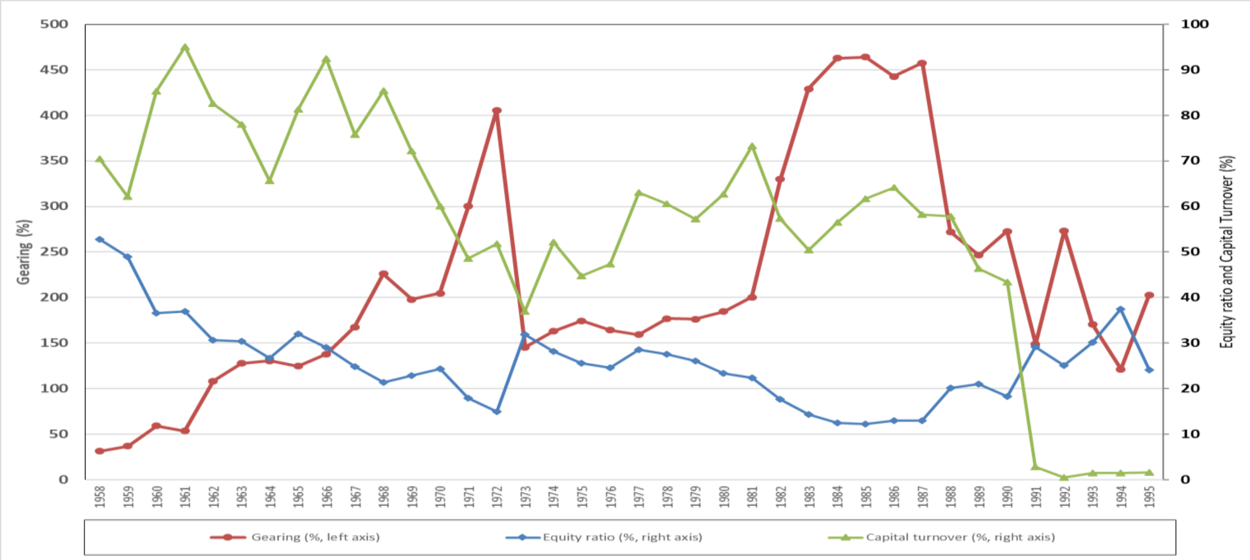
4.1.4 Gearing, capital turnover and equity ratio

Tampella's capital turnover (i.e. the efficiency of the capital utilisation concerning the turnover) was ineffective throughout the period considered, as presented in Figure 9. The major problem was massive debt, and only between 1958 and 1962 was the debt ratio below 120 per cent, which means satisfactory performance. Over the whole period under review, the debt ratio[554] was generally weak or inadequate, and the weakest periods were from 1968 to 1972, 1981 to 1990, 1992 and 1995. The executives noticed the weak equity in 1967, 1972 and 1977, as they reduced the value of the investments, as presented in Figure 5.[555]

554 Calculated ratio of the interest-bearing debt to the shareholders' equity and reservations.

555 Tampella Annual Reports 1967, 1972 and 1977.

Figure 9 The Tampella parent company's gearing, the capital turnover and the equity ratio between 1958 and 1995.



Source: Tampella Annual Reports from 1958 to 1995.

The company started to be indebted at the end of the 1960s, as the foreign creditors' monetary policy tightened. The turnover rate of the capital[556] was until 1968 at the best level in Tampella's history, even though the company continuously became more and more indebted. Hereafter, the turnover rate of the capital declined until 1972. It then ranged from 37 to 73.2 per cent until 1991, after which it collapsed until the end of the review period. The annual absolute value of the capital turnover collapsed due to the divestments of the company's different business units. The equity ratio[557] was good or excellent between 1958 and 1961 and in 1994. It was weak in 1972 and between 1983 and 1987. In other years, it was satisfactory or weak. Between 1973 and 1981, the indebtedness increased, but the turnover rate of the capital improved at the same time.

The reasons for the indebtedness between 1981 and 1987 was the revaluation of the Finnish mark in 1979, increased costs of wood fibre and labour, increased energy prices, the substantial devaluation of the Swedish Crown and increased national protectionism. The company's situation improved significantly between 1987 and 1991, as the company divested its energy operations, a 14,200 ha forest area and company shares. The economic situation between 1991 and 1995 was not comparable to previous years, as in January 1992 Solidium Oy acquired 80.4 per cent of Tampella's shares and in May of the same year, Valmet acquired 91 per cent of Tampella's Papertech shares.

Since 1958, Tampella's capital turnover was slower than that of Enso-Gutzeit or Kymi Oy. The utilisation of Kymi Oy's capital was the best until 1968, after which Enso-Gutzeit utilised its capital more efficiently. Surprisingly, Kymi Oy and Tampella were nearly as ineffective concerning capital turnover until

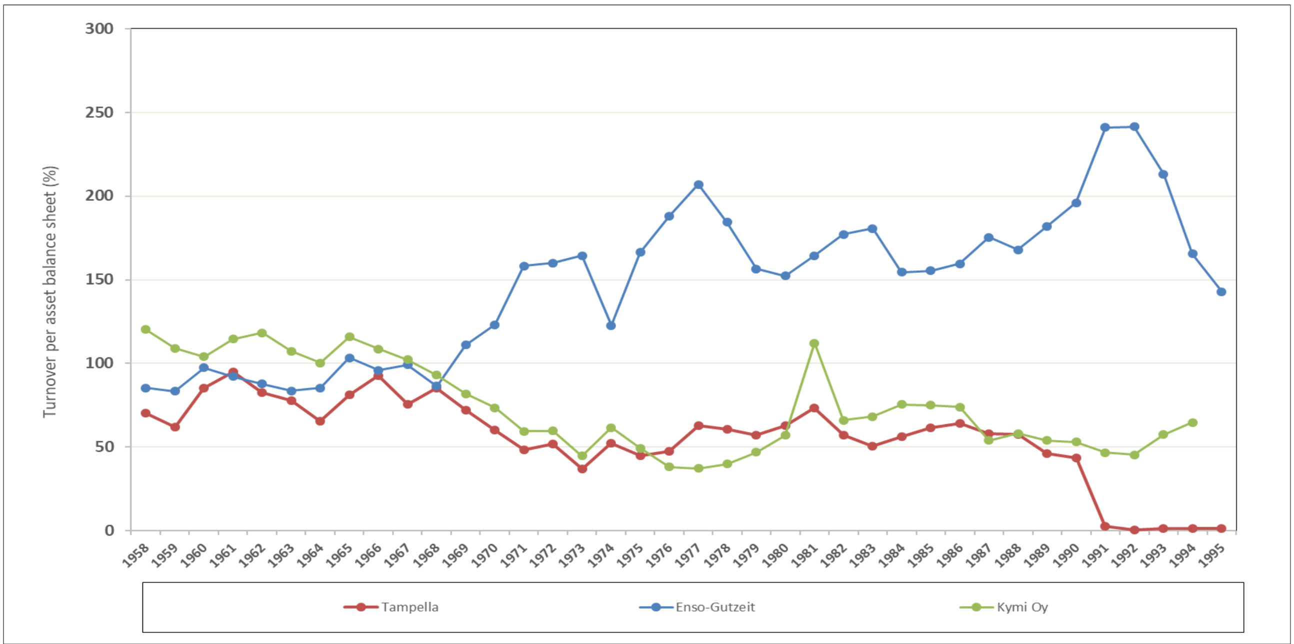
556 Calculated as the ratio of the annual turnover to the adjusted balance sheet total.
557 Calculated as the annual equity ratio in the adjusted balance sheet total.

1990. The turnover rate of Kymi Oy's capital was better than that of Tampella throughout the analysed period, with the exception of 1976 to 1980 and 1987. Kymi Oy weakened by about 5 to 10 per cent per year until 1973, after which the company gradually improved until 1995. However, it remained below the level of the 1960s. It is interesting to see how both of their net sales grew at approximately the same rate up to the year 1982, when in the following year Kymi Oy merged with Oy Strömberg Ab.

Despite the upturn and full employment of 1969, Tampella needed new loans due to its investments and machinery workshop's order book. One of the most significant single factors was the growing funding needs for Eurocan Kitimat Pulp and Paper. Already in 1969, its debt was USD 81 million. Up until 1971, this project required additional funding due to a failed production start-up. At the same time, foreign financing tightened, the machinery workshop's customer loans and interest expenses increased, and the forest industry's business tax was FIM 5 million.

Since 1971, the machinery workshop's customers had to grant credits not only for the manufacturing time of the equipment but also for several years after delivery. Previously, it was customary to arrange the customers' payments so that they covered the need for financing during the manufacturing process and the final payment was made at the time of delivery. The machinery workshop's new contractual approach's costs accounted for FMK 166 million by the end of 1971.

Figure 10 Tampella parent company, Enso-Gutzeit and Kymi Oy's capital turnover between 1958 and 1995.

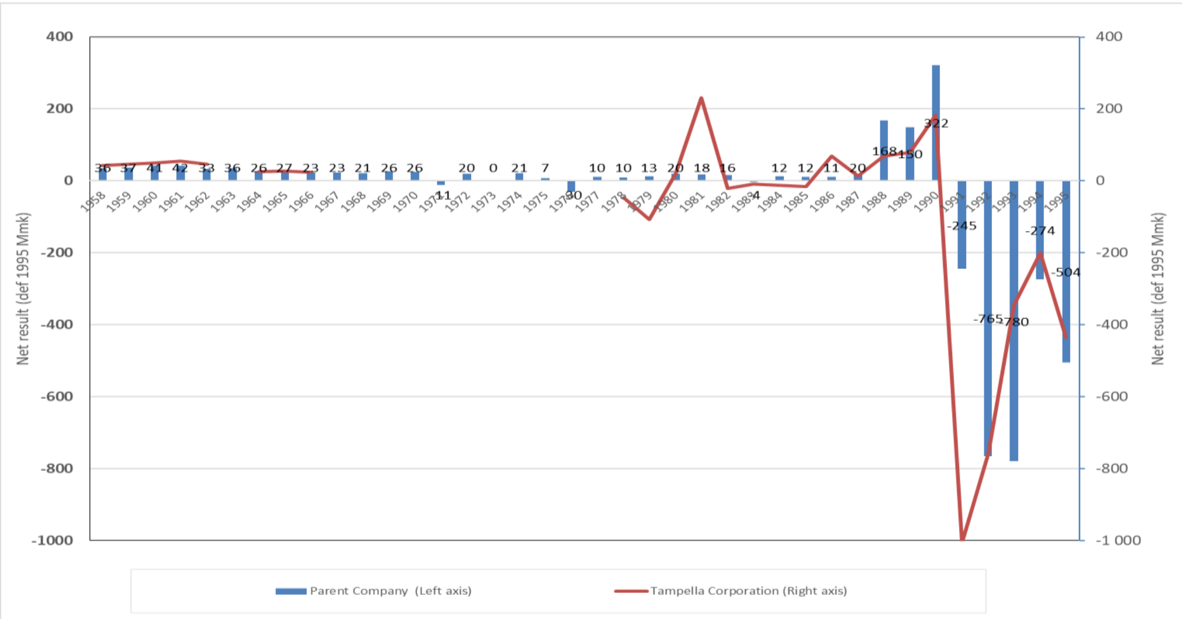


Source: Tampella parent company, Enso-Gutzeit and Kymi Oy's Annual Reports from 1958 to 1995.

4.1.5 Net profit

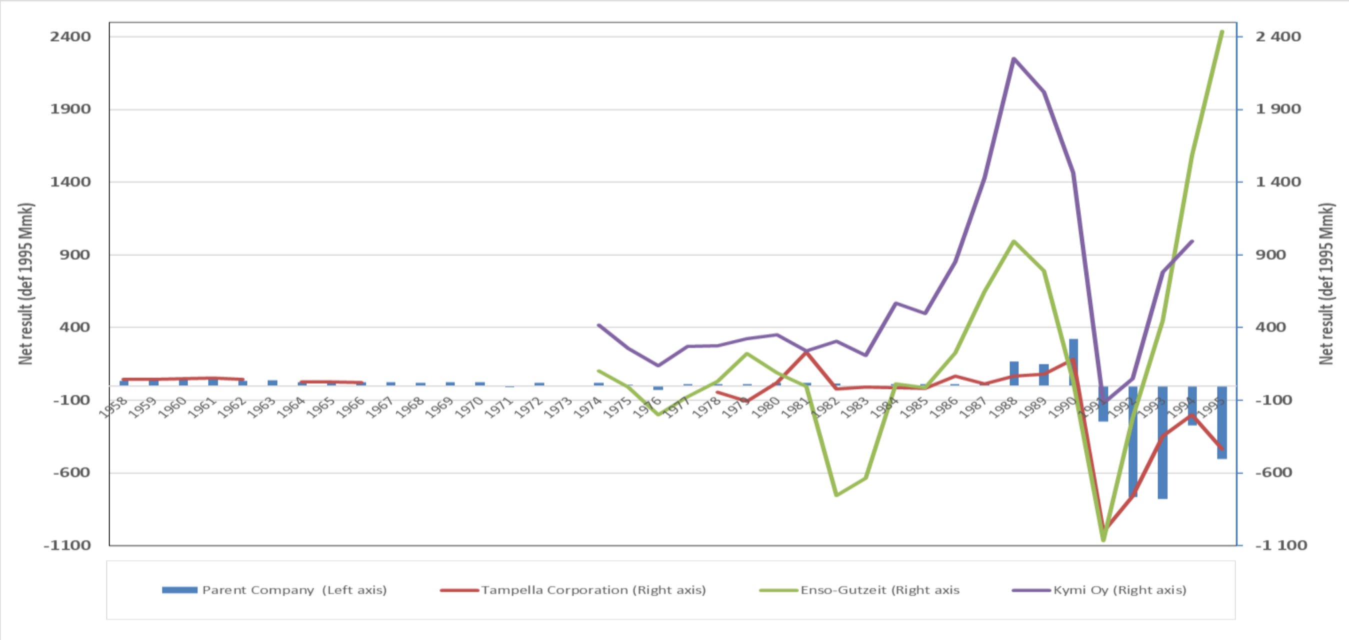
As presented in Figure 11, Tampella's net results were very poor. From 1958 to 1970, the company had positive but weak results. The 1970s and 1980s represented a struggle for survival for the company year after year. Only in the last few years of the 1980s did the company create results, but it was too late. This is witnessed in the fact that Tampella's net profit was significantly lower than that of Enso-Gutzeit or Kymi Oy, as presented in Figure 12. Since the 1980s, Kymi Oy's excessive growth was due to several mergers, such as Kymi-Strömberg in 1983, Kymi-Kaukas in 1985, Kymmene-Schauman in 1986 and Kymmene-Repola in 1995.

Figure 11 Tampella's parent company and corporation's net results (Def. 1995) between 1958 and 1995.



Source: Tampella Annual Reports from 1958 to 1995.

Figure 12 Tampella's parent company and corporation, Enso-Gutzeit and Kymi Oy net results (Def. 1995) between 1958 and 1995.



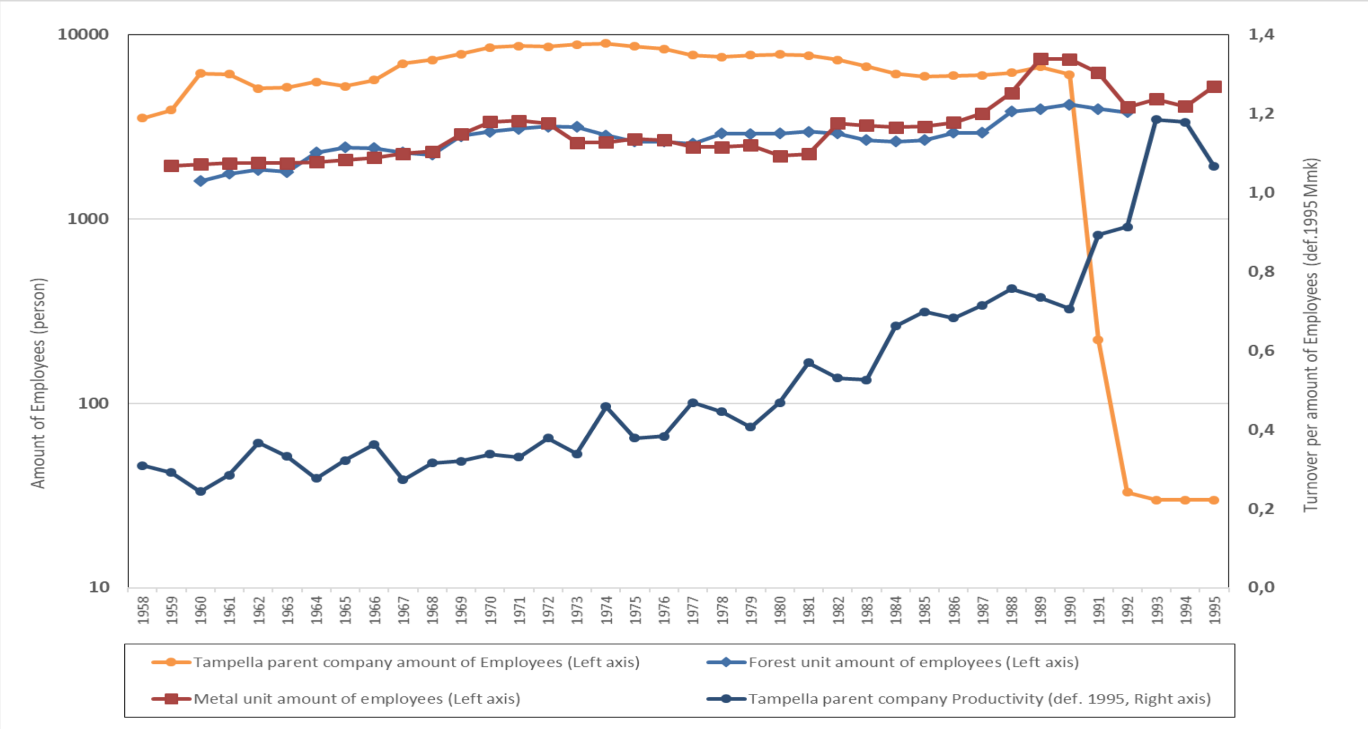
Source: Tampella parent company and corporation, Enso-Gutzeit and Kymi Oy's Annual Reports between 1958 and 1995.

4.1.6 Productivity

The size of the labour force at Tampella's forest and machinery workshop remained at roughly the same level throughout the analysis period, as presented in Figure 13. The number of Tampella employees was, for example, 8,967 in 1974, after which the personnel was reduced. In 1969, the increase of employees in the machinery workshop unit was due to the newly established Tampella Tamrock manufacturing unit for rock-drilling machines, which was later sold to Sandvik in 1997. Overall, the machinery workshop's employees increased until 1989. In the forest unit, personnel increased until 1990.

Between 1973 and 1984, the growth in the forest unit's employees remained moderate due to the recruitment ban and savings activities to ensure the firm's liquidity in 1975. Also, two years later, the company's profitability was improved both through employees' retirement and the termination of 599 persons. The reason for these activities, as mentioned earlier, was significant economic turmoil. The firm's economics had grown so critical that both long- and short-term loans had to be increased. In 1991, the reduction of 1,473 employees took place due to the company's massive losses in all five of the central business units. Due to that, the productivity per hour worked rose sharply. During the following year company divested the paper and board industry, the manufacture of water turbines and the non-woven textile industry.

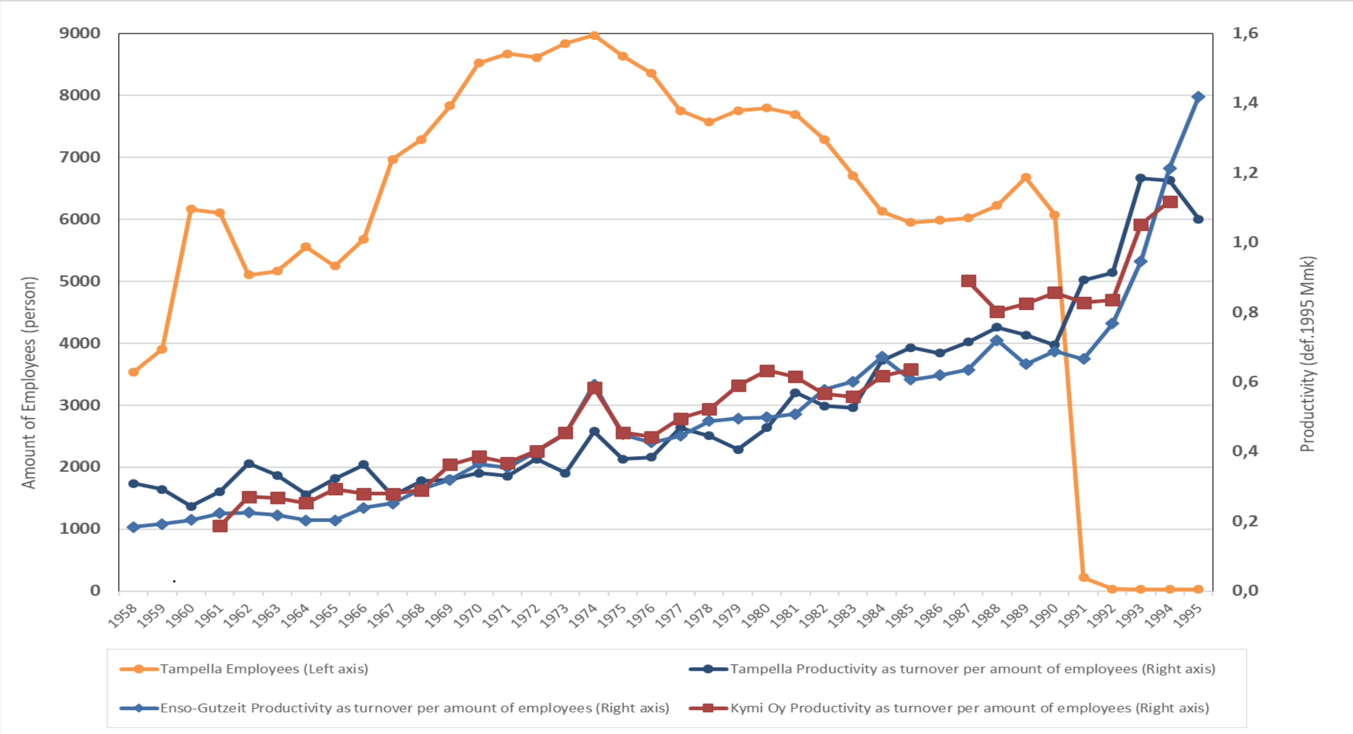
Figure 13 Tampella's metal and forest units' quantity of employees and productivity (Def. 1995) from 1958 to 1995.



Source: Tampella Annual Reports from 1958 to 1995. Note: The years 1958–60 are calculated based on employees' salaries in the annual balance sheets of the company. Since 1981, the employees' amount of the corporation and parent company data is the same.

Labour productivity improved substantially over the entire period, from 0.31 to 0.68Mmk from 1958 to 1990. Only between 1958 and 1967 was Tampella's productivity better than Kymi Oy and Enso-Gutzeit, as presented in Figure 14.

Figure 14 The Tampella parent company's quantity of employees and productivity (Def. 1995), Enso-Gutzeit and Kymi Oy's productivity (Def. 1995) as turnover per quantity of the employees from 1958 to 1995.



Sources: Tampella, Enso-Gutzeit and Kymi Oy's Annual Reports from 1958 to 1995.[558]
Notes: Years 1958–60 are calculated based on employees' salaries in the annual balance sheets of the company. Since 1981 the employees' amount of the corporation and parent company data is the same.

4.2 The endogenous technology

Tampella's forest units' available technologies in terms of major machinery equipment were designed and manufactured mainly by the firm's internal machinery workshop until the 1980s. In Tables 2 and 3, the analysis presents the technological change by Tampella's forest business units and machinery workshop technological capabilities in terms of average design speed and width of the paper of board machines. A comparative analysis focuses on the markets of Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia) between 1958 and 1995. The values are based on the firm's individual business units' design speed of the machines, which are compared to the same grade of machines in the defined four markets. The selected grades equal the forest units' portfolio in Tampella, which meant newsprint, cartonboard and kraft- and test-liner.

558 Lamberg 2001, p. 60.

The essential research question is, did Tampella's machinery workshop deliver more advantage technology in terms of machinery speed and width to its production units, compared to its competitive environment?

4.2.1 The grade-specific design speed of the paper and board machines

Between 1958 and 1995, Tampella's forest units of Anjalankoski, Inkeroinen, Espanola and Heinola Fluting had machines whose average design speeds were lower than those with equal paper or board grades in Europe (excluding the Nordic countries, North and Latin America, and Asia), as presented in Table 2.[559] Similar performance was seen at Pineville BM 1 after 1971 and at Eurocan Kitimat BM 1 and BM 2 after 1973.

Tampella's newsprint machines were not particularly fast compared to those of the international competition, as Anjalankoski's machines proved. The company's machinery workshop tried to stay in the international competition by cooperating with several domestic and foreign machinery manufacturers through licensing agreements, national networking and study trips overseas.[560] From the perspective of Anjalankoski, the newsprint paper machines in the global markets had higher average design speeds than its PM 1 between the years 1958 and 1995, as presented in Table 2. In 1973, the average design speed of Anjalankoski PM 1 improved considerably concerning the global newsprint paper machines until the early 1980s, but without reaching the global machines' average design speeds at any stage of the analysis period.[561] The average design speed of Anjalankoski PM 2 was generally lower than that of the newsprint paper machines in a competitive environment. Between the years 1989 and 1995, PM 2 improved considerably yet without reaching the global machines' average design speeds.[562] The aforementioned technological underdevelopment in terms of the average machine speed was repeated in Anjalankoski PM 3 during the entire analysis period, even though the new newsprint machine start-up was in 1983 and the supplier was Valmet, following the TVW agreement. Similarly, Tampella's board machines were slower than the European average. From the perspective of the Inkeroinen production, its board machines had lower average design speeds than the cartonboard machines in four market areas throughout the period analysed.[563]

During the entire research period since 1960, the cartonboard, kraft- and test-liner machines manufactured by Tampella's machinery workshop had

559 Average design speed is calculated value (average) from Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.

560 Director Sucksdorff's letter to board members 2.2.1973, *Paper and Timber Journal* 1958 and 1963, Hjerppe 1989, p. 78, Nykänen and Paulapuro 2005, pp. 58–61, Särkkä et al. 2018, p. 44.

561 In 1973, speed was increased based on a major modification of the drives, press section and machine calender.

562 In 1989, the machine speed was increased based on the new headbox and machine calender.

563 See Table 2. There are four market areas in question for analysis: Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.

higher average design speeds than the machines in Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia). Since 1970 throughout the analysed period, the machines manufactured by Tampella's machinery workshop had higher design speeds than the machines in Inkeroinen, Espanola, Heinola Fluting, Eurocan Kitimat and Pineville. Between 1958 and 1995, the situation was the opposite of the newsprint machines in question, as the average design speeds of the machines manufactured in Tampella's workshop were lower than the newsprint machines in the global competitive environment.[564]

[564] See Table 2.

Table 2 The machines' average speed difference (per cent) between Tampella's production units and manufactured in its machinery workshop and global machines in the markets of Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.

Tampella production unit	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Anjalankoski PM 1 (1938, renewed 1973, 1983)	-39	-48	-48	-55	-58	-60	-62	-64	-64	-64	-64
Anjalankoski PM 2 (1938, renewed 1969, 1979, 1989,	-39	-48	-48	-55	-58	-60	-62	-64	-64	-64	-64
Anjalankoski PM 3 (1983, renewed 1990)											
Inkeroinen BM 1[1] (1897)	-87	-92	-92	-89	-88	-89	-89	-89	-90	-90	-90
Inkeroinen BM 2[1] (1899, renewed 1969)	-91	-95	-95	-89	-88	-89	-89	-89	-90	-90	-90
Inkeroinen BM 3[1] (1927)	-87	-92	-92	-89	-88	-89	-89	-89	-90	-90	-90
Inkeroinen BM 4 (1965, renewed 1972, 1980, 1990)									-23	-23	-27
Workshop and Newsprint	-60	-66	-66	-70	-44	-46	-49	-51	-51	-51	-44
Workshop and Cartonboard	31	-25	-25	-40	19	11	11	11	4	4	14
Workshop and Kraft-& Testliner	-2	-9	-9	-9	78	74	64	20	2	-3	11
Espanola (1967, renewed 1991)										-32	-32
Heinola Fluting (1960, renewed 1967, 1972, 1989)					78	74	64	20	2	-3	-3
Eurocan, Kitimat BM 1 (1970)											
Eurocan pulp and Paper Kitimat BM 2 (1970)											
Pineville Kraft Corporation (1968)											11

Tampella production unit	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**
Anjalankoski PM 1 (1938, renewed 1973, 1983)	-64	-64	-64	-37	-37	-37	-37	-37	-39	-40	-41
Anjalankoski PM 2 (1938, renewed 1969, 1979, 1989,	-64	-64	-64	-65	-65	-65	-65	-65	-66	-66	-67
Anjalankoski PM 3 (1983, renewed 1990)										-11	-12
Inkeroinen BM 1[1] (1897)	-90	-91	-91	-91	-91	-91					
Inkeroinen BM 2[1] (1899, renewed 1969)	-90	-91	-91	-91	-91	-91	-91				
Inkeroinen BM 3[1] (1927)	-90	-91	-91	-91	-91	-91	-91	-91	-91	-91	-91
Inkeroinen BM 4 (1965, renewed 1972, 1980, 1990)	-27	-30	-30	-30	-30	-30	-30	-30	-30	-30	-30
Workshop and Newsprint	-26	-26	-26	-28	-28	-16	-14	-14	-16	-18	-19
Workshop and Cartonboard	49	41	41	41	41	64	70	70	70	70	70
Workshop and Kraft-& Testliner	46	30	27	25	19	38	43	42	42	42	42
Espanola (1967, renewed 1991)	-32	-39	-40	-41	-44	-44	-44	-45	-45	-45	-45
Heinola Fluting (1960, renewed 1967, 1972, 1989)	-3	-13	-15	-17	-21	-21	-21	-21	-21	-21	-21
Eurocan, Kitimat BM 1 (1970)		7	4	3	-3	-3	-3	-3	-3	-3	-3
Eurocan pulp and Paper Kitimat BM 2 (1970)		8	6	4	-1	-1	-1	-2	-2	-2	-2
Pineville Kraft Corporation (1968)	11	0	-3	-4	-9	-9	-9	-10	-10	-10	-10

Tampella production unit	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**
Anjalankoski PM 1 (1938, renewed 1973, 1983)	-41	-45	-46	-48	-50	-50	-50	-50	-50	-52
Anjalankoski PM 2 (1938, renewed 1969, 1979, 1989,	-67	-69	-69	-3	-6	-6	-6	-6	-6	-11
Anjalankoski PM 3 (1983, renewed 1990)	-12	-17	-18	-23	-25	-25	-25	-25	-25	-28
Inkeroinen BM 1[1] (1897)										
Inkeroinen BM 2[1] (1899, renewed 1969)										
Inkeroinen BM 3[1] (1927)	-91	-91	-91	-91	-91					
Inkeroinen BM 4 (1965, renewed 1972, 1980, 1990)	-30	-30	-30	-30	-26	-26	-26	-29	-29	-36
Workshop and Newsprint	-19	-24	-25	-29	-31	-25	-25	-25	-25	-28
Workshop and Cartonboard	70	70	70	70	63	78	78	70	70	53
Workshop and Kraft-& Testliner	42	32	32	32	32	44	29	27	27	19
Espanola (1967, renewed 1991)	-45	-49	-49	-49	-49	-49	-54	-54	-54	-57
Heinola Fluting (1960, renewed 1967, 1972, 1989)	-21	-27	-27	8	8	8	-3	-5	-5	-11
Eurocan, Kitimat BM 1 (1970)	-3	-10	-10	-10	-10	-10	-19	-21	-21	-26
Eurocan pulp and Paper Kitimat BM 2 (1970)	-2	-9	-9	-9	-9	-9	-18	-19	-19	-25
Pineville Kraft Corporation (1968)	-10	-16	-16	-16	-16	-16	-25	-26	-26	-31

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995. Data presented in Annex 3. Note 1: In 1958 and 1960, board machines' speeds are calculated from the production of individual board machines in Inkeroinen. Note 2: The speed difference (per cent) is calculated by comparing the design speed of the machines in Tampella's production units or its machinery workshop to the competitors' newsprint, cartonboard, kraft- and test-liner machines in the markets of Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia. In the calculation, the machine comparison is made between the same paper or paperboard grade in question.

The average design speeds of Espanola's BM 1 were lower than the kraft- and test-liner machines in all market areas of Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia throughout the period analysed.[565]

Between 1967 and 1988 and 1992 and 1995, Heinola Fluting BM 1's average design speed was lower than the kraft and liner machines in the globally competitive environment.[566] From the perspective of the individual markets, its design speed was higher than the kraft- and test-liner machines in Europe (excluding the Nordic countries) throughout the research period until 1994, and after that the design speed was equal or lower. It was lower than the machines in the Nordic countries and North and Latin America. Furthermore, its design speed was higher before 1970, and after that, it was equal or lower, which means that BM 1 lagged behind the Asian kraft and liner machine competitors in machine speed development.[567] Heinola Fluting's different competitive position per market area proves the importance of the local market in the context of new investment decisions.[568] Furthermore, it indicates how critical it is to maintain machine production capability compared to the competitors' investment activities.

From the perspective of the individual markets, Eurocan Kitimat BM 1 and BM 2 only had higher design speeds than the kraft- and test-liner machines in Europe excluding the Nordic machines between 1968 and 1991. Furthermore, Kitimat's BM 1 had higher design speeds than the kraft- and test-liner machines in the Nordic countries between 1968 and 1970. Its BM 2 had higher design speed than the kraft- and test-liner machines in the Nordic countries between 1968 and 1971. Pineville BM 1 had higher design speeds than the kraft- and test-liner machines in Europe (excluding the Nordic countries) between 1968 and 1991, and in Asia between 1968 and 1986. Furthermore, it had lower design speeds than the kraft- and test-liner machines in the Nordic countries and North and Latin America between 1968 and 1995.

The results above indicate that Tampella's forest units' existing technology in terms of the machines' design speed with similar paper and board grades was behind that of their competitors in the primary market areas throughout the entire research period. For instance, Anjalankoski PM 1 started up in 1938, and the rebuild took place in 1973. PM 2 started up in 1938, and the rebuilds took place in 1969, 1979 and 1990.[569] At Inkeroinen, BM 1 operated for almost 80 years, between 1897 and 1978, without any significant rebuilds. BM 2 operated between 1899 and 1979 with one rebuild in 1969. BM 3 operated between 1927 and 1990 without any significant rebuilds. BM 4 started up in 1965, and the rebuilds took place in 1972, 1980 and 1990.[570] The above examples illustrate the practice in the

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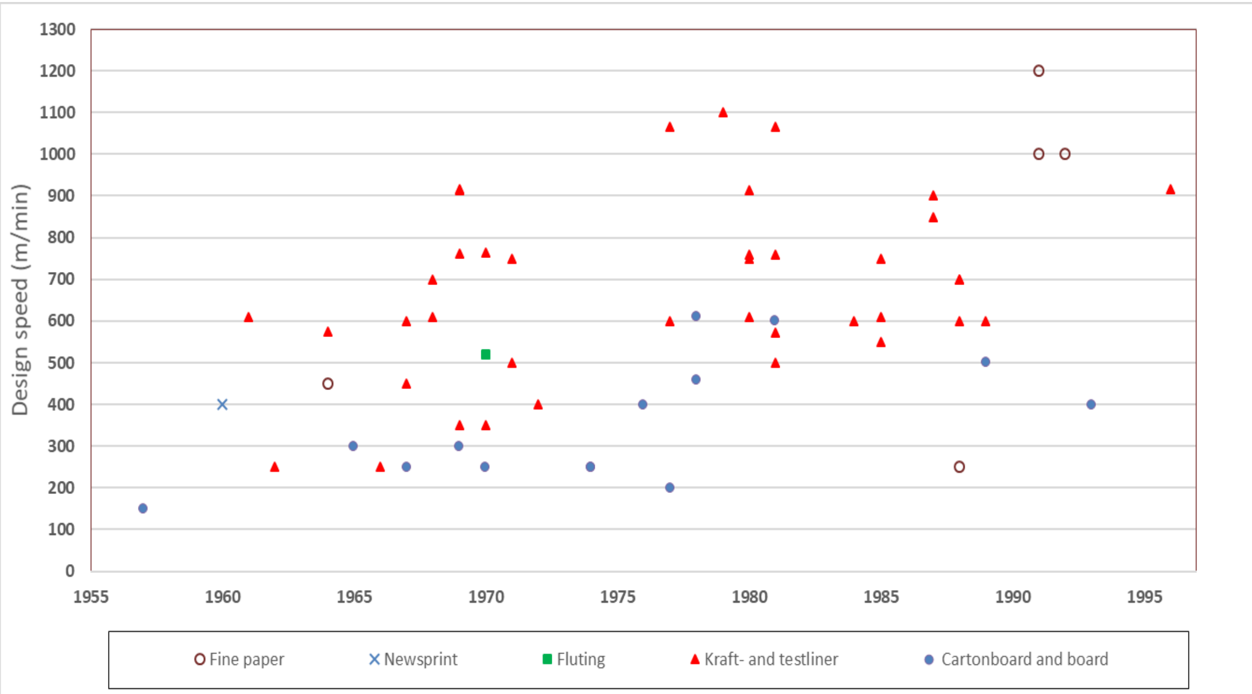
565 See Table 2.
566 See Table 2.
567 See Annex 3 for the speed difference between Tampella's production plants and other global machines (per cent).
568 Wiersema and Bowen 2008, p. 128.
569 Anjalankoski PM 2 started to produce mechanical MFC grades (machine-finished coated grades) in 1990.
570 Tampella Annual Reports from 1958 to 1995, *Paper and Timber Journal* 1972, No. 10, pp. 667–668.

forest industry at that time that the aim was to use the machines for as long as possible without significant capital investment. Unless a company upgrades old machines or invests in new ones, its profitability will inevitably be left behind that of its competitors. If the old machine's original design dimensions for production capacity are large enough, then even it can generate a decent profit (without high capital costs).

Based on the results above, Tampella focused on the development of the kraft- and test-liner machines' technology in terms of the machines' speed significantly more than the technological development of the other paper or board grades, as presented in Picture 10. This result also indicates that Tampella followed the TVW agreement, which was signed in 1969.

Picture 10 The paper and board machines' design speeds and grades manufactured by Tampella's machinery workshop from 1957 to 1996 (N=57).

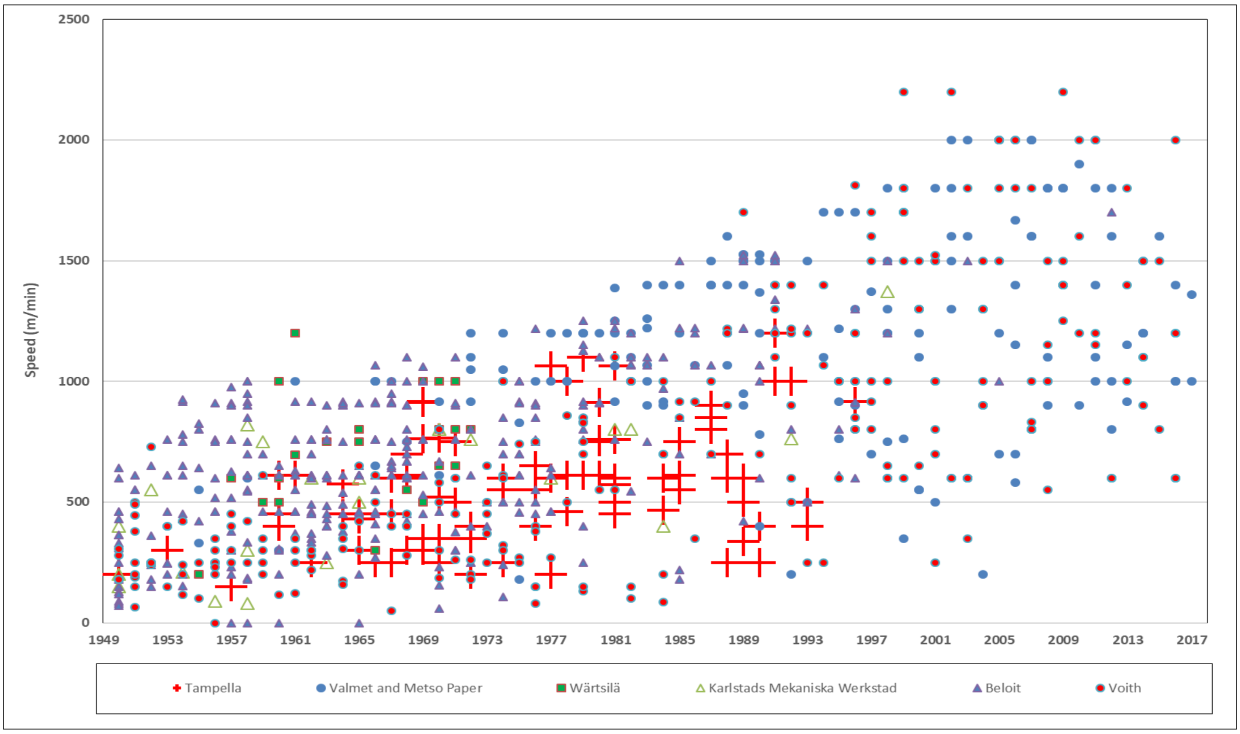


Sources: Pöyry Group in 2018, *Paper and Timber Journal* between 1957 and 1996. The technology data is presented in Annex 3.

From the perspective of the machinery workshop, the design speed development of the machines manufactured by Tampella corresponded to that of its main competitors until 1979, after which this development did lag, as presented in Picture 11. From the perspective of the paper and board machines, it is evident that Valmet/Metso Paper and Voith became global technology leaders.[571]

571 Järvinen et al. 2012c, p. 239.

Picture 11 The major global machinery suppliers' machinery speeds in newsprint, cartonboard, kraft- and test-liner, and woodfree and coated woodfree machines (excluding tissue) between 1949 and 2018 (N=896).



Sources: Pöyry Group in 2018 from 1949 to 2017, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995. The technology data is presented in Annex 3.

4.2.2 The design width of the paper and board machines

Between 1958 and 1995, the average design width of machines in Anjalankoski, Inkeroinen and Espanola were lower than the equal paper and board machines' design widths in the global markets, as presented in Table 3.[572] This means that all of Anjalankoski's newsprint machines had lower productivity compared to those of their competitors with wider machines. This was the case even in 1983, as Valmet's machinery workshop delivered Anjalankoski's new PM 3 there. Valmet was capable of delivering wider machines, as they delivered newsprint machines to Tampella's competitor with the same width as Anjalankoski already in 1980, and another with the design width of 9.45m to North America in 1983.[573] The average design width of Anjalankoski PM 3 was 2 per cent less than the global newsprint paper machines until 1989. Between 1990 and 1995, its average design width difference increased by one or two per cent per year until 1995. The average design width of Anjalankoski PM 1 and 2 was 43 per cent less than the newsprint paper machines in the competitive environment.[574]

572 There are four market areas for analysis: Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia. See Annex 3.
573 Pöyry Group 2018 from 1949 to 2017.
574 See Table 3.

Similar performance was seen in Inkeroinen, as all four board machines had average design widths that were 26 to 78 per cent lower than the cartonboard machines in Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia throughout the period analysed. It had a lack of new machine investments related to machine width development, which proves a significant path-dependent nature in terms of technological development.

Since 1969, the paper and board machines manufactured by Tampella's machinery workshop had wider design widths than its own production units' paper and board machines.[575] It indicates a strong path dependence of the paper and board mill's technological development in terms of the machines' width. Tampella's machinery workshop had the average design width of the newsprint machines manufactured in its workshop that was higher or equal in 1969, and between 1978 and 1992, than the newsprint machines in the global competitive environment, as presented in Table 3. Considering the previous case, the average design width was lower between 1958 and 1977, and from 1994 to 1995. The result proves that Tampella's machinery workshop was capable of manufacturing above-average width newsprint machines.

In terms of the comparison of Tampella's machinery workshop regarding cartonboard, and kraft- and test-liner machines in the global competition environment, the situation was opposite than in newsprint. In the entire research period since 1960, the board machines mentioned above manufactured by Tampella's machinery workshop had higher average design widths than the machines in Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia, as presented in Table 3.[576]

575 Average design width is calculated value (average) from Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.

576 See Table 3.

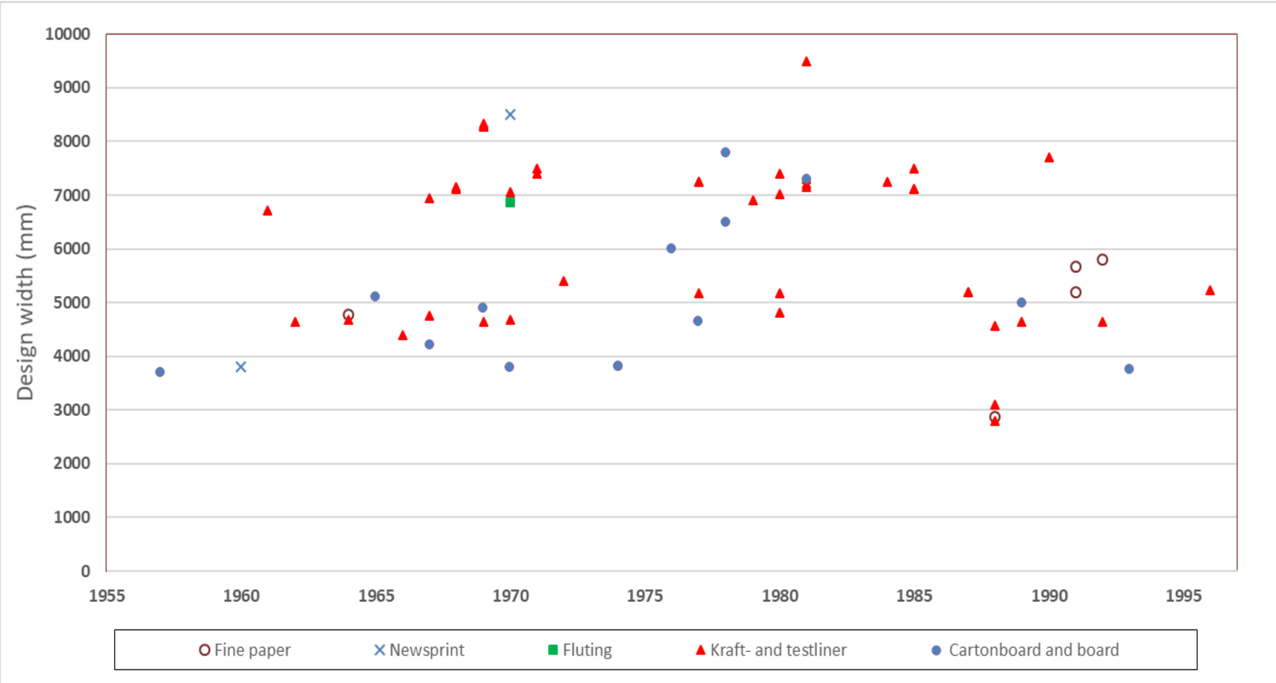
Table 3 The machines’ average width difference (per cent) between Tampella’s production units and manufactured in its machinery workshop and global machines in the markets of Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.

Tampella production unit	1955	1956	1957	1958	1960	1961	1962	1964	1965	1967	1968
Anjalankoski PM 1 (1938, renewed 1973, 1983)	-14	-21	-21	-24	-29	-31	-31	-31	-31	-32	-34
Anjalankoski PM 2 (1938, renewed 1969, 1979, 1989,	-14	-21	-21	-24	-29	-31	-31	-31	-31	-32	-34
Anjalankoski PM 3 (1983, renewed 1990)											
Inkeroinen BM 1 (1897)	-59	-72	-72	-73	-73	-74	-76	-76	-76	-76	-76
Inkeroinen BM 2 (1899, renewed 1969)	-41	-60	-60	-62	-62	-63	-65	-65	-65	-65	-66
Inkeroinen BM 3 (1927)	-41	-60	-60	-62	-62	-63	-65	-65	-65	-65	-66
Inkeroinen BM 4 (1965, renewed 1972, 1980, 1990)									-26	-26	-28
Workshop and Newsprint	-43	-48	-48	-49	-10	-13	-13	-13	-13	-14	-13
Workshop and Cartonboard	-2	-33	-33	-34	23	20	12	12	12	13	13
Workshop and Kraft-& Testliner	-2	-33	-33	-34	23	20	12	12	12	13	13
Espanola (1967, renewed 1991)										-37	-38
Heinola Fluting (1960, renewed 1967, 1972, 1989)					23	20	12	12	12	12	9
Eurocan, Kitimat BM 1 (1970)											
Eurocan pulp and Paper Kitimat BM 2 (1970)											
Pineville Kraft Corporation (1968)											13
Tampella production unit	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**
Anjalankoski PM 1 (1938, renewed 1973, 1983)	-34	-38	-38	-38	-38	-38	-38	-41	-41	-41	-42
Anjalankoski PM 2 (1938, renewed 1969, 1979, 1989,	-34	-38	-38	-38	-38	-38	-38	-41	-41	-41	-42
Anjalankoski PM 3 (1983, renewed 1990)										-2	-2
Inkeroinen BM 1 (1897)	-76	-78	-78	-78	-78	-78					
Inkeroinen BM 2 (1899, renewed 1969)	-66	-69	-69	-69	-69	-69	-69				
Inkeroinen BM 3 (1927)	-66	-69	-69	-69	-69	-69	-69	-69	-69	-69	-69
Inkeroinen BM 4 (1965, renewed 1972, 1980, 1990)	-28	-35	-35	-35	-35	-35	-35	-35	-35	-35	-35
Workshop and Newsprint	1	-4	-4	-4	-4	7	7	2	2	2	2
Workshop and Cartonboard	32	22	22	22	22	37	37	36	36	36	36
Workshop and Kraft-& Testliner	32	22	22	22	22	37	37	36	36	36	36
Espanola (1967, renewed 1991)	-38	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44
Heinola Fluting (1960, renewed 1967, 1972, 1989)	9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Eurocan, Kitimat BM 1 (1970)		2	2	2	2	2	2	2	2	2	2
Eurocan pulp and Paper Kitimat BM 2 (1970)		2	2	2	2	2	2	2	2	2	2
Pineville Kraft Corporation (1968)	13	3	3	3	3	3	3	3	3	3	3
Tampella production unit	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**	
Anjalankoski PM 1 (1938, renewed 1973, 1983)	-42	-42	-42	-42	-43	-43	-43	-43	-43	-43	
Anjalankoski PM 2 (1938, renewed 1969, 1979, 1989,	-42	-42	-42	-42	-42	-42	-42	-43	-43	-43	
Anjalankoski PM 3 (1983, renewed 1990)	-2	-2	-2	-3	-4	-4	-4	-4	-4	-5	
Inkeroinen BM 1 (1897)											
Inkeroinen BM 2 (1899, renewed 1969)											
Inkeroinen BM 3 (1927)	-69	-69	-69	-69	-69						
Inkeroinen BM 4 (1965, renewed 1972, 1980, 1990)	-35	-35	-35	-35	-28	-28	-28	-28	-28	-30	
Workshop and Newsprint	2	2	1	1	0	0	0	-1	-1	-1	
Workshop and Cartonboard	36	36	36	36	35	35	35	35	35	31	
Workshop and Kraft-& Testliner	36	36	36	36	35	35	35	35	35	31	
Espanola (1967, renewed 1991)	-44	-44	-44	-44	-45	-39	-39	-39	-39	-41	
Heinola Fluting (1960, renewed 1967, 1972, 1989)	-1	-1	-1	-1	-2	-2	-2	-2	-2	-5	
Eurocan, Kitimat BM 1 (1970)	2	2	2	2	1	1	1	1	1	-2	
Eurocan pulp and Paper Kitimat BM 2 (1970)	2	2	2	2	1	1	1	1	1	-2	
Pineville Kraft Corporation (1968)	3	3	3	3	2	2	2	2	2	-1	

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* from 1957 and 1996, Tampella Annual Reports from 1958 to 1995. The technology data is presented in Annex 3.
Note 1: The width difference (per cent) is calculated by comparing the design width of the machines in Tampella’s production units or its machinery workshop to the competitors’ newsprint, cartonboard, kraft- and test-liner machines. The markets are defined as Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia. In the calculation, the machine comparison is done between the same paper or paperboard grade in question.

Tampella focused on the development of kraft- and test-liner technology in terms of the machines' width significantly more than other paper or board grades, as presented in Picture 12. The aforementioned conclusion indicates that it was the main reason for Tampella's technology sharing in the TVW agreement, which later, however, significantly slowed down the machinery workshop's long-term technological development.

Picture 12 The paper and board machines' design width and grade manufactured by Tampella's machinery workshop between 1957 and 1996 (N=64).

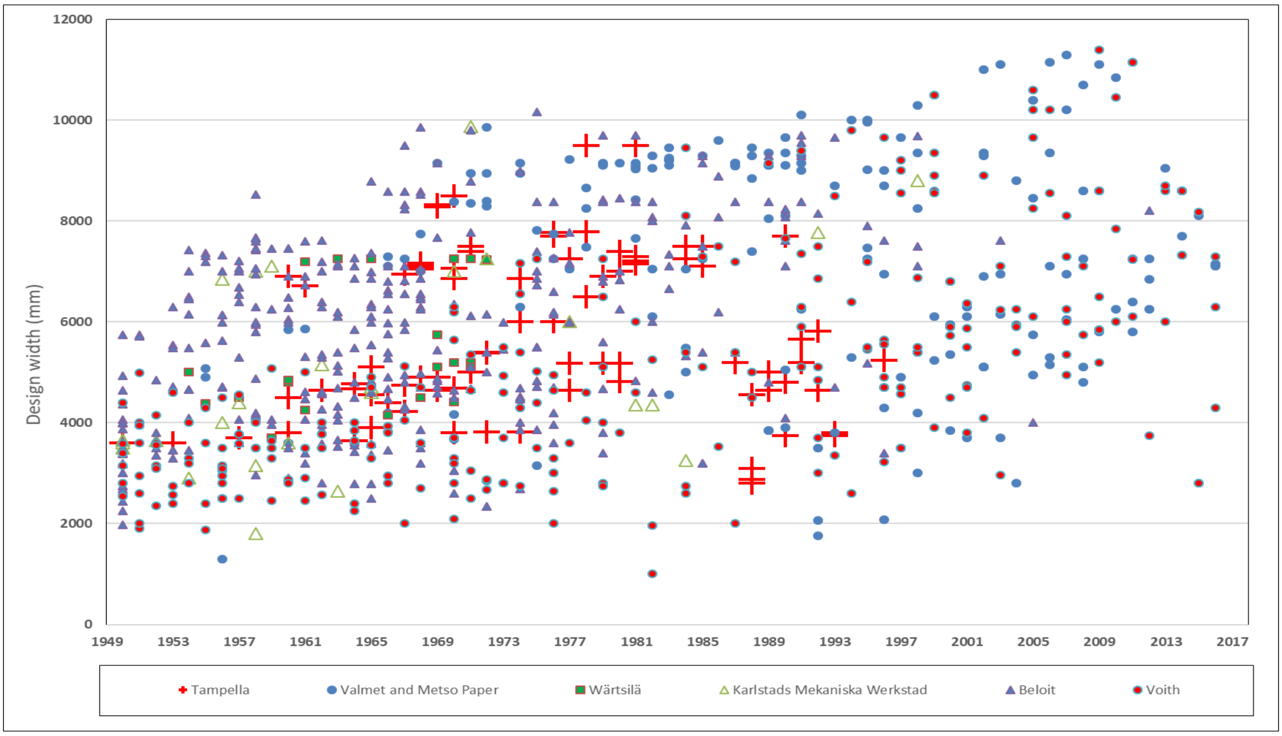


Sources: Pöyry Group in 2018 from 1955 to 1996, *Paper and Timber Journal* from 1957 to 1996. The technology data is presented in Annex 3.

From the perspective of the global machinery workshops, the Tampella machinery workshop developed its technology in terms of the machines' width at the same rate as the major global machinery suppliers in newsprint, cartonboard, kraft- and test-liner, woodfree and coated woodfree machines (excluding tissue) until 1981, as presented in Picture 13. After that, the machines manufactured by Tampella's machinery workshop had significant design width reduction compared to its major machinery workshop competitors. Furthermore, the results also show other changes in the competitive landscape between the global machine manufacturers; for instance, Valmet significantly strengthened its competitive position with Beloit's expense.[577]

[577] Toivanen 2005, p. 211.

Picture 13 The major global machinery suppliers' machinery widths in newsprint, cartonboard, kraft- and test-liner, woodfree and coated woodfree machines (excluding tissue) between 1949 and 2018 (N=922).



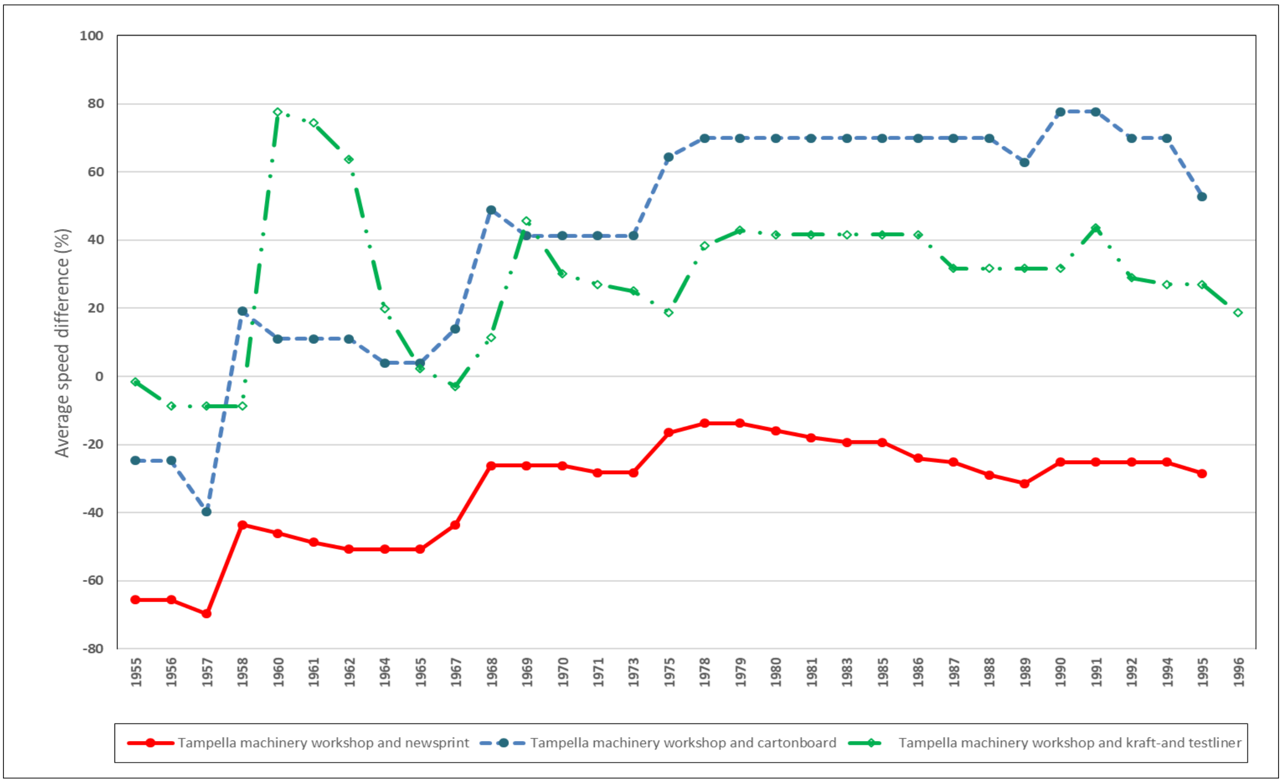
Source: Pöyry Group in 2018 from 1955 to 1996. The technology data is presented in Annex 3.

4.2.3 The great success or stagnation?

Between 1958 and 1995, Tampella's development of endogenous technology was based primarily on the centralised function of the machinery workshop. The results of the analysis indicate that the company's paper and board production units were in a difficult situation with its old machines of the 1970s and 1980s due to significant technological path dependence. After all, the company had made a profit in the 1960s by using old and cheap machinery without any major capital investment; this later backfired. Notwithstanding the above, the endogenous machinery workshop had generated stagnation for its newsprint business units due to the signed TVW agreement since 1969. Furthermore, the machinery workshop did not develop faster machines any further for their customers of kraft- and test-liner and cartonboard, due to the lack of the customers' cooperation, as explained in Chapter 6.

Between 1958 and 1995, the cartonboard machines, and between 1959 and 1995, the kraft- and test-liner machines manufactured by Tampella's machinery workshop had higher machine speed compared to the global markets. Since 1991, the cartonboard, and kraft- and test-liner machines' speed development stagnated as presented in Picture 14 due to arrangements to sell up the company's functions.[578] The situation was the opposite of the newsprint machines in question throughout the analysis period, as the average design speeds of the machines manufactured in Tampella's machinery workshop were lower than those of the newsprint machines in the global competitive environment.[579] It indicates that the machinery workshop focused on board-grade development more than newsprint. Furthermore, the significant technological path dependence was evident, as since 1970 throughout the analysed period, the machines manufactured by Tampella's machinery workshop had higher design speeds than the machines in Inkeroinen, Espanola, Heinola Fluting, Eurocan Kitimat and Pineville.

Picture 14 The speed difference between machines manufactured at Tampella's machinery workshop and global newsprint, cartonboard and kraft- and test-liner machines.



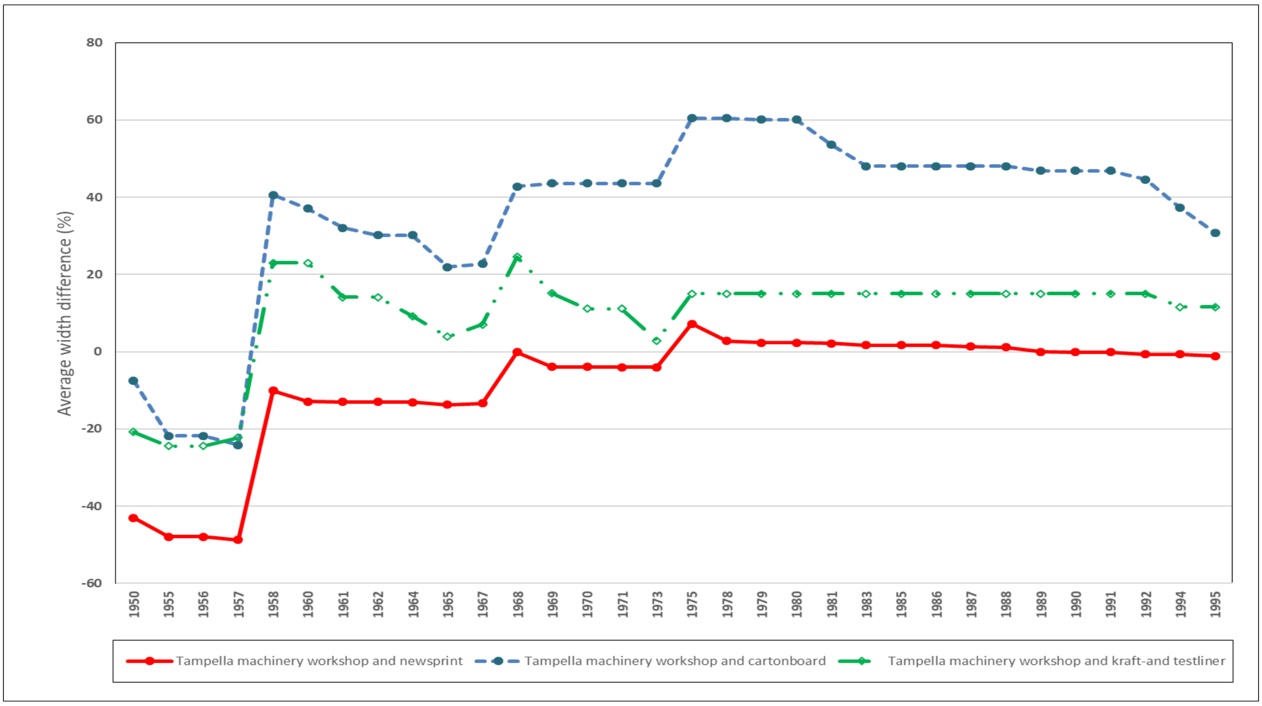
Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* from 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

A similar development is seen in the machine's width, especially in newspaper and cartonboard, but not as significantly as in kraft- and test-liner machines, as presented in Picture 15. In the entire research period since 1960, the board machines mentioned above manufactured by Tampella's machinery workshop had higher average design widths than the machines in Europe (excluding the Nordic

578 Oy Tampella AB sold 91 per cent of Tampella Papertech's shares to Valmet Oy, including the pulp, paper, board and machinery workshop businesses on 8 May 1992.
579 See Table 2.

countries), the Nordic countries, North and Latin America, and Asia, as presented in Table 3.[580] Since 1969, the aforementioned machines had wider design widths than its own production units' paper and board machines, which indicates strong path dependence.[581] Tampella's machinery workshop developed its machines' width at the same pace as major global machinery suppliers in the newsprint, cartonboard, kraft- and test-liner, woodfree and coated woodfree machines (excluding tissue) until 1981, as presented in Picture 13. It is evident that Tampella's machinery workshop was also capable of manufacturing width newsprint machines. After that, the machines manufactured by Tampella's machinery workshop had a significant design width reduction, compared to its major machinery workshop competitors.

Picture 15 The width difference between the machines manufactured in Tampella's machinery workshop and global newsprint, cartonboard and kraft- and test-liner machines.



Sources: Pöyry Group 2018 from 1950 to 1995, *Paper and Timber Journal* from 1957 to 1996, Tampella Annual Reports from 1958 to 1995.

Furthermore, the study results show that Valmet significantly strengthed its competition position to be a reliable machine supplier already in the early 1980s.[582] The question remains, why did Tampella's top management make the decision to purchase a narrower machine for Anjalankoski PM 3 than Valmet was capable of manufacturing in 1983?

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580 See Table 3.
581 The average design width is the calculated value (average) from Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.
582 Toivanen 2005, p. 166.

4.3 Non-market-driven investments

4.3.1 A series of compromises and misbalancing between business units

The impact of different market variables (presented in Table 20) on the investment and operative performance of Tampella's various production units is analysed due to the market factors directly affecting the financial performance of the production units. In this section, which is based on the event analysis, I first define the performance of the investment or operational activity, either as a *positive* or a *negative* function [-5 to +5]. The definition is based on the calibration model, as presented in Annex One. Second, I define activity timing based on a good market situation or weak market situation. Third, I define the quantity of the optimum investment, which means the *positive investment* takes place at the same time as there exists a weak market situation.

The first part of the following analysis focuses on the technological investments and operational improvements of Tampella's various production units. It is a necessary step because the reader needs to understand the antecedents of the decision-making and its relation to, for instance, the available technology for production facilities. Also, it is essential to understand the production unit's long-term and robust path dependencies in the technology development process. Such tremendous and significant investments should also be interpreted in a broader context. For this reason, the analysis presents the technological change in the time context of both investment decisions and operational performance activity. The time dependence of technological change is analysed by market demand, market prices, financial crises, production volumes, and production quality, as presented in Picture 4. Based on the above variables, the optimum investments or operational performance activities are determined.

The second part of the analysis will focus on investment decisions and operational performance decision-making factors. These are used to demonstrate the relevance of factors for technological decision-making. This analysis is divided into three sections. First, summarising the market factors' quantity is based on the investments or operational performance activities. Second, the distribution of a single market factor between different production units is determined. It defines Tampella's senior management's customer-orientation attitude and decision-making among the various production units. Third, the distribution of market factors within one production plant is analysed. It defines a single production plant and mill's managerial customer-orientation attitude and culture.[583]

The decision-making challenge for the Tampella corporation was for the optimum investment timing in the forest units to be when the forest industry's market demand was weak, while the optimum workshop's investment activity would be the reverse. In the forest industry, this means that during strong demand, the company designed investments and maximised profitability by having a full capacity utilisation rate of production. Immediately when the

583 Data of the optimum capital investment activities in market context. See Annex 4.

market declines, the company should implement investments. The challenge is even more prominent as this is only possible by having a market orientation strategy to gain market information and proper portfolio management to generate new possibilities.[584] The management needs to have expanded information on the short- and long-term pricing dynamics and mechanisms in order to understand the real reasons behind the market demand and fluctuations. As a consequence, the effective and correct decision-making of the investments or operational performance activities takes place in the context of time and profitability.

In this dissertation, investment activity is defined as a current event in the context of the variable being studied. For example, in the case of the same investment, investment decision and investment implementation are separate individual activities both in terms of time and content.[585] This approach determines the importance of timing and the importance of capital for investment; as well, it gives the reader more precise information on the course of events. Thus, based on the above definition, I look at the relationship between demand, price, financial crises and production volumes and production quality in Tampella's technological investment activities.

From the technology investment perspective, the typical characteristic of the forest industry is that the forest company needs to have a relationship with a global machine supplier that is as close as possible for knowledge of the advantage technology, flexible purchasing contracts and delivery terms, fast trouble-shooting support and skills, joint development projects, and sharing benchmarking information. Through close cooperation, it is possible to avoid the typical long delivery times of machinery equipment. The delivery times of individual components such as a headbox or single online calender unit is much faster, so this kind of machinery equipment can be bought without a close relationship. In the Tampella case, the flexible cooperation of the machinery supplier should not have been a problem, because they had their own workshop.

4.3.2 Self-reinforcing decisions in Anjalankoski newsprint

This section analyses the timing of Anjalankoski's investments and operational performance activities in relation to the market demand, product prices, financial crises, production volumes and quality of newsprint paper. As presented in Table 4, the growth of the global newsprint capacity was 41.6 per cent between the years 1958 and 1969 and only 7.5 per cent between the years 1990 and 1995. Finnish producers doubled production during the years 1958 to 1969.[586] The annual capacity increased until 1984, after which the total capacity declined. The production also decreased in the UK from 1970 to 1979 and in the Soviet Union from 1990 to 1995, respectively. Canadians were the largest newsprint producer during the period, and until 1992 their production was more significant than the European ones combined, as presented in Table 4.

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[584] Brown 1991, p. 110.
[585] See Lamberg et al. 2006, Näsi et al. 2001.
[586] http://www.fao.org. from 1958 to 1995.

Table 4 Newsprint production capacity growth.

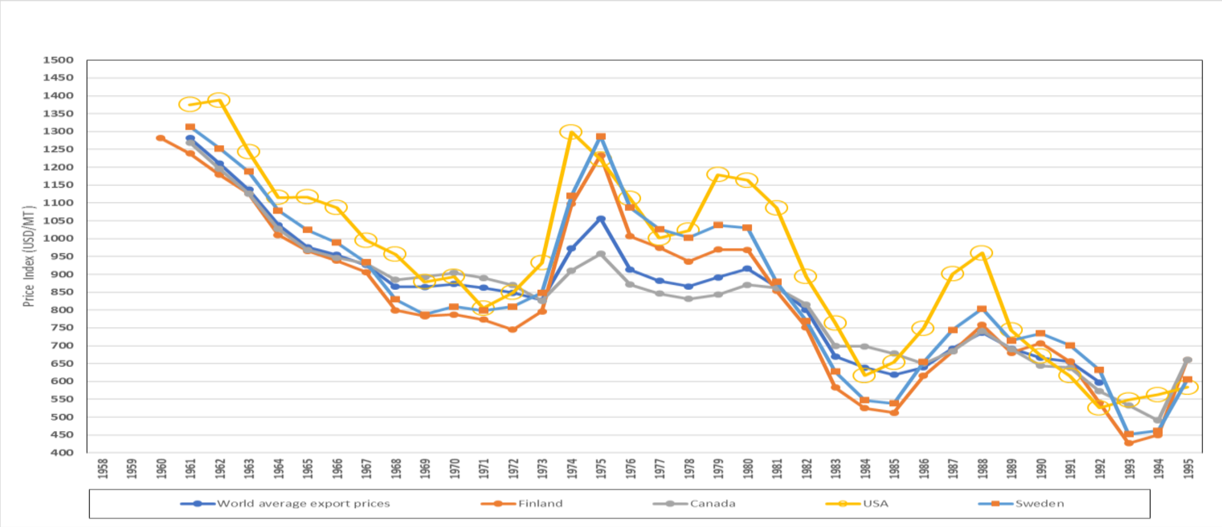
		Newsprint Production capacity growth (Million MT)							
Years	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
1958	12.1	0.6	0.5	5.5	1.6	3.5	0.6	0.2	0.4
1969	20.8	1.2	0.9	8.1	3.0	5.7	0.8	0.3	1.0
1970	21.5	1.3	1.0	8.0	3.0	5.6	0.8	0.4	1.1
1979	24.9	1.5	1.5	8.7	3.7	6.3	0.4	0.6	1.4
1980	26.2	1.6	1.5	8.6	4.2	6.4	0.4	0.6	1.4
1989	32.0	1.3	2.2	9.7	5.5	8.1	0.6	1.0	1.8
1990	32.8	1.4	2.3	9.1	6.0	8.6	0.7	1.1	1.8
1995	35.4	1.4	2.3	9.2	6.4	11.5	0.9	1.7	1.4
		Newsprint Production capacity growth (%)							
Years	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
1958-1969	41.6	49.4	46.5	31.8	47.0	38.3	21.0	25.4	61.7
1970-1979	13.8	13.7	30.6	8.2	17.6	10.8	-108.0	33.2	18.7
1980-1989	18.3	-18.8	29.1	10.9	23.3	20.9	36.5	38.8	24.8
1990-1995	7.5	-0.4	3.1	1.7	5.5	25.3	20.3	34.2	-23.7
		Newsprint Production capacity growth (%)							
Years	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
1958-1995	65.7	56.0	78.7	40.1	75.4	69.6	28.5	85.6	73.0

Source: http://www.fao.org from 1958 to 1995.

The weakness of the newsprint market in 1959 caused Tampella's Anjalankoski units to use production limits, which Tampella's management, with the lead of the CEO Åke Kihlman, thought to be permanent.[587] In the market price context, Kihlman's estimation came true. Even though the international economy grew in Finland during 1956–58, the newspaper prices continued to decline after the public strike, devaluation and recession during the 1960s, as presented in Figure 15.[588]

587 Tampella Annual Report 1959.
588 Hjerppe 1989, p. 49.

Figure 15 Newsprint export price index per million ton (Def. 1995) development during 1958–1995.

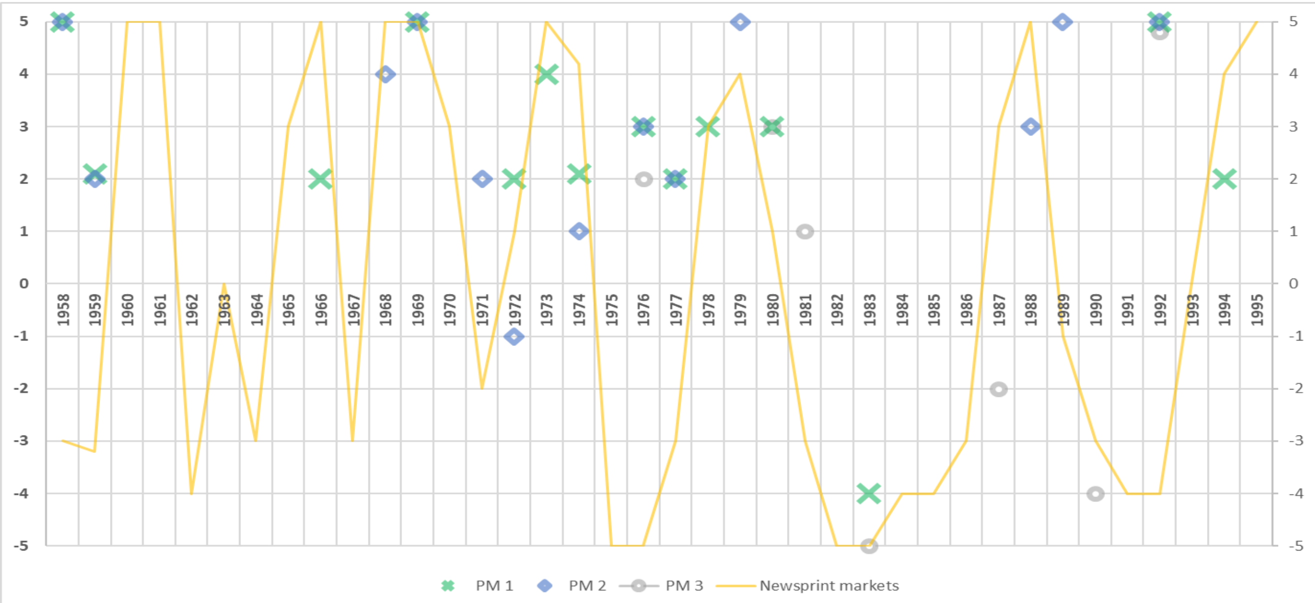


Source: http://www.fao.org from 1958 to 1995.[589] Note: Price index is calculated by export value per export quantity.

This particular period of Anjalankoski's PM 1 and 2 lines' technological investment was sensible and moderate concerning newsprint's annual demand, as presented in Figure 16, which was challenging especially in relation to the price trend. At this moment, when the demand weakened, the investments focused on new, improved Hi-Fi-grade development. Previous investments were, for instance, PM 1's short circulation – and hard calender projects in 1966 – and PM 2's modernisation in 1969. During that particular year, the character of the market was stable, positive, and preceded in devaluation as well as price and salary stabilisation in 1967.[590]

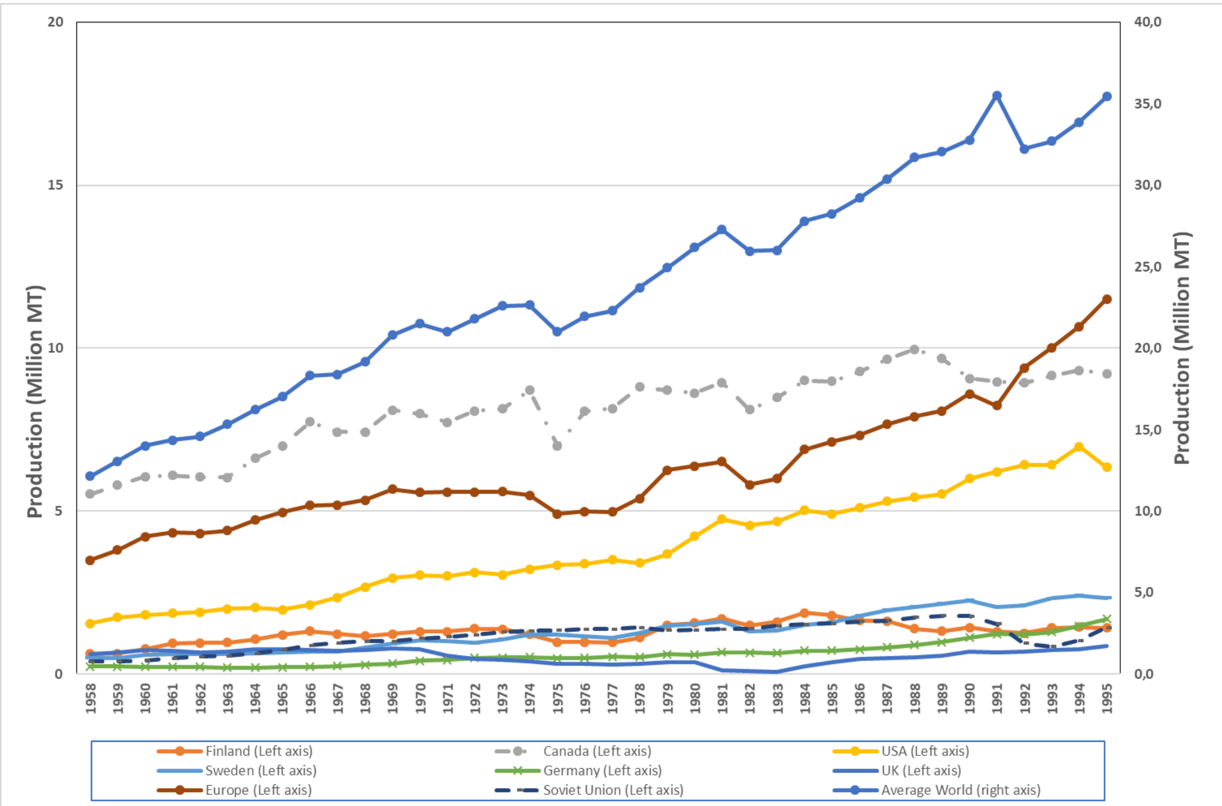
589 Ojala and Tenold 2018, pp. 265–266.
590 Tampella Annual Reports 1966 and 1969.

Figure 16 Anjalakoski's investment activities and newsprint market demand from 1958 to 1995.



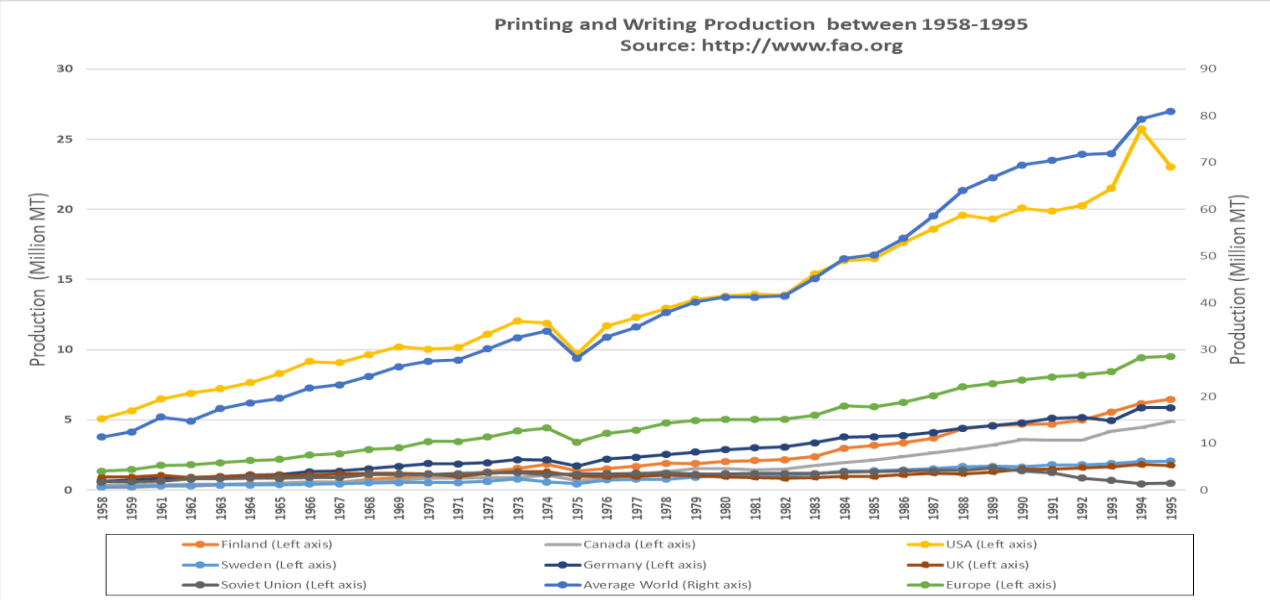
Source: Tampella's annual reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on the event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. Note 2: The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

Figure 17 Newsprint production quantity development during 1958–1995.



Source: http://www.fao.org from 1958 to 1995.

Figure 18 Printing and writing production quantity development during 1958–1995.



Source: http://www.fao.org from 1958 to 1995.

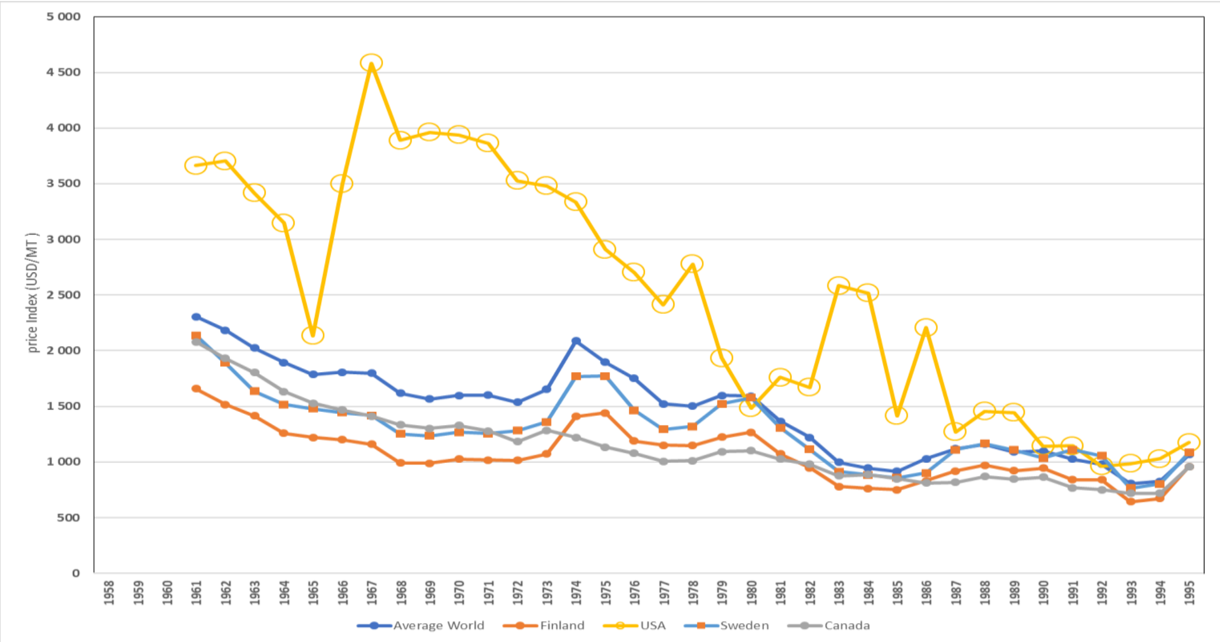
During the years 1970 to 1979, newsprint production increased globally by an average of 13.8 per cent. The most significant production increases occurred by the Swedish (30.6 per cent) and German (33.2 per cent) companies.[591] The British decreased production by 108 per cent, as presented in Table 4, which allowed the Canadian, Finnish and Swedish producers to export significantly more newsprint to Britain.[592] During 1971–1972, the prices kept on decreasing in Finland, Canada, and America.[593] Newsprint was not a very important export product for Finnish producers and the price of Finnish newsprint remained low, as presented in Figure 19. However, unlike other Finnish companies, it was a core product for Tampella. This, in turn, led to path dependence, which the company struggled with for decades.

When the newsprint market was still favourable, Tampella made several small capital investments (FMK 1.9–8.5 million) from the beginning of the 1970s to 1974. The investments were substantial or significant by nature. For example, in 1971, PM 2's process computers and broke treatment investments improved the paper machines' runnability and the quality of the paper.[594] Two years later, PM 1's press section, hard calender and drive renewal improved the paper machines' runnability and the quality of the end products.[595] From the point of view

591 Bergquist and Söderholm 2018, p. 82. In 1975, Swedish producers increased their newsprint business productivity significantly through use of recycled paper as raw material. It was possible after improved innovations to remove inks and contaminants from the recycled paper, as well as a public collection system for old newsprint paper.
592 Särkkä 2018, p. 238.
593 See Figure 15.
594 Tampella Annual Report 1971.
595 Tampella Annual Report 1973.

of profitability, a significant investment was made in the facilities of the thermo-mechanical pulp, as homogeneous furnish improved paper and board quality based on the wood chips from Tolkkinen sawmill.[596] In the first instance, the mentioned investments strengthened Anjalankoski's qualified market stance in the Hi-Fi newsprint markets and the investments significantly improved the paper machines' runnability. The annual production gained in 1974 accounted for 128,000 tonnes, which was a production record until 1980.[597]

Figure 19 Printing and writing grades' price index per million tonne (Def. 1995) from 1958 to 1995.



Source: http://www.fao.org from 1958 to 1995.598 Note: The price index is calculated by export value per export quantity.

Due to the oil crisis, the price of oil increased tenfold during the years 1974 to 1979.[599] It was followed by global inflation and recession. The recession in Finland was eased by bilateral trade with the Soviet Union: counter-purchases balanced trade due to the Soviet Union's more expensive oil.[600] For instance, Tampella's forest unit utilised its full capacity in 1973, and the demand even exceeded the production capacity.[601] Newsprint prices improved after 1973 and the boom lasted until 1975. At that time, Finnish and Swedish producers had their price records as 1 233 USD/mt and 1,280 USD/mt. Their prices were higher than Canadian and American producers during the years 1974 to 1979. The above price

596 Tampella Annual Report 1975.
597 Tampella Annual Report 1974.
598 Ojala and Tenold 2018, pp. 265–266.
599 Hjerppe 1989, p. 50.
600 Hjerppe 1989, p. 50, Paavonen 1998, p. 67, pp. 100–101, 158–170.
601 Tampella Annual Report 1973.

development remained good throughout the 1970s, compared to the late 1960's prices and the global market prices' annual average, as presented in Figure 15.

Despite the 1975 financial downturn[602] and its following decrease in newsprint prices until 1978, Tampella's management began planning the new improved Hi-Fi newsprint PM 3 in Anjalankoski in the autumn of 1976.[603] The mentioned period supports the building of Anjalankoski's PM 3. First, the British production contraction was very significant, so it formed a potential market. Second, German, Canadian and American companies did not significantly increase their newsprint capacity, so it was easier to predict the impact of their competitive position in the European market.[604] Third, the stabilisation of the late 1970s' market prices brought certainty to the makers of the forest industries' future. To Tampella's management, it justified a new very significant and big investment with a positive market prediction. Fourth, during the years 1975 to 1978, the Russian and Swedish companies produced more newsprint than the Finnish ones, so the competitive environment created pressure to act. Finnish producers surpassed both countries in 1979 as a newsprint producer. Tampella's share in Finnish newsprint production at the time was between 8.4 per cent and 10.4 per cent, which increased significantly at the end of the 1980s, up to 27.1 per cent.[605] It means that Tampella was the main player in this process. During the same year, Anjalankoski's PM 2 went through a significant renewal, worth approximately 21 million FMK, including a drying part, heat recovery system, mechanical drives, and pope reel.[606] As a consequence, in the 1970s, Tampella answered to the competition with its technological updates by improving its end products' quality and robotics. The management's decision to build a new newsprint paper machine secured a good market position, utilising scale economics to minimise the products' cost structure.

During the years 1980 to 1989, newsprint production increased globally by 18.3 per cent. In Finland, it decreased by 18.8 per cent, and of the Finnish companies, only Tampella invested heavily in newsprint production. All other countries that were engaged in paper manufacturing had their production increase by 10.9–38.8 per cent. From the point of view of the European market, the Swedish producers' capacity grew significantly from 1958 to 1989: 29.1–46.5 per cent. The corresponding increase for producers in West Germany over the whole period considered was 25.4–38.8 per cent, as presented in Table 4. Swedish newsprint producers bypassed Finnish's quantity in 1986, maintaining their position until the end of the period analysed. During this period, Canadian producers re-

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602 Mika Tiivola's opening speech of the government and business delegation's meeting memo, 29.4.1976, p. 2.
603 Oy Tampella Ab 20.4.1977, A. Auvinen Anjala paper and board industry's internal memo.
604 Kuhlberg 2012, pp. 101–133.
605 Tampella Annual Reports from 1959 to 1989, http://www.fao.org from 1958 to 1995. Tampella's share (per cent) is calculated based on Anjalankoski's total newsprint production and Finland's total newsprint export quantity.
606 Tampella Annual Report 1979.

mained the largest newsprint producer, and their production was still more significant than the whole of Europe's top ones in 1992. Correspondingly, the American producers were the second largest, as presented in Figure 17. North America was the only market for the Canadian newsprint producers.[607]

In the mid-1980s, Tampella's management reported that there was no noticeable decline in the market. Thus, the board approved the paper machine (AP-83) for improved newsprint with two terms: getting permission from the Finnish bank and financing.[608] The paper machine had to be in production in 1983, and Managing Director N.G. Grotenfelt was named the project director.[609] Research was carried out under Hakalehto's leadership to determine the quality of the new paper machine as a newspaper, SC (super calendered) and LWC (light weight coated).[610] As a justification, they defined that off-set newspaper represented a secure, even and large volume product in the European and American markets, Anjalankoski had a customer base, a good name, and expertise in manufacturing and marketing.

At the end of the same year, Tampella's management predicted that the downturn would have a significant impact on Anjalankoski's order backlog, and the following year, 3 per cent of the production time was spent on production restriction and investment work in shutdowns.[611] In 1982, the capacity of the paper mill was only 80 per cent.[612] After that, the price of paper fell further, and the market saw only individual annual price increases for a few years.[613] Over the whole period considered, the decline in prices globally varied between 86.2 per cent and 135.8 per cent, as presented in Table 5. The dynamism of world market prices means that it is a challenge to estimate the changes in the markets based on the available information. As a result, the timing of expensive capital investment becomes difficult, which in turn directly affects the profitability and repayment of the investment.

607 Kuhlberg 2012, pp. 123–128, Kuhlberg et al. 2012, p. 280.
608 Tampella Annual Report 1980, Tampella Direktiones Protokoll 1978, No. 5, §43, Elka archives, Mikkeli.
609 Tampella Board meeting memo 1980, No. 6, §66 and §67.
610 Oy Tampella Ab 20.9.1979 board meeting memo on long-term planning for the years 1980–84.
611 Oy Tampella Ab 20.9.1979 board meeting memo on long-term planning for 1980–84.
612 Tampella Annual Report 1982.
613 Tampella Annual Report 1983.

Table 5 Calculated price per tonne (Def. 1995) development of newsprint between 1961 and 1995.

	Price development of Newsprint during 1961-1995 (def.1995 USD /tons)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany
Years	(USD/MT)[1]	(USD/MT)[1]	(USD/MT)[1]	(USD/MT)[1]	(USD/MT)[1]	(USD/MT)[1]	(USD/MT)[1]	(USD/MT)[1]
1961	1277	1231	1314	1269	1375	1281	1618	1415
1969	865	784	788	893	879	791	987	971
1970	875	789	810	904	893	805	807	969
1979	891	968	1037	843	1179	994	1189	1165
1980	917	968	1030	871	1163	1000	1203	1149
1989	693	681	715	690	744	696	808	774
1990	671	708	735	644	672	723	965	819
1995	659	661	606	661	583	659	743	755
	Price development of Newsprint during 1961-1995 (%)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany
Years	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1961-1969	-47.6	-57.0	-66.8	-42.1	-56.4	-61.9	-63.9	-45.7
1970-1979	1.8	18.5	21.9	-7.2	24.3	19.0	32.1	16.8
1980-1989	-32.3	-42.1	-44.1	-26.2	-56.3	-43.7	-48.9	-48.4
1990-1995	-1.8	-7.1	-21.3	2.6	-15.3	-9.7	-29.9	-8.5
	Price development of Newsprint during 1961-1995 (%)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany
Years	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1961-1995	-93.8	-86.2	-116.8	-92.0	-135.8	-94.4	-117.8	-87.4

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960. Note 1: Price value def. 1995.

Presumably, price fluctuations in the market affected the positive conclusion that the new paper machine was switched to Hi-Fi grades, also to SC grades, and PM 1 and PM 2 would be able to switch to coated types. Unfortunately, during the launch of PM 3 in 1983, the world markets suffered from overcapacity and the production of the other Anjalankoski news machines was reduced, so that in 1984 the paper's capacity was only 90 per cent. Even the next year was considered a production restriction of downtime.[614] Thus, due to the market situation and the timing of the investment, profitability and the repayment of the investment weakened throughout the Anjalankoski production unit, as presented in Figure 16. In 1988, it was decided to increase the capacity of PM 3 from 200,000 to 225,000 tons/year and to improve the Hi-Fi-newsprint to the improved newsprint.[615] Two years later, Valmet delivered a new headbox and former to PM 3 in a very

614 Tampella Annual Report 1984.

615 *Paper and Timber Journal* 1988, No. 10, p. 843.

challenging market situation.[616] Even in 1992, there was an oversupply in newspaper, and thus Anjalankoski's operating rates were below 90 per cent.[617]

A very significant investment was the conversion of PM 2 to coated grades.[618] The justification was to abandon newsprint that had experienced world market price declines since 1958, with the exception of a few individual years. Also, annual market demand was highly cyclical, and since 1975 it was weak, excluding the years 1978–79. The launch of the new Tamedia product family brought the company a positive image in 1989.[619] From the technology perspective of the forest unit, the choice of the online double-coating concept was excellent, as the efficiency of the entire production line was improved. However, choosing Tampella as a major supplier without a coated machine line reference was a risky decision. Anjalankoski bought coating stations from Beloit and a soft-calender from Kleinewefers, which reduced the technology risk.[620] In any case, an ordinarily inexperienced supplier heightened the launching cost, and this was also the case in PM 2, as only after long laboratory experiments and trial production on the paper machine was the MFC product released for sale. As a consequence, finally, the quality of the MFC (machine finished calendered) product was at least as good as the similar products of the major competitor's Kymmene, Yhtyneet Paperitehtaat, and Enso-Gutzeit.[621] For Tampella's paper machine manufacturing, the deal was an excellent opportunity, however, as they received in this way their first online coated paper machine reference, even though Tampella was not the supplier for online coating units and a soft-calender.

Tampella's technological investments in the 1980s did not take into account the market dynamics overall.[622] The investment in PM 3, which started in 1976, seemed sensible for several years, but in 1980 the market strongly influenced newsprint prices and demand. Despite the market factors in 1983, PM 3 started in a situation where newsprint overcapacity caused prices to fall for the next two years.[623] That said primarily, it is challenging to estimate the timing of the investment, if the management had a lack of market information or they ignored it. It was only in 1988 that Tampella's management decided to move away from standard newspaper to improved news quality and PM 2 to coated paper grades.[624] It can be said that the market forced Tampella's management to make significant grade-change decisions. The whole case shows the management's inability to act on time and with strong leadership when there was sufficient information available about challenging market demand and unfavourable price developments.

In 1994, there was no overcapacity in the market, and in the same year, Enso-Gutzeit (the new owner of Tampella Forest Oy since 1993) invested in a new

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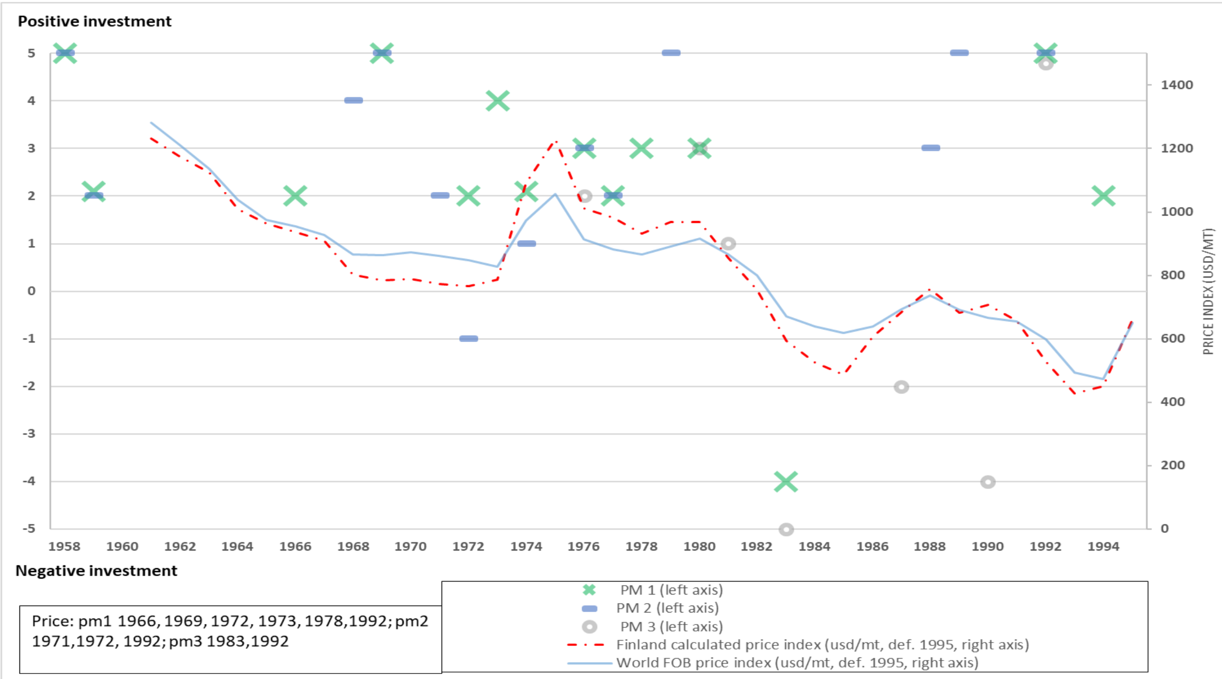
616 *Paper and Timber Journal* 1990, No. 72, pp. 735, 737.
617 Tampella Annual Report 1992.
618 Tampella Annual Report 1988, *Paper and Timber Journa*l 1988, No. 10, p. 843.
619 Tampella Annual Report 1989.
620 *Paper and Timber Journal* 1990, No 72.
621 Tampella Annual Report 1979.
622 Oy Tampella Ab board meeting memo 1980, No. 10, §107.
623 Tampella Annual Reports from 1976 to 1983.
624 *Paper and Timber Journal* 1988 No. 10, p. 843.

surface sizing equipment at the Anjalankoski paper mill (PM 1).[625] With this investment, the company reacted to the 6 per cent per year growth in demand for special (four-colour) newsprint, especially in the UK. In 1995, the market for newsprint grew by two per cent and prices by 24 per cent. Enso-Gutzeit's machine utilisation rates in Finland were 98 per cent.[626]

Figure 20 World FOB price index per million ton (Def. 1995) and Finnish producers calculated by price index of newsprint (Def. 1995) and Anjalankoski investments between 1958 and 1995.



Sources: http://www.fao.org from 1958 to 1995, Tampella Annual Reports from 1958 to 1995. Note 1: The price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on the event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

Anjalankoski's mill unit allocated between 46.2 to 71.4 per cent of its technology investment activities in years of global economic downturns. In the context of time cyclicality, the individual investment activities were distributed evenly, as activities accounted for between 5 to 15 per cent of Anjalankoski's investments during the years 1958 to 1995, as presented in Table 6. The performance of PM 2 was the weakest, and it was also weaker than the average of Tampella's other production units. The performance of PM 1 and PM 3 was better than the average of Tampella's other production units. This result indicates that the newsprint's order backlog was still good during the economic downturn in 1969, 1974, 1978

625 Enso-Gutzeit Annual Report 1994.
626 Enso-Gutzeit Annual Report 1995.

and 1980, when at the same time some of the investments were implemented in PM 1 and PM 2. Also, the PM 3 investments in 1981 and 1990 indicate an excellent performance from the perspective of investment timing.

Table 6 Anjalankoski's investments during the financial downturn measured by GDP.[627]

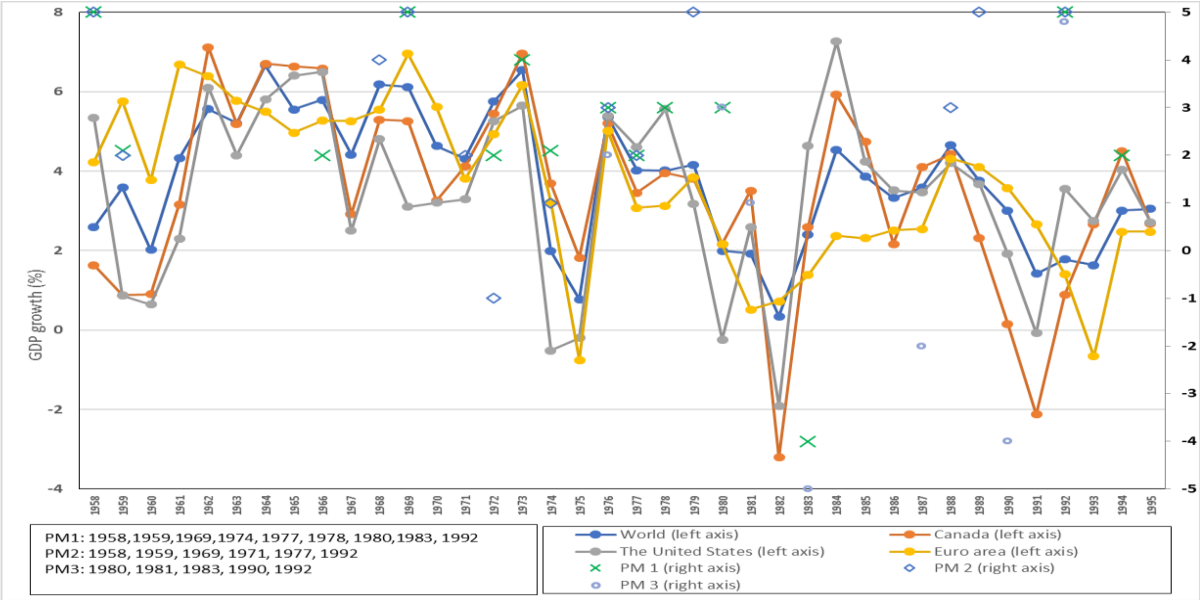
Years of economic crises				Anjalankoski investments				% of all Investments
World	USA	Canada	Euro	PM 1	PM 2	PM 3	Sum	(Total 34)
1958		1958		1	1		2	10
	1959	1959		1	1		2	10
1960	1960	1960					0	0
1967	1967	1967					0	0
	1969			1	1		2	10
1970	1970	1970					0	0
1971	1971		1971		1		1	5
1974	1974			1			1	5
1975	1975		1975				0	0
			1977	1	1		2	10
			1978	1			1	5
1980	1980	1980	1980	1		1	2	10
1981	1981		1981			1	1	5
1982	1982	1982	1982				0	0
			1983	1		1	2	10
		1986					0	0
	1990	1990				1	1	5
1991	1991	1991	1991				0	0
1992			1992	1	1	1	3	15
1993			1993				0	0
				9	6	5	20	100.0
All machine line investments				14	13	7	34	
% of recession timing investments				**64.3**	**46.2**	**71.4**	**58.8**	

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995.

As presented in Figure 21, the timing of the economic downturn was not an essential variable for the investment decisions of Anjalankoski PM 1 and PM 2. However, the timing was considerably more frequent in the investments or operational performance activities in PM 3.

627 http://data.worldbank.org from 1961 to 1995: Definition for GDP: 'An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.'

Figure 21 World Gross Domestic Product growth, GDP vs Anjalankoski's investments between 1958 to 1995.



Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on the event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities are including investments and activities that are relevant to performance, whose details are presented in Annex 4.

At Anjalankoski, 85.3 per cent of all its investments were *positive*, and 14.7 per cent were *negative*, as defined by the functions explained in Annex One. Furthermore, 47.1 per cent of Anjalankoski's investments or operational performance activities took place in a good market situation, and 52.9 per cent took place in a weak market situation. All its *positive investments* or operational performance activities, which took place in the weak market situation, accounted for 44.1 per cent. It is evident that most of Anjalankoski's investments were positive, but it was not successful in terms of the optimum investment timing, as presented in Table 7.

Table 7 Statistics of Anjalankoski's *positive investment* activities and *negative* markets in 1958–1995 (Def. 1995).

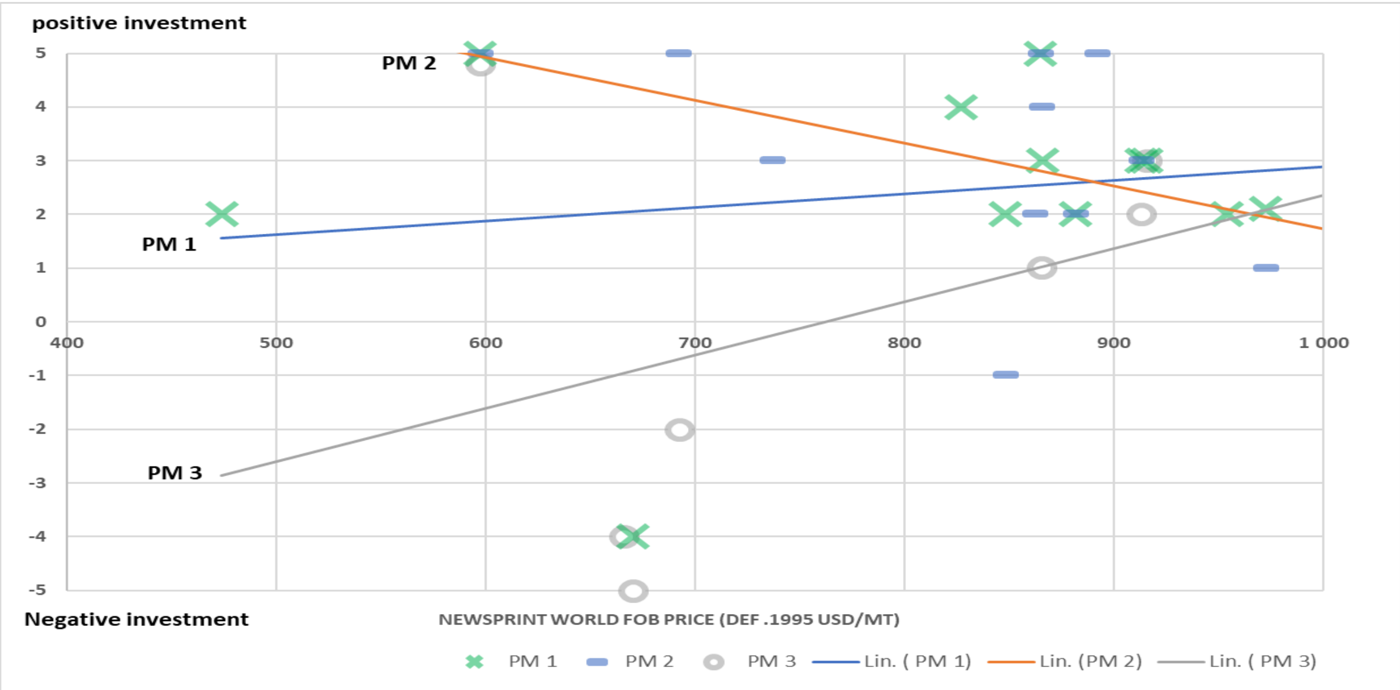
	Investments of Anjalankoski (pcs)			**Investments of Anjalankoski (%)**		
	all	positive	negative	all	positive	negative
PM1	14	13	1	41.2	92.9	7.1
PM2	13	12	1	38.2	92.3	7.7
PM3	7	4	3	20.6	57.1	42.9
Total	34	29	5	100	85.3	14.7
	Newsprint market status (pcs)			Newsprint market status (%)		
	all	good	weak		good	weak
PM1	14	8	6		57.1	42.9
PM2	13	6	7		46.2	53.8
PM3	7	2	5		28.6	71.4
Total	34	16	18		47.1	52.9
	Positive Investment activity and negative market status					
		(pcs)			(%)	
PM1	14	5			35.7	
PM2	13	7			53.8	
PM3	7	3			42.9	
Total	34	15			44.1	
Investments vs Finland market prices (usd/mt)				Investments vs Finland prices (%)		
	all	< 800	> 800		< 800	> 800
PM1	14	6	8		42.9	57.1
PM2	13	6	7		46.2	53.8
PM3	7	4	3		57.1	42.9
Total	34	16	18		47.1	52.9
Investments vs World FOB prices (usd/mt)				Investments vs World FOB prices (%)		
	all	< 800	> 800		< 800	> 800
PM1	14	3	11		21.4	78.6
PM2	13	3	10		23.1	76.9
PM3	7	3	4		42.9	57.1
Total	34	9	25		26.5	73.5

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note: Figure is based on event analysis, as I define the performance of the investment or operational activity and market status as a *positive* or a *negative* function [-5 to +5]. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

Anjalankoski's investments or operational performance activities did not follow the newsprint FOB prices. This is evident in that 52.9 per cent of the activities took place over the 800 USD/mt (def. 1995) and 47.1 per cent below the 800 USD/mt (def. 1995) price level of newsprint in Finland. Furthermore, 73.5 per cent of the activities took place over the 800 USD/mt (def. 1995) and 26.5 per cent below the 800 USD/mt (def. 1995) price level of the world's newsprint FOB, as presented in Table 7. This means that Tampella's investments were made regardless of the domestic price level of newsprint, during the high global price level. It is worth noting that the machine's rebuilding investments during the high-end of the product's prices became more expensive for the company than during low prices, due to the required equipment' installation downtime.

Between 1961 and 1995, from the perspective of development and the price of the market, Anjalankoski's PM 3 investments correlated well with the average price development of world newsprint FOB, so that the higher the market price was, the more positive the investment was. There was no correlation between investments in Anjalankoski PM 1 and PM 2, as presented in Figure 22. As a whole, I can primarily conclude that market fluctuations are difficult to predict, and, secondly, market cycles did not dominate the investment decision-making in Anjalankoski.

Figure 22 Relationship between newsprint world FOB price per million ton (Def. 1995 usd/mt) and Anjalankoski's investment activities during 1961–1995.



Sources: http://www.fao.org from 1958 to 1995, Tampella Annual Reports from 1958 to 1995. Note 1: Price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.3.3 Expansion of board capacity in Inkeroinen

This section analyses the timing of Inkeroinen's investments and operational performance activities in relation to the market demand, product prices, economic downturns, production volumes and quality of packaging board grades. Between 1958 and 1995, the world's other paper and paperboard production increased by 76.4 per cent and wrapping and packaging grades increased by 83 per cent. The most substantial growth was between 1958 and 1969, as the world's paper and paperboard production grew by 48.3 per cent, and wrapping and packaging grades grew by 58.5 per cent. Subsequently, the increase in capacity contracted substantially and at its lowest in 1990–95 was only 17.4 per cent. The production growth of analysed board grades was the strongest in 1958–1969, when production of this grade grew in Finland alone by 57.9 per cent. Since then, production growth in all countries has been considerably lower. Between 1970 and 1979, the exceptions were the British producers with 6 per cent reduction and Russian producers with a decline of 226.4 per cent between 1990 and 1995, as presented in Tables 8 and 9.

Table 8 Other paper and paperboard production capacity growth between 1958 and 1995.

		Other Paper and Paperboard Production (million MT)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
Years	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)
1958	39.1	0.8	1.0	0.9	19.8	11.0	1.9	2.1	2.0
1969	75.7	1.9	2.7	2.6	33.9	19.1	3.0	3.2	3.8
1970	77.6	2.0	2.8	2.4	33.0	19.7	3.0	3.3	4.4
1979	103.1	2.3	4.1	3.3	40.1	29.3	2.8	4.1	6.2
1980	102.7	2.3	3.7	3.3	38.8	28.7	2.5	4.1	6.2
1989	133.4	2.8	4.5	3.7	44.7	35.6	2.6	5.7	7.4
1990	137.1	2.9	4.5	3.8	45.9	34.6	2.7	6.0	7.6
1995	165.9	3.2	4.8	4.6	56.1	39.4	3.5	7.2	2.3
		Other Paper and Paperboard Production capacity growth (%)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
Years	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1958-1969	48.3	57.9	63.0	65.4	41.6	42.3	36.4	36.3	47.8
1970-1979	24.7	13.0	31.7	27.3	17.7	32.7	-6.0	20.7	29.0
1980-1989	23.0	17.9	17.8	10.8	13.2	19.6	5.5	28.1	15.4
1990-1995	17.4	9.4	6.3	17.4	18.2	12.0	20.6	17.4	-226.4
		Other Paper and Paperboard Production capacity growth (%)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
Years	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1958-1995	76.4	75.0	79.2	80.4	64.7	72.0	45.1	71.6	13.6

Source: http://www.fao.org from 1958 to 1995.

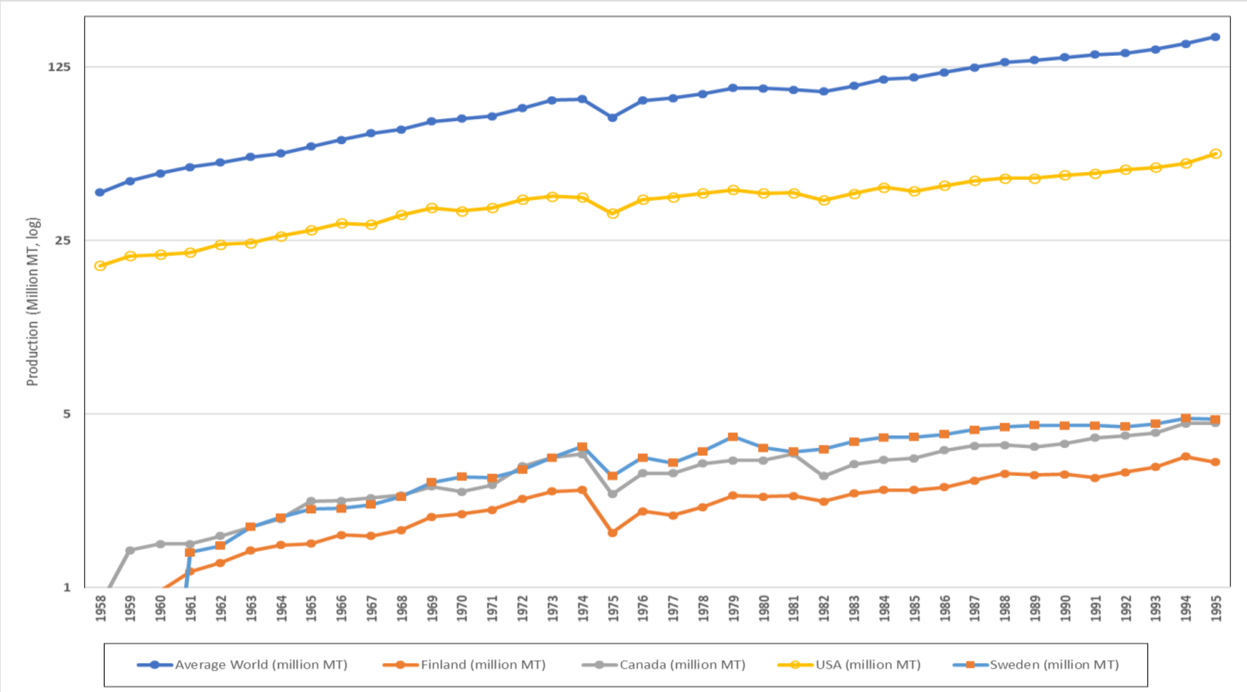
Table 9 Wrapping and packaging board production capacity growth.

		Wrapping and Packaging Board Production (million MT)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
Years	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)	(million MT)
1961	22.0	1)	1)	1)	19.0	1)	1)	1)	1)
1969	52.9	1.7	2.1	2.1	28.8	14.5	2.1	2.4	1)
1970	53.7	1.7	2.3	2.0	28.2	14.8	2.1	1.9	1)
1979	70.9	1.9	3.4	2.7	31.7	21.2	2.0	3.1	1)
1980	70.1	1.9	3.0	2.7	31.3	20.3	1.7	3.1	1)
1989	100.9	2.3	4.0	3.2	36.4	26.2	1.8	4.1	4.6
1990	103.1	2.3	4.0	3.3	36.9	26.6	2.0	4.3	4.8
1995	129.6	2.6	4.5	4.0	46.6	31.4	2.5	5.3	1.6
		Wrapping and Packaging Board Production capacity growth (%)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
Years	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1961-1969	58.5	1)	1)	1)	34.0	1)	1)	1)	1)
1970-1979	24.3	9.0	32.7	25.8	11.1	30.3	-6.9	39.0	1)
1980-1989	30.5	18.1	23.6	16.9	14.1	22.6	8.3	25.1	1)
1990-1995	20.5	10.8	10.8	16.5	20.9	15.3	20.3	20.5	-195.1
		Wrapping and Packaging Board Production capacity growth (%)							
	World	Finland	Sweden	Canada	USA	Europe	UK	Germany	Soviet Union
Years	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1958-1995	83.0				59.2				
1969-1995		35.4	51.8	48.0		53.7	17.0	55.9	

Source: http://www.fao.org from 1958 to 1995. Note1: Production data not available for Finland, Sweden, Canada, Europe, UK and Germany in 1961, and the Soviet Union between 1961 and 1980.

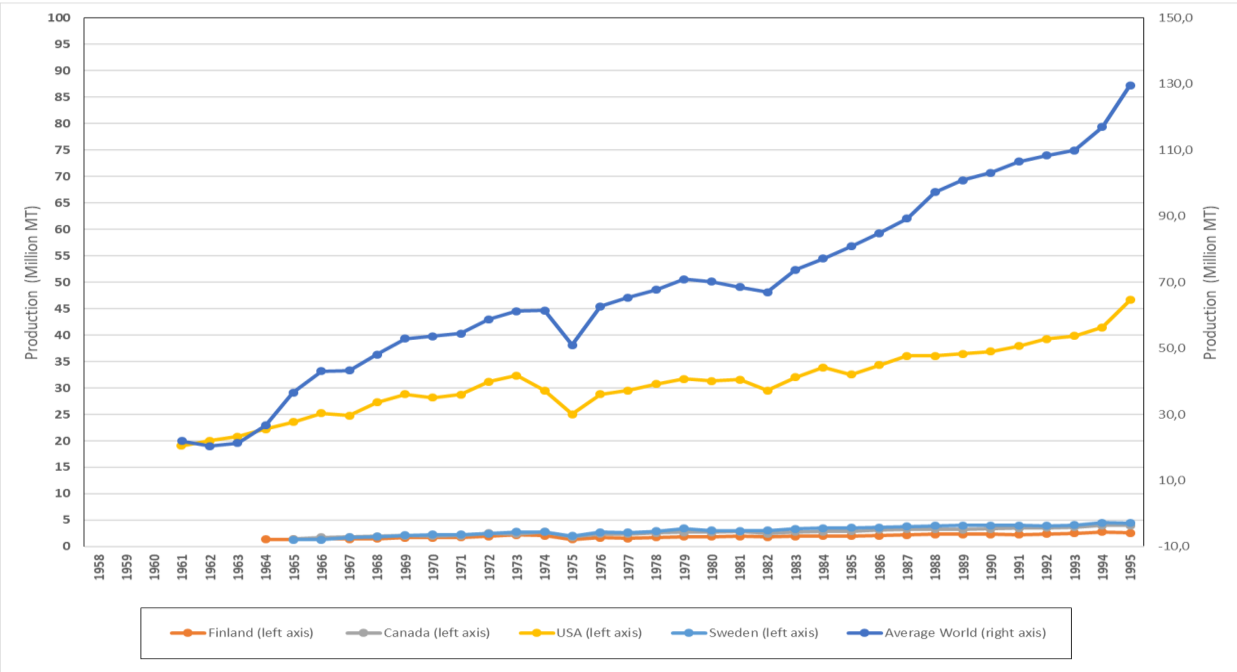
The U.S. producers had the largest paper and paperboard and wrapping and packaging board-grade production throughout the reference period, and the production of both cardboard grades was at least a third of the world's output over the reference period. (See Figures 23 and 24.) Thus, for a Finnish forest company, investments that increased Tampella's capacity were generally interpreted as *positive* activities, as the company had to remain in the international competition and respond in particular to the dominant U.S. producers' position in the European market as well.

Figure 23 Other paper and paperboard production quantity development between 1958 and 1995.



Source: http://www.fao.org from 1958 to 1995.

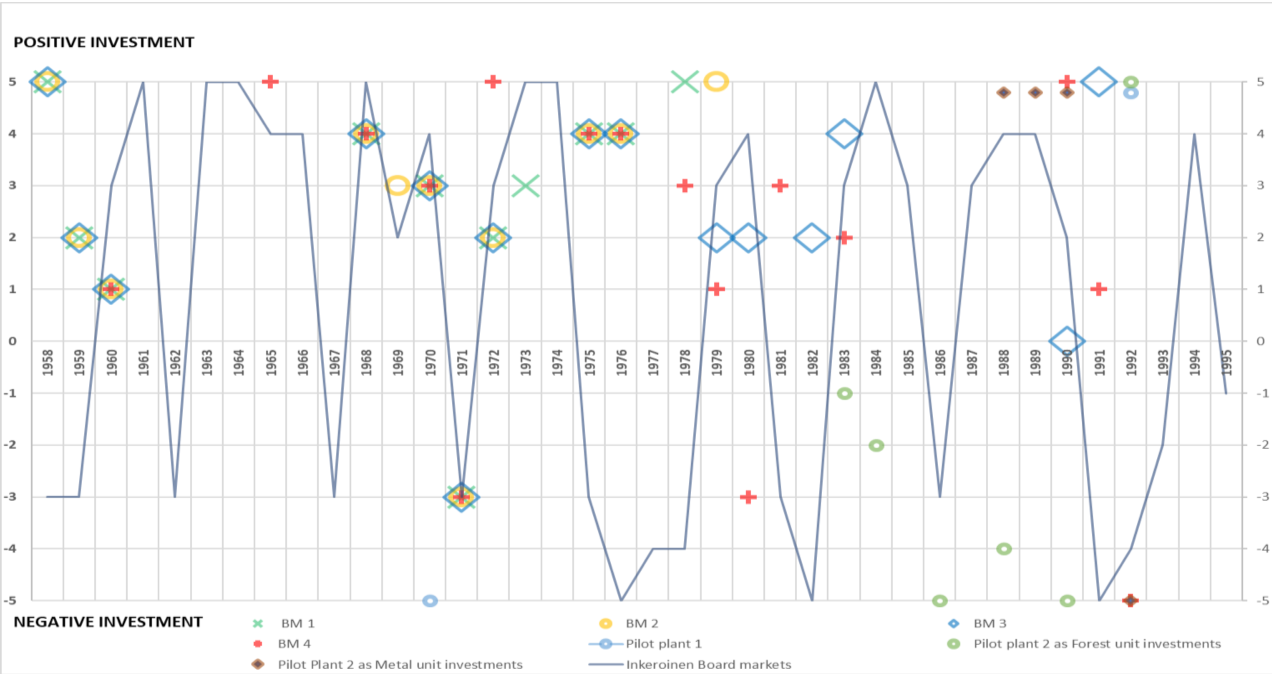
Figure 24 Wrapping and packaging board production amount development during years 1958–1995.



Source: http://www.fao.org from 1958 to 1995.

Between 1958 and 1969 at Inkeroinen's plant, all investment activities were *positive*, which was mainly based on the result of a good market situation. (See Figure 25.) In 1959, the individual orders of BM 1 appeared due to the cyclical nature of the demand in the forest and metal industries.[628] The demand was improving already in the following year. In the same year, the new BM 2 launched its new design. The company's board business focused on quality improvement as the customers' quality requirements increased.[629]

Figure 25 Figure 25. The investment activities and board market demand during 1958–1995 at Inkeroinen's plant.

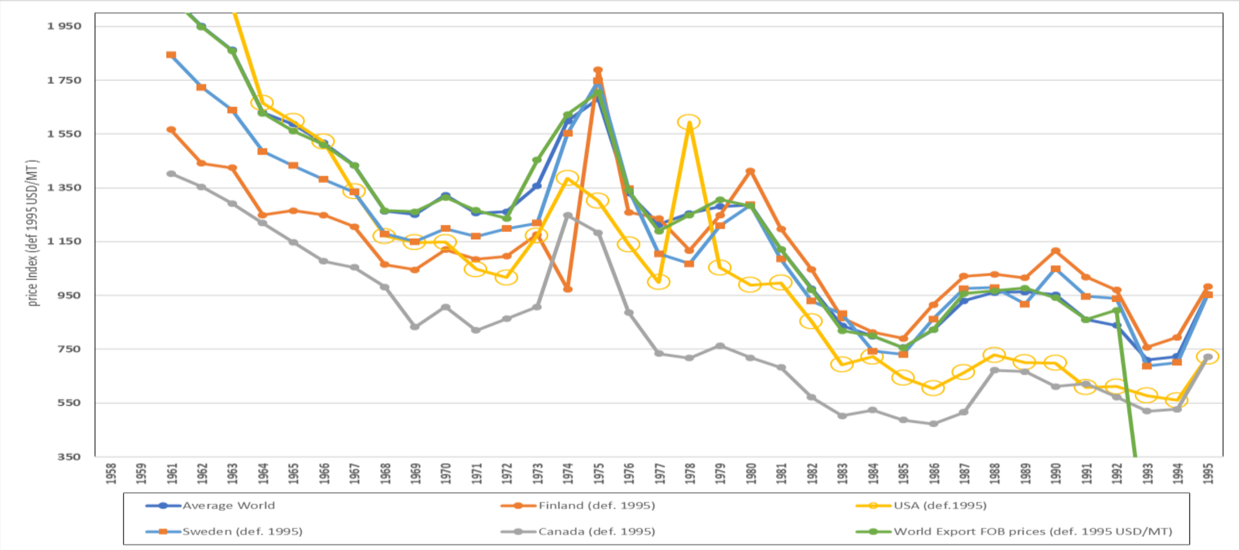


Sources: Tampella Annual Reports from 1958 to 1995, Enso-Gutzeit Annual Reports from 1992 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

The management of the Inkeroinen board mill decided to focus on quality improvement, which was an important investment activity to improve the unit's profitability, as its market prices against other Finnish paper and paperboard were the lowest in the 1960s, and the third lowest until 1974, as presented in Figure 26. From 1975, production volumes in Finland fell significantly, bringing the value of the other paper and paperboard products to one of the highest in the market until 1995. For instance, between 1970 and 1979, Finnish production capacity growth was 13 per cent, while Swedish production was 31.7 per cent.[630]

628 Tampella Annual Report 1959.
629 *Talouselämä Journal* 29.4.1966, No. 17, *Paper and Timber Journal* 1966, No. 11, p. 723.
630 See Table 8.

Figure 26 Other paper and paperboard calculated price index per million ton (Def. 1995) development during 1961–1995.

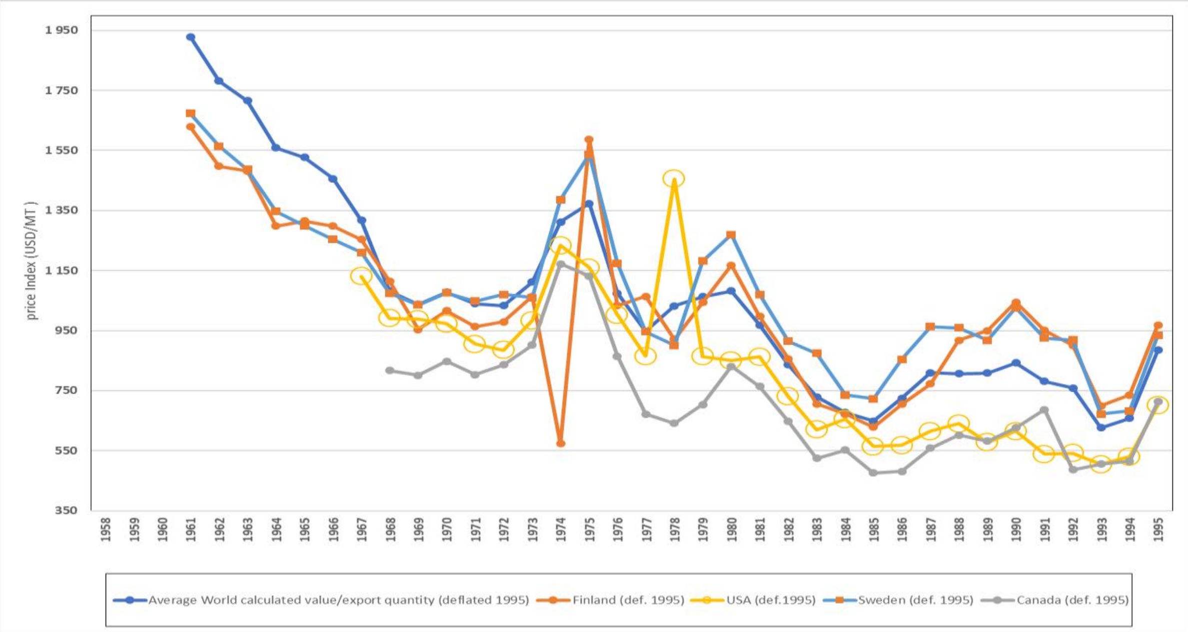


Source: http://www.fao.org from 1958 to 1995.[631] Note 1: Price index is calculated by export value per export quantity (deflated 1995).

The Finnish market prices for wrapping and packaging board grades followed the Swedish producers' price development within the price difference of 100 USD/mt throughout the comparison period, as presented in Figure 27. Furthermore, a similar trend as other paper and paperboard products occurred in the price value of wrapping and packaging board grades, as it became one of the highest since 1975.[632]

631 Ojala and Tenold 2018, pp. 265–266.
632 See Table 9.

Figure 27 Wrapping and packaging board price index per million ton (Def. 1995) development between 1958 and 1995.



Source: http://www.fao.org from 1958 to 1995. Note: Price index is calculated by export value per export quantity (deflated 1995).

In 1962, demand did not respond to increasing production capacity.[633] Between 1963 and 1969, the mills had a full order backlog, excluding the year 1967 when the board prices were declining due to the financial downturn, especially in West-Germany. The construction of the new BM 4 started in 1963 and the machine was ready for production in July 1965.[634] This activity is regarded here both as a *positive investment* activity and a significant investment decision. The board machine had a capacity of 80,000 t/a.[635] The primary raw material was waste paper, and the end products were defined as the 'the best possible modern grades'.[636] Inkeroinen's mill made a significant and large *positive investment* in a steam plant, whose value was FMK 40 million in 1968; it started in 1971.[637] BM 2 also achieved an excellent operating rate, excluding three weeks of modernisation shutdowns in 1969.[638]

In 1970, BM 1 and 3 had shutdowns due to a lack of orders, and in 1972, the order backlog was only 3–4 weeks. As a consequence, the board machine's running order reduced profitability by the increased grade changes. Overcapacity in the market produced pressure to meet the tightening competition, and a series of folding box tests were implemented at BM 4. These successful pilot runs created such innovations as a new Tam-Duplex grade and increased drying capacity by

633 Tampella Annual Report 1962.
634 *Talouselämä* 29.4.1966, No. 17, *Paper and Timber Journal* 1966, No. 11, p. 723.
635 *Talouselämä Journal* 29.4.1966, No. 17.
636 Tampella Annual Report 1963.
637 Tampella Annual Report 1968.
638 Tampella Annual Report 1969.

5000 t/a.[639] In general, improvements at the pulp typically improved the quality of the finished product and the board machine runnability, so such investments are defined as *positive* or significant investment activities. In the 1970s, examples of such investments included the new groundwood plant, a new thermomechanical plant (FMK 1 million, in 1973–74) and a water protection process (FMK 8.49 million).[640]

The in-house pilot machine was both a *negative* and a *positive investment* activity, reflecting the fact that Tampella was both a forest company and a metal company. From the forest unit's perspective, the pilot machine represented *negative* investment activity. This interpretation can be justified by CEO Johan Nykopp's comments in the annual report in 1971: 'The primary market is satisfactory, but the secondary market is not pulling. Quality will be prioritised in the production. Poor profitable test-liner orders were cut off. The sales of the folding boxboard were weak.'[641] There was no particular reason to have in-house pilot machines in the forest unit. The pilot machines' chemicals and impurities accumulated in a short circulation due to the closed water system and, as a consequence, the formed web did not correspond to the production machines' web, excluding the first test run an hour. For these reasons, the web surface properties and tailor-made coating components were typically developed in collaboration with external research institutions, such as Teknologian tutkimuskeskus Oy (VTT) and Oy Keskuslaboratorio Ab (KCL), and with machine suppliers, such as Voith and Valmet. The test runs would take place in the external pilot facilities and then in the company's production machines.

From the 1960s until the 1990s, it was typical for the forest industry to build pilot paper machines and research centres in Finland. It was also the case with Enso-Gutzeit and Valmet Oy when they established a joint venture named Enso-Valmet Oy in 1967. Two years later, they started research work for the development of machinery types of equipment and new paper products. At the beginning of 1990, already about 160 people worked there.[642]

Between 1975 and 1978, the economic cycle weakened dramatically and Inkeroinen's board machines' operating rates were as low as 63.4 to 84 per cent. In 1978, demand at BM 1 continued to pick up after a prolonged recession. The demand continued to be very challenging with other board machines because of existing overcapacity in the market. Due to the tight competition, Finland's first continuous board machine was closed in November 1978, after 81 years of operation.[643] In the following year, BM 2 was also closed.[644] These two mill closures

639 Tampella Annual Report 1972.
640 Tampella Annual Report 1974.
641 Tampella Annual Report 1971.
642 The internal meeting memo of the Enso-Valmet Oy A archives between 1967 and 1978, No. 1, Elka Archives, Mikkeli. Enso-Gutzeit Annual Reports from 1967 to 1978, Elka Archives, Mikkeli.
643 Tampella Annual Report 1978.
644 *Paper and Timber Journal* 1991, No. 73(4), p. 294.

are considered here as very significant and large *positive* divestments, as Tampella had sufficient board capacity with its newer and effective machines. In the same year, it was decided to rebuild BM 4.[645] The distributed computer system (DCS) investment increased the process of automation knowledge. The BM 4 modification took place in 1980 (FMK 21 million), and the investment shutdown lasted 66 days.[646] The optimal implementation timing for this project would have been in 1975–78 from point of view of market demand, as presented in Figure 25. During the years 1979–80, there was good demand in all market areas until the end of 1980, when BM 3 had a 14-week rationalisation shutdown. It was a *negative* activity due to production losses. The year-to-year production record of BM 4 was the result of a previous improvement in production capacity through investments. Between 1981 and 1982, the board market had a downward trend and Inkeroinen's board machines had shutdowns for 2 per cent of their production time.[647] For example, in 1982, the capacity utilisation rate was only 90 per cent. The 1983 shift from recycled furnish to pure groundwood (FMK 25 million) took place until the market was up in 1989.[648] Already in 1984, more than half of the production was folding boxboard. These investments reflect the nature of the pulp and paper industry, with continued small investments and improvements aimed at greater competitiveness. Similarly, the timing of the aforementioned investments demonstrates the fact that market cycles posed an overwhelming challenge to optimise the timing of the investment in advance.

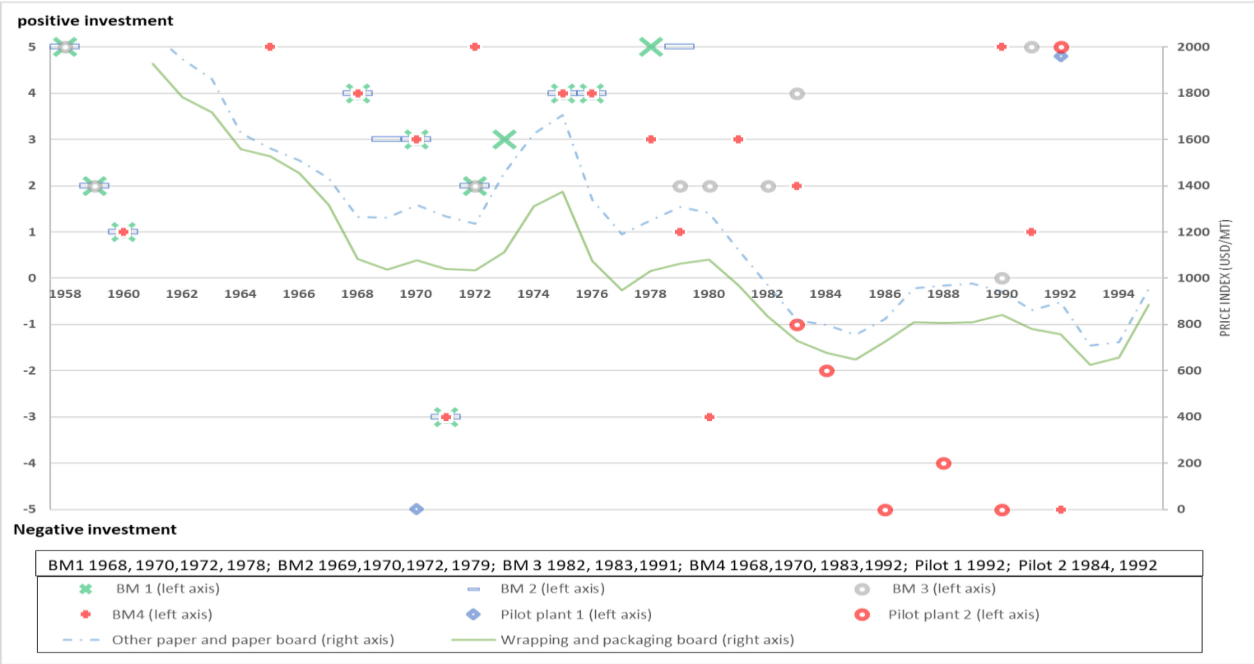
In the market upturn in 1983, a second pilot plant was started, consisting of a test machine, stock preparation, pressure, and water treatment plants.[649] This investment is regarded as a *negative* investment activity and large investment from the forest unit's point of view. From the workshop's point of view, they had no role other than acting as an internal equipment supplier. The project tied its resources for three years in a good market situation, as the plant was completed in 1986. In 1988, a FIM 100 million decision was made to extend the Research Center in Inkeroinen, including a new paper machine with stock preparation.[650] For the workshop, the ownership of the pilot plant was a major and *positive investment* activity. The role of the pilot plant was necessary for improving major machinery concepts and related processes, further developing the existing equipment, confidential customer trials, and reference value. For the forest unit, again, the extension of the pilot plant was a very significant and *negative* investment activity, just like in 1983. This is evident, as the pilot plant's initial investments and annual employee's costs were expensive. Also, its annual operational results were never profitable. Moreover, Tampella already had a constant liquidity issue.

Tampella's management decided to improve internal quality and profitability without any more significant investments during the years 1984 to 1989.

645 Tampella Ab board meeting memo 1979 No. 3, Tampella Annual Report 1979.
646 Tampella Annual Report 1980.
647 Tampella Annual Report 1981.
648 *Paper and Timber Journal* 1983 No. 5, Tampella Annual Report 1983.
649 Tampella Annual Report 1983, *Paper and Timber* 1983 No. 8, p. 439.
650 *Paper and Timber Journal* 1988, No. 5.

The target was to utilise existing production capacity in a good market situation fully, even though board prices continued to decline, as presented in Figure 28.

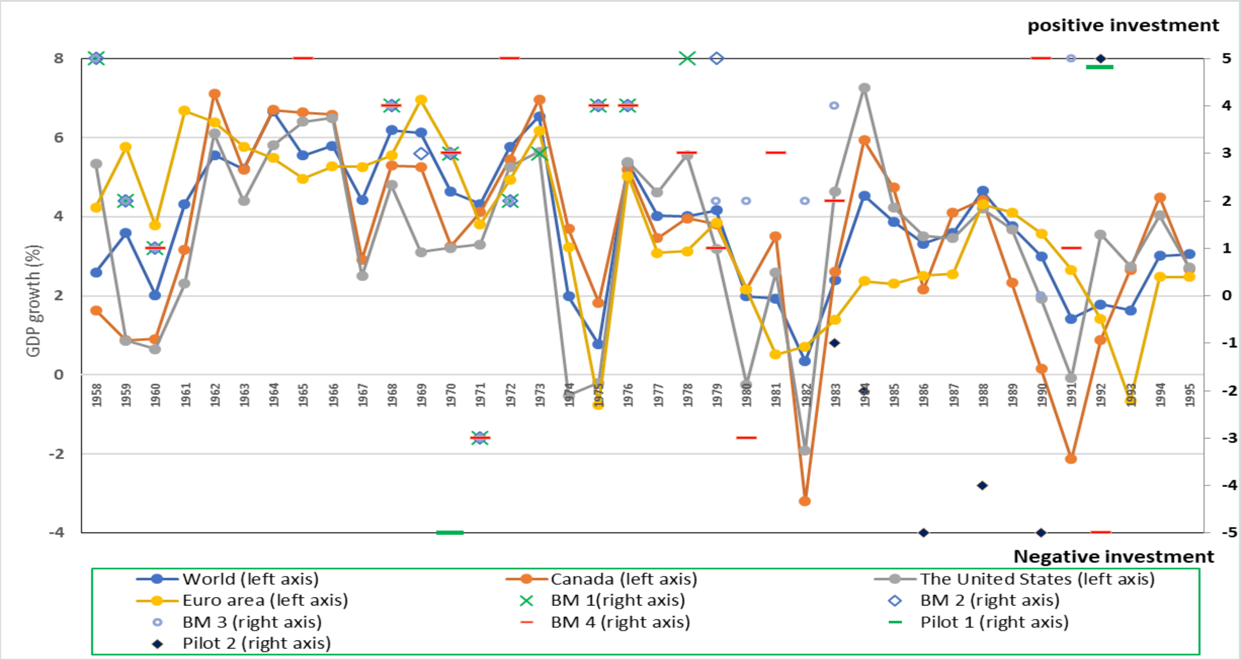
Figure 28 Other paper and paperboard, and wrapping and packaging board price index per million ton (Def. 1995) development and Inkeroinen board investments between 1958 and 1995.



Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: Price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

It is also worth noting that even though the European economy had already begun to rise after two recessions between 1980 and 1983 and between 1984 and 1987, the gross domestic product of the economy in question improved very moderately, as presented in Figure 29.

Figure 29 World Gross Domestic Product growth and Inkeroinen's investments from 1958 to 1995.



Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

The downturn in demand began in 1990, and as a result, BM 4 had ten weeks of shutdown due to a lack of the orders in 1991.[651] The operating rate was as low as 80 per cent. Inkeroinen's BM 3 stopped after trade with the Soviet Union practically ended.[652] It was a significant *positive* divestment activity. During the same year, BM 4 made a significant and large *positive investment* activity worth FMK 392.5 million. The target was to improve the quality, capacity, and value by their three folding boxboard machines. The brand names were double-coated Tamwhite and Tambrite, and single-coated Tamfold.[653]

Enso-Gutzeit's ownership meant considerable changes in mill management and, subsequently, in performance. In 1994, BM 4 produced 155,580 t/a, which was 12 per cent more than the previous year and represented a new production record. Net sales grew by 18 per cent from the previous year. Enso-Gutzeit integrated all packaging businesses and units into Pakenso Oy, including liquid packaging board in 1993, transformed product strategies, and shifted its regional focus from Europe to the potential of Asia.[654]

651 Tampella Annual Report 1991.
652 *Paper and Timber Journal* 1991, No. 73/4, p. 294.
653 *Paper and Timber Journal* 1991, No. 73/4, pp. 294–296.
654 Enso-Gutzeit Annual Reports 1993 and 1994. See Ahvenainen 1992, and Ahvenainen for Enso-Gutzeit Oy materials in central government archive, Elka Mikkeli.

Inkeroinen's board mill allocated between 63.6 to 71.4 per cent of its activities in the years of global financial downturns, as presented in Table 10. The performance of BM 3 was good, as 71.4 per cent of its technology investment activities were utilised during the global financial crises. The individual investment activities were distributed evenly, so that those accounted for between 3 to 13 per cent of all economic investments between 1958 and 1995. This result indicates first that the board machines' order backlog was good during the financial downturn in the years 1960 and 1981, when minor investments took place. As a consequence, some quantity of production was lost due to the investment's shutdowns. Second, it indicates an excellent performance from the perspective of investment timing, as the board machine's investments took place in 1959, 1969, 1970, 1971, 1975, 1978, 1980, 1982, 1983, 1990 and 1991. This result reflects that the timing of the economic downturns was not an essential variable for the investment decisions of Inkeroinen's machines one and two. However, the timing was considerably more frequent in the investments or operational performance activities at BM 3 and BM 4. In the Inkeroinen production unit, the average investment timing accounted for 67.2 per cent, as the average of the other production units accounted for 55.5 per cent, as presented in Table 10.

Table 10 Table 10. Inkeroinen's investments during the economic downturns measured by GDP.[655]

Years of economic crises				Investments							% of all Investments
World	USA	Canada	Euro	BM1	BM 2	BM3	BM4	Pilot 1	Pilot 2	Sum	(total 58)
1958		1958		1	1	1				3	8
	1959	1959		1	1	1				3	8
1960	1960	1960		1	1	1	1			4	10
1967	1967	1967								0	0
	1969				1					1	3
1970	1970	1970		1	1	1	1	1		5	13
1971	1971		1971	1	1	1	1			4	10
1974	1974									0	0
1975	1975		1975	1	1	1	1			4	10
			1977							0	0
			1978	1			1			2	5
1980	1980	1980	1980			1	1			2	5
1981	1981		1981				1			1	3
1982	1982	1982	1982			1				1	3
			1983			1	1		1	3	8
		1986							1	1	3
	1990	1990					1		1	2	5
1991	1991	1991	1991			1	1			2	5
1992			1992				1			1	3
1993			1993							0	0
				7	7	10	11	1	3	39	100.0
All machine line investments				11	11	14	16	1	5	58	
% of recession timing investments				**63.6**	**63.6**	**71.4**	**68.8**	**100.0**	**60.0**	**67.2**	

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995.

Most of the Inkeroinen's investments were *positive* activities, which is an excellent result. However, Inkeroinen was unsuccessful in terms of the optimum investment timing, as presented in Table 11. This is evident, first, as 79.3 per cent of all its investments were *positive*, and 20.3 per cent were *negative*. Second, 48.3 per cent of Inkeroinen's investments or operational performance activities took place in a good market situation, and 51.7 per cent took place in a weak market situation. Third, 29.3 per cent of Inkeroinen's *positive investment*s or operational performance activities took place in a weak market situation.

The market price did not affect Inkeroinen's investment activities: 98.3 per cent of the investment activities took place at higher than 800 USD/mt (def. 1995) prices of the world's other paper and paperboard, and 100 per cent of the investment activities took place at higher than Finnish producers' prices of the other paper and paperboard; 84.5 per cent of the investment activities took place at higher than 800 USD/mt (def. 1995) prices of the world's wrapping and packaging prices, and 89.7 per cent of the investment activities took place at higher than Finnish producers' prices of wrapping and packaging, as presented in Table 11.

655 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. The aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

Table 11 Statistics of Inkeroinen mill's *positive investment*s and *negative* markets during the years 1958–1995.

	Investments of Inkeroinen (pcs)			Investments of Inkeroinen (%)		
	all	**positive**	**negative**	**all**	**positive**	**negative**
BM1	11	10	1	19.0	90.9	9.1
BM2	11	10	1	19.0	90.9	9.1
BM3	14	13	1	24.1	92.9	7.1
BM4	16	13	3	27.6	81.3	18.8
Pilot 1	1	0	1	1.7	0.0	100.0
Pilot 2	5	0	5	8.6	0.0	100.0
Total	**58**	46	12	100.0	**79.3**	**20.7**
		Market status (pcs)			**market status (%)**	
	all	**good**	**weak**		**good**	**weak**
BM1	11	6	5	19.0	54.5	45.5
BM2	11	6	5	19.0	54.5	45.5
BM3	14	7	7	24.1	50.0	50.0
BM4	16	9	7	27.6	56.3	43.8
Pilot 1	1	0	1	1.7	0.0	100.0
Pilot 2	5	0	5	8.6	0.0	100.0
Total	**58**	28	30	100.0	48.3	51.7
		Positive Investment activity and negative market status				
	all	**(pcs)**			**(%)**	
BM1	11	4			**36.4**	
BM2	11	3			**27.3**	
BM3	14	5			**35.7**	
BM4	16	5			**31.3**	
Pilot 1	1	0			**0.0**	
Pilot 2	5	0			**0.0**	
Total	**58**	17			**29.3**	
Investments vs world prices of other paper and paperboard (usd/mt) and (%)						
	all	**< 800**	**> 800**	**all**	**< 800**	**> 800**
BM1	11		11	19.0		100.0
BM2	11		11	19.0		100.0
BM3	14		14	24.1		100.0
BM4	16		16	27.6		100.0
Pilot 1	1		1	1.7		100.0
Pilot 2	5	1	4	8.6		80.0
Total	**58**	1	57	100.0	1.7	98.3
Investments vs Finland prices of other paper and paperboard (usd/mt) and (%)						
	all	**< 800**	**> 800**		**< 800**	**> 800**
BM1	11		11	19.0		100.0
BM2	11		11	19.0		100.0
BM3	14		14	24.1		100.0
BM4	16		16	27.6		100.0
Pilot 1	1		1	1.7		100.0
Pilot 2	5		5	8.6		100.0
Total	**58**		58	100.0		100.0
Investments vs world Wrapping paper and packaging prices (usd/mt) and (%)						
	all	**< 800**	**> 800**		**< 800**	**> 800**
BM1	11	0	11	19.0	0.0	100.0
BM2	11	0	11	19.0	0.0	100.0
BM3	14	2	12	24.1	14.3	85.7
BM4	16	3	13	27.6	18.8	81.3
Pilot 1	1	0	1	1.7	0.0	100.0
Pilot 2	5	4	1	8.6	80.0	20.0
Total	**58**	9	49	100.0	15.5	84.5
Investments vs Finland Wrapping paper and packaging prices (usd/mt) and (%)						
	all	**< 800**	**> 800**		**< 800**	**> 800**
BM1	11	0	11	19.0	0.0	100.0
BM2	11	0	11	19.0	0.0	100.0
BM3	14	2	12	24.1	14.3	85.7
BM4	16	1	15	27.6	6.3	93.8
Pilot 1	1	0	1	1.7	0.0	100.0
Pilot 2	5	3	2	8.6	60.0	40.0
Total	**58**	6	52	100.0	10.3	89.7

Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.3.4 International transactions by the machinery workshop

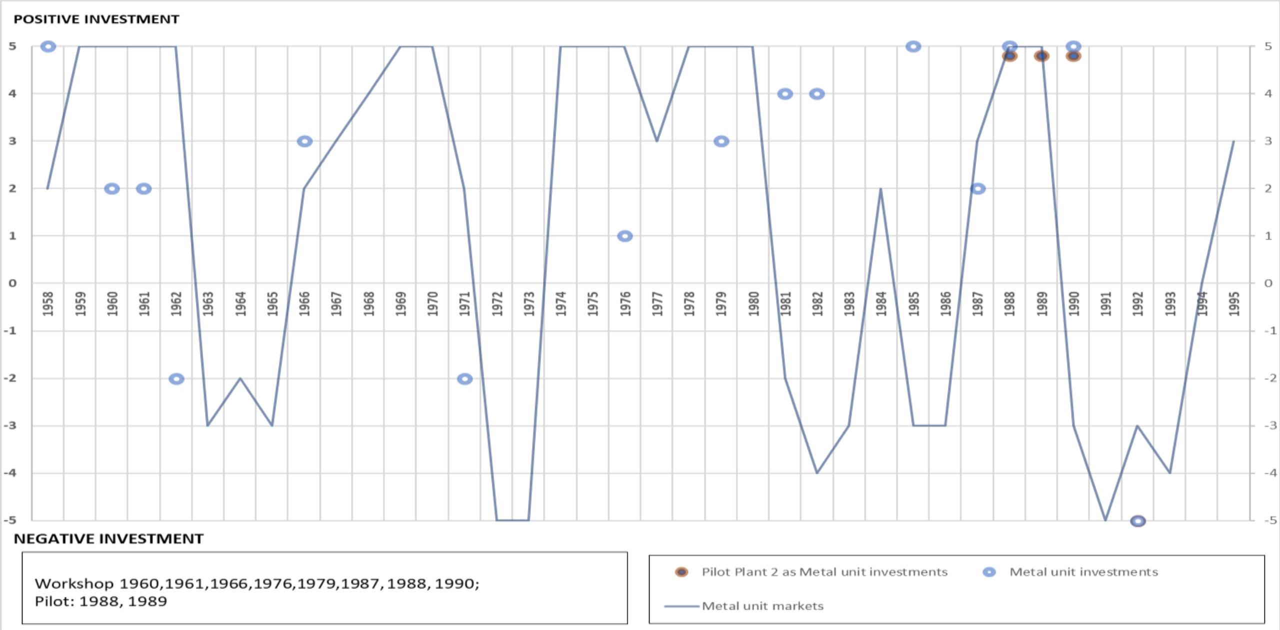
This section analyses the timing of Tampella's machinery workshop investments and operational performance activities in relation to the board grade's market demand and product prices, financial crises, production volumes and quality of packaging board grades. It should be noted that the optimum timing of the machinery workshop and its internal capital investments should be made in the forest industry's good market, as the forest industry maximises capacity and minimises downtime then. In practice, this is a problem for a diversified group, as other paper and board manufacturers also want to keep their investment shut down during periods of poor market demand. Thus, the workshop was in a position where it should have been possible to estimate the value of external orders concerning the company's internal trading, the so-called transfer prices.

The history of Tampella's machinery workshop began in 1856 when Gustaf August Wasastjerna purchased the blast furnace, foundry and sawmill located on the coastline of Tammerkoski.[656] Already in 1897, Tampella's machinery workshop products were the wood industry's machines and types of equipment, the steam boilers and the water turbines. From the 1930s, plywood presses, recovery boilers and debarking drums were also exported.[657] In 1959, the machinery workshop had a full operation rate based on excellent business cycles and successful marketing. This indicates that already in 1959, the machinery workshop's management was market-orientated. The entire manufacturing capacity was in use, deliveries were exported to 22 different countries, and 80 per cent of the total workshop production was exported in 1961.[658] For example, Russians were the largest customer of the wood industry machinery, and they ordered both semi-cellulose and board mill types of equipment from Tampella.[659]

In 1960, the company invested heavily in its machinery technology, and the following year, the expansion of the plate workshop and the foundry of Messukylä were completed.[660] Good demand continued until 1962, when the exports accounted for 80 per cent of the total manufacturing volume. Between 1963 to 1965, the order backlog of the workshop declined significantly compared to the previous year, as presented in Figure 30.

656 See Bonsdorff 1956.
657 Sainio 2003, p. 8.
658 Tampella Annual Reports 1959 and 1962.
659 Tampella Annual Reports 1959 and 1960.
660 Tampella Annual Report 1961.

Figure 30 Tampella metal unit's investment activities and machinery market demand between 1958 and 1995.



Source: Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

The production hours decreased by 20 per cent from the previous year, causing a shorter working week in the foundry, model and plate departments. In 1965, the project of Inkeroinen's BM 4 was a significant workshop employer. The installation work at customer mills accounted for 19 per cent of total production hours.[661] Overall, the 1960s comprised a decade of good demand. The deliveries included major wood industry orders for both external customers and Tampella's own internal customers. The deliveries were, for example, the Heinola Fluting mill, five complete sets of mill equipment (including a 280,000 t/a kraft-liner machine to the Soviet Union), Pineville Kraft Corporation's 225 000 t/a kraft-liner machine, Savon Sellu Oy's liner machine, wood-grinding equipment sent to Norway and Italy, a new kind of plate refiners, Owens-Illinois Inc.'s kraft-liner machine, Boise Cascade Corporation's swing kraft-liner and sack machine, Eurocan Pulp and Paper Ltd. Kitimat's kraft-liner machine, three big liner board machines, and a folding boxboard machine for the Soviet Union and Serlachius Tako.[662]

In 1969, the workshop's order books reached a record high. The principal received orders were Kemi Oy's 18,000 ton/month kraft-liner machine, Kitimat's two high-speed paper machine and Tampella non-woven mill in Tampere.[663] In

661 Tampella Annual Report 1965.
662 *Talouselämä Journal* 25.9.1969 No. 39, *Talouselämä Journal* 4.12.1969 No. 49, *Paper and Timber Journal* 1969, No. 6, Tampella Annual Reports in 1965–1967.
663 *Paper and Timber Journal* 1969 No. 6, *Talouselämä Journal* 25.6.1969.

1966, the Tampella metal unit made remarkable *positive investment* activities in the extension of the core workshops and Messukylä's department and acquired two cupola furnaces and three electric ovens for the foundry. Extending operations had been sensible due to good market conditions.

In the machinery workshop, the first factor limiting the portfolio development of technology was the centralisation of technology, mainly for paperboard and pulp types of equipment. In 1967, Tampella tried to change its profile so that it was not just a board machine manufacturer. After two years, the signed TVW agreement restored the situation to the same as before 1967.[664] This is evident in that the customer orders of the machinery workshop included machines of semi-cellulose, board, fluting, kraft-liner, liner, sack paper, wood-grinding types of equipment, plate refiners, non-woven machines, recovery and power boilers, recycled fibre plants, and pressure groundwood types of equipment. The TVW agreement was broken due to the merger of Valmet and Wärtsilä in 1986.[665] In early 1987, Tampella decided to start manufacturing paper machines.[666] It was as late as in 1989 when machinery workshop expanded their references, including for paper machines for SC grades and self-copy grades and coating units.[667]

At the end of 1970, the order backlog of the machinery workshop declined and demand weakened, so that a downturn in markets took place between 1972 to 1973.[668] For instance, the foundry went to a three-day working week in 1972. Since the 1950s, the company had been involved in the financing or construction of workers' single-family houses and apartment blocks. Consequently, the company owned 1,114 houses in 1971.[669] It was a significant negative investment activity, as the workshop's main problem was the company's debt, primarily due to their customers' financing arrangements. Between 1974 and 1980, the order backlog of the machinery workshop was excellent; for example, in 1978, the order backlog was equivalent to the production capacity, and its value was FIM 437 million.[670] In 1979, the machinery workshop continued to acquire machine tools, and in particular, the capacity of the hydraulic drilling machines and the pressure grinders increased.[671] These were very significant *positive investment* activities, as they secured the metal workshop unit's profitable operations in the future as well.

The significant orders in the 1970s were two board machines with stock preparation equipment to Romania, a wet-end delivery to Venezuela, modernisation of the Fiskeby board machine in Sweden, a cylindrical board machine to Switzerland, a recovery boiler for Yhtyneet Paperitehtaat Oy, board machine modernisation for Enso-Gutzeit, a board machine for the USA, four

664 Toivanen 2005, p. 91, Skippari 2005, pp. 130, 260, Paranko 2012, p. 175.
665 Toivanen 2005, p. 91.
666 Laurila 1997, p. 224.
667 Tampella Annual Reports 1987 and 1988.
668 Tampella Annual Reports 1972 and 1973.
669 Tampella Annual Reports 1965 and 1971.
670 Tampella Annual Report 1978.
671 Tampella Annual Report 1979.

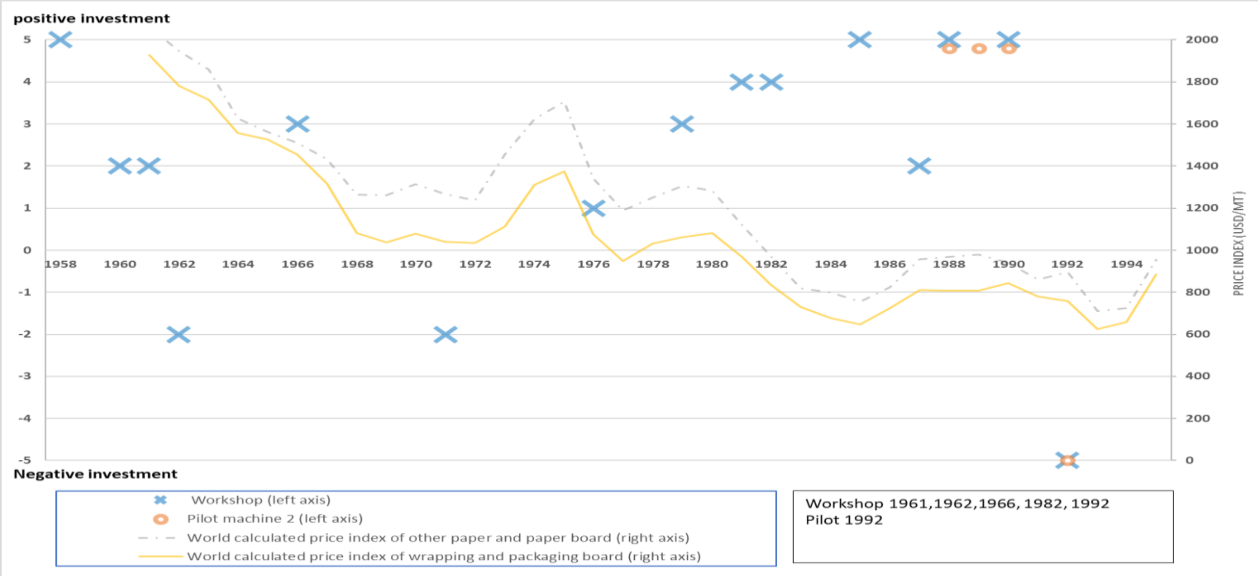
board machine rebuilds for the Soviet Union and two board machines sent to Sweden for Fors and SCA.[672] In 1979, Tampella's metal unit's workshop was also an essential machine and equipment supplier for Tampella's forest unit's investment projects. The most significant investments were Anjalankoski's PM 2 (FMK 20.8 million), Heinola's automatic roll-packaging line (FMK 4.3 million), a rebuild of the recovery boiler FMK (12.8 million), Inkeroinen's board machine's process computer system (FMK 3.7 million), a rebuild of Inkeroinen BM 4's forming section and a new brush calender unit (FMK 32.2 million), and Tolkkinen's new steam power plant.[673]

The years 1980–86 were challenging for the workshop unit. From 1981 to 1983, the order backlog of the workshop was weak, excluding the boiler orders and Tamrock's orders in 1980–81. There were no board machine orders in 1981–82 at all. As a consequence, the production operation rate was low.[674] In 1984, a new board machine order came from America, but in the coming year, only the Tamrock unit had a full employment situation.[675] In 1986, the Soviet Union trade declined, and as a result, the order backlog declined and reduced the financial results. Since 1987, the order backlog improved, especially in the pulp and paper business, and as a consequence, all workshop units' production capacity was full.[676]

In 1981–1987, the expansions of the metal unit's workshop were defined as significant and *positive investment* activities, including the spare parts business, which supported the sales of the main types of equipment and stabilised the impact of annual cyclical cash flow fluctuations. Year after year, the mining business was one of Tampella's most profitable businesses. Examples of mining unit expansions were Tamrock Myllypuro's mill, Tampere's heat treatment, hard chrome-plate function, the machine tools in the pulp and paper functions, diversification of the machines in the Tampere units, Tamrock's new spare parts centre and Tamrock Trackdrill's plant expansion.[677] From the workshop perspective, Inkeroinen's new pilot paper machine (FIM 100 million) in 1988 and in the following year a power plant investment in the development centre (FIM 75 million) were very significant and extensive *positive activities*.[678] These indicate the management's market-orientated attitude again, because the pilot plant served their research and development operations and the confidential trials of the workshop's customers. It was an essential part of the image of the machinery workshop, as presented in Figure 31.

672 Oy Tampella Ab board meeting memo 1979, No. 3.
673 Tampella PTS-meeting (long-term plan) memo for 1980–84, 27.6.1979, Tampella Annual Report 1979.
674 Tampella Annual Reports from 1981 to 1983.
675 Tampella Annual Report 1984.
676 Tampella Annual Report 1987.
677 Tampella Annual Report 1987.
678 Tampella Annual Report 1988, Nykänen 2018, p. 55.

Figure 31 Machinery workshop's investments and other paper and paperboard and wrapping and packaging board calculated price index per million ton (Def. 1995) development between 1958 and 1995.



Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org. from 1958 to 1995. Note 1: Price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

The most significant customer deliveries in the 1980s were the equipment and the process deliveries of Inkeroinen's AP-83 project, Tolkkinen's machine tools for open quarry mining types of equipment, the waste paper de-inking plant to Oy Nokia Ab, Mead Corporation's recovery boiler (FIM 200 million),[679] Kitimat's board machine rebuild (FIM 84 million),[680] a 4-ply board machine with sheet cutter to China (FIM 100 million),[681] Tampella Carcano's fine paper machine rebuild (FIM 75 million),[682] Kymi 7's rebuild of a fine paper machine, a board machine to the Far East, a boiler to Haapavesi, pressure groundwood equipment to Scotland, Heinola Fluting's board machine and semi-cellulose mill rebuilds (FIM 300 million),[683] a folding boxboard machine to Canada without coating units (FIM 150 million),[684] St Mary's Paper Inc. SC-grade paper machine to Canada, and a board machine rebuild to the USA (FIM 250 million).[685]

679 *Paper and Timber Journal* 1988, No. 5.
680 *Paper and Timber Journal* 1988, No. 5.
681 *Paper and Timber Journal* 1988, No. 5.
682 *Paper and Timber Journal* 1988, No. 5.
683 Tampella Annual Report 1988, Talouselämä Journal 1988, No. 4.
684 *Paper and Timber Journal* 1988, No. 4.
685 *Paper and Timber Journal* 1989, No. 3.

Between 1990 and 1993, Tampella Papertech (formerly the machinery workshop) and Tamrock's demand weakened due to the general market situation and the financial crises in 1991. The collapse of the mining machinery market was the result of a global downturn in mining operations and the dismantling of Soviet and other significant stockpiles.[686] The demand for Tampella Power's boilers also fell, but substitute turnover was generated from the maintenance and the spare parts businesses. In 1992, Tampella had already sold all other business units, excluding the metal units; the units left were Tamrock Oy[687] and Tampella Power Oy.[688,689]

Even in 1993, the demand for Tamrock and Tampella Power's products was weak, except in the Far East. Thus, the activities were focused on after-sales services to cover the low business of new capital investments.[690] In 1995, Tamrock's products had good demand, and Tampella Power also received several orders, but it was sold in March 1996 to Kvaerner Group at a price of FIM 110 million.[691] The reason for divestment of Tampella Power was due to loss-making operations.

In 1990, the machinery workshop's investments were Myllypuro's machines and tools, the completion of the pulp and paper machine research centre (FIM 25.4 million), completion of Tampella Carcano's development project (FIM 50 million), Tamrock Myllypuro's production and office facilities (FIM 84 million), Lapua's metal-manufacturing facilities (FIM 20 million) and Tampere's new development centre (FIM 75 million).[692]

The most significant customer deliveries between years 1990–95 were Inkeroinen's board machine (FIM 340 million),[693] Espanola's rebuild (FIM 249 million),[694] a 7.7-metre width liner machine to the USA, the rebuild of six-metre width board machine including in new headbox and drying section to Mexico,[695] a pressure groundwood-S-plant to Kymmene Oy Voikkaa, board machine rebuilds for Enso-Gutzeit Kaukopää and Tampella Forest Inkeroinen, a 100 per cent recycled fibre (RCF) liner machine for Inland Container Corporation in the USA, and a self-copy paper machine to the USA (FIM 20 million).[696]

The machinery workshop and its pilot plants allocated 46.7 to 50 per cent of the technology investment activities during global economic downturns, as presented in Table 12. The optimum timing of the machinery workshop to implement its investments was an upswing in the business cycle, as the forest

686 Tampella Annual Report 1991.
687 Tampella Annual Report 1993. Tampella owned 75 per cent and Sandvik AB owned 25 per cent of Tamrock Oy: the design, the manufacture and the market of the mining and drilling technology.
688 Tampella owned 60 per cent and L & C Steinmullaer GmbH owned 40 per cent of Tampella Power with its subsidiaries.
689 Tampella Annual Report 1993.
690 Tampella Annual Report 1993.
691 Toivanen 2005, p. 139, Tampella Annual Report 1995.
692 Tampella Annual Report 1990.
693 Tampella Annual Report 1990.
694 Tampella Annual Report 1991.
695 *Paper and Timber Journal* 1990, No. 72.
696 *Paper and Timber Journal* 1991, No. 73.

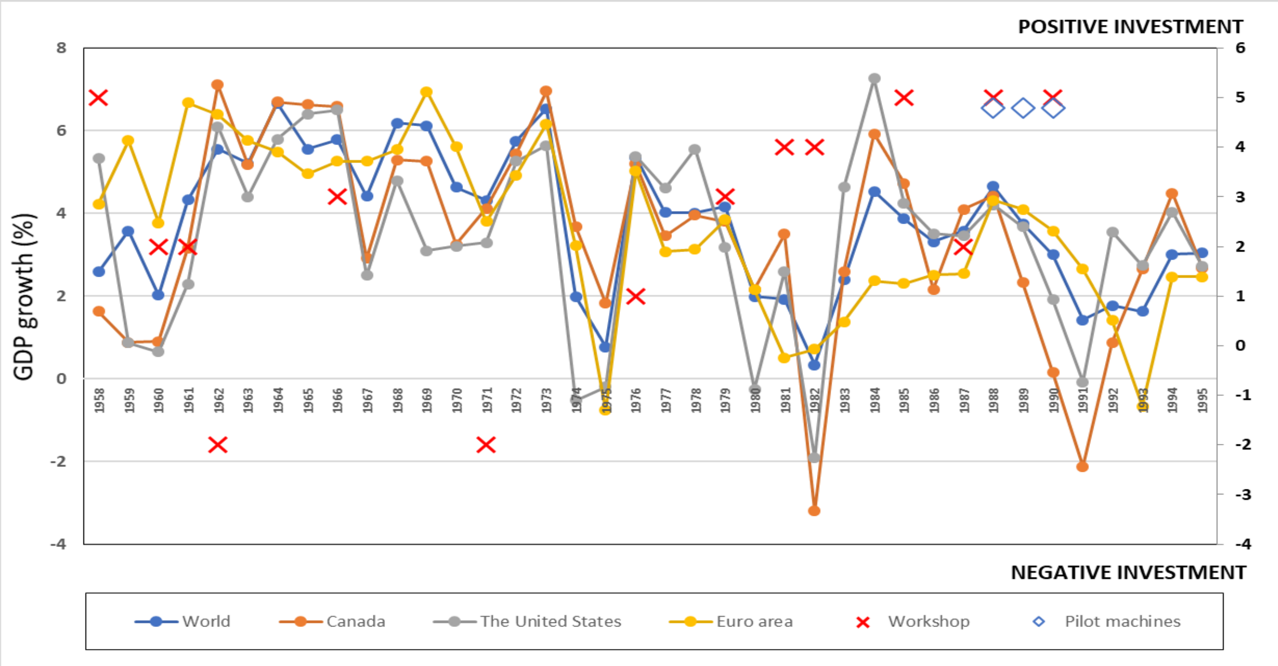
industry should take advantage of the economic downturn in implementing its investment activities. In the downturn, the machinery workshop should focus on forest industry investment projects. After the economic recessions of 1958 and 1960, the machinery workshop carried out its investment activities during the economic downturn in cycles of about 8 to 10 years, up to 1990. The individual investment activity accounted for between 11 to 22 per cent of investments during the financial crises between 1958 to 1995, as presented in Table 12. This result reflects that the timing of the economic downturns was not an essential variable for the investments of the machinery workshop. However, it is evident that the machinery workshop scheduled its investments during the economic downturn every eight to ten years throughout the review period, as presented in Figure 32.

Table 12 The workshop's investments during the economic downturns measured by GDP.

Years of economic crises				Investments			Ratio of all investment activities (%)
World	USA	Canada	Euro	Workshop	Pilot	Sum	(Total 19)
1958		1958		1		1	11
	1959	1959				0	0
1960	1960	1960		1		1	11
1967	1967	1967				0	0
	1969					0	0
1970	1970	1970				0	0
1971	1971		1971	1		1	11
1974	1974					0	0
1975	1975		1975			0	0
			1977			0	0
			1978			0	0
1980	1980	1980	1980			0	0
1981	1981		1981	1		1	11
1982	1982	1982	1982	1		1	11
			1983			0	0
		1986				0	0
	1990	1990		1	1	2	22
1991	1991	1991	1991			0	0
1992			1992	1	1	2	22
1993			1993			0	0
				7	2	9	100.0
All machine line investments				15	4	19	
% of recession timing investments				**46.7**	**50.0**	**47.4**	

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995.

Figure 32 World Gross Domestic Product growth and machinery workshop's investments between 1958 and 1995.



Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

In this section, I first define the performance of the investment or operational activity as either a *positive or negative* function. The definition is based on the calibration model, as presented in Annex One. Second, I define activity timing based on the good market situation or weak market situation. Third, I define the quantity of the optimum investment, which means the *positive investment* takes place at the same time as there exists a positive market situation. The decision-making challenge in the Tampella Corporation was that the optimum forest units' investment timing was when the forest industry's market demand was weak; the optimum machinery workshop's investment activity is the reverse.

Roughly 80 per cent of the machinery workshop's investments were *positive* and 20 per cent were *negative*. In the pilot plant, 75 per cent of its all investments activities were *positive*, and 25 per cent were *negative*. The machinery workshop's and the pilot plant's investments or operational performance activities accounted for 63.2 per cent in a good market situation and 36.8 per cent in a weak market situation. 52.6 per cent of the machinery workshop's and the pilot plant's *positive investments* or operational performance activities took place in a *positive* market situation. It is evident that, first, most of the machinery workshop's and pilot plant's investments were *positive investment activities*, which is an excellent result. However, the machinery workshop and the pilot plant were unsuccessful in terms of the optimum investment timing, as presented in Table 13.

The market price did not affect the workshop's *investment activities*. First, 94.7 per cent of the *investment activities* took place at higher than 800 USD/mt (def. 1995) prices of the world's and Finnish producers' other paper and paperboard. Second, 89.5 per cent of the *investment activities* took place at higher than 800 USD/mt (def. 1995) prices of world's wrapping and packaging, and 84.2 per cent of the *investment activities* took place at higher than 800 USD/mt (def. 1995) prices of the Finnish producers' wrapping and packaging, as presented in Table 13.

Table 13 The statistics of the machinery workshop's and the pilot plant's *positive* and *negative* investments and market demand from 1958 to 1995 (Def. 1995).

	Investments (pcs)			Investments (%)		
	all	positive	negative		positive	negative
Workshop	15	12	3		80.0	20.0
Pilot 1	4	3	1		75.0	25.0
Total	19	15	4		78.9	21.1
				market status (%)		
	all	good	weak		good	weak
Workshop	15	10	5		66.7	33.3
Pilot 1	4	2	2		50.0	50.0
Total	19	12	7		63.2	36.8
	Positive Investment activity and positive market status					
	all	(pcs)			(%)	
Workshop	15	8			53.3	
Pilot 1	4	2			50.0	
Total	19	10			52.6	
Investments vs world prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Workshop	15	1	14		6.7	93.3
Pilot 1	4	0	4		0.0	100.0
Total	19	1	18		5.3	94.7
Investments vs Finland prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Workshop	15	1	14		6.7	93.3
Pilot 1	4	0	4		0.0	100.0
Total	19	1	18		5.3	94.7
Investments vs world Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Workshop	15	2	13		13.3	86.7
Pilot 1	4	0	4		0.0	100.0
Total	19	2	17		10.5	89.5
Investments vs Finland Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Workshop	15	3	12		20.0	80.0
Pilot 1	4	0	4		0.0	100.0
Total	19	3	16		15.8	84.2

Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.3.5 A lesson about the sensitivity of the local market by Espanola

This section analyses the timing of Espanola's investments and operational performance activities in relation to the market demand, product prices, financial crises, production volumes and quality of packaging board grades. In the 1960s, in general, there was good demand for different board grades, and so a joint venture company called Capdevila Tambar S.A. was established with Hija de Capdevila Guarro in 1964.[697] The next year, the construction of a board mill near Barcelona began.[698] This investment activity is considered to be a significant *positive investment* activity, due to the investment being reasonable concerning the regional market potential and because it was established in the local market to improve product cost structure. It indicated Tampella's customer-orientated attitude. From the point of view of the market, however, the open questions are why Tampella made a joint venture when it was already an international board producer with a stable position, especially in the European market. From the point of view of technology, the width of the new board machine was only 3.9 metres. Did the own machinery workshop's skills limit the width? Thirdly, was there market demand to have higher value products than cartonboard? With low margin products, the temporal market crises had a stronger impact on the production unit's profitability.

From 1958 to 1969, despite periodic fluctuations in demand for the board market, the demand for corrugated boxes increased, as presented in Figure 33. Therefore, the investments made by Espanola were good concerning the market demand.

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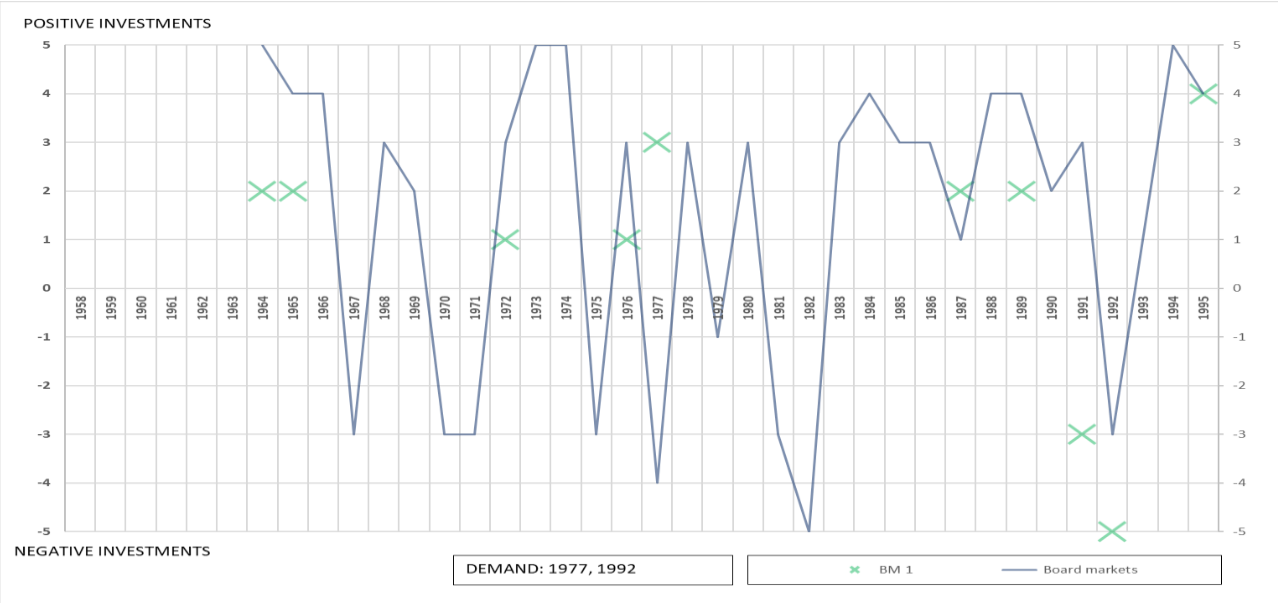
697 Tampella Annual Report 1964.

698 Gutiérrez-Poch 2012, pp. 220–222. See Gutiérrez-Poch 2018, pp. 161–186 for development of the papermaking industry and technology transfer in Spain.

Figure 33 Espanola's investment activities and the board market demand between 1958 and 1995.



Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

From 1972 to 1974, there was still good demand, but as a whole, the 1970s represented an era of dynamic markets, which challenged predictions. The market crises took place in 1970, 1975 and 1977. Although Espanola reached a production of 36,700 mt/a in 1970, the result was poor due to the weak demand for cartonboard during the next two years. Similarly, in 1975, production declined by 16 per cent due to the weakening market demand. Therefore, Tampella invested in quality improvements in Espanola. As a result, in 1977, a *positive investment* activity took place through the modification of the forming section to increase production capacity and to expand the product portfolio. Profitability declined significantly in 1979 due to overcapacity in cartonboard production and a financial crisis, which caused a 30–40 per cent reduction in prices, as presented in Figure 34.

Figure 34 Figure 34. Espanola's investment activities and the world price index per million ton of other paper and paperboard (Def. 1995), and the world's calculated price index per million ton of wrapping and packaging board (Def. 1995) during 1958 to 1995.

Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: Price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

During 1981 and 1982, the board market had a downward trend, and despite the years of record production in 1982–83, the result was weak or inadequate.[699] In 1985, Spain joined the EEC, and as a result, the competitive situation improved substantially through the gradual removal of protective duties and the change in taxation practice.[700] Espanola's management paid attention to the portfolio issue as late as 1986 and 1989. In 1986, the mill transformed from earlier cartonboard grades to the recycled- and groundwood-based folding boxboard. This transaction improved Espanola's turnover substantially.[701] Besides, there were *positive investments* to improve the mill's operations, such as a new gas turbine, waste heat boiler and sheet cutter, in 1987.[702] Two years later, the decision to modify the board machine took place. Its value was FMK 249 million. The construction began in December of the following year. Tampella Carcano from Italy supplied the major equipment.[703]

699 Tampella Annual Reports from 1981 to 1983.
700 Tampella Annual Report 1985.
701 Tampella Annual Reports 1986 and 1987.
702 Tampella Annual Report 1987.
703 Tampella Annual Report 1989.

This investment decision was significant, as it was essential to improve the board's quality in the ever more competitive market situation.[704] Demand weakened in 1990, and this continued until 1992. Espanola's portfolio reduced its competitiveness due to use of mechanical pulp instead of 100 per cent recycled fibre.[705] As a consequence, profitability was reduced in 1992, as the internal cost structure did not sufficiently improve competitiveness. Furthermore, from a technology point of view, it was costly to design the process for 140,000 t/a operational process conditions, which exceeded the actual 115,000 t/a operational process conditions; the oversized process also caused board machine runnability problems. This is evident, as the long-standing quality problems continued still in 1992.[706] As a summary, this was a *negative* investment activity due to technological disadvantages.

In the spring of 1993, Enso-Gutzeit acquired Tampella Forest Oy and started to pay attention to Espanola's cost structure. As a result, under the new leadership, Enso Espanola S.A. hit a new production record of 121,727 t/a, which was 20 per cent more than the previous year.[707] The new owner transformed the Espanola mill to focus solely on the production of recycled-based board, and the production of folding boxboard was concentrated at Inkeroinen. The transformation was successful, and in 1995 Enso Espanola's net sales increased 42 per cent from the previous year, and the new production record was 12 per cent higher than the previous record.[708]

In Espanola, 50 per cent of the investment activities were implemented when the market price was low. Two-thirds of those activities occurred before the year 1978. In 1977, the timing of the investments in the market price perspective was excellent, because immediately the following year, the board prices started to increase. In any case, Espanola utilised the low board price period well (third best of Tampella's different production units). As a whole, I can conclude that the end products' price was not an essential factor for the investment decision-making in Espanola.

Furthermore, in Espanola, 30 per cent of the technology investment activities were allocated during the global financial downturns. The individual invest-

704 First, the competition is considered to have become more intense since 1980, as the market price of cardboard declined steadily until 1994, excluding the rise in prices in 1986 and 1987. (See Figure 33.) Secondly, the competition is considered to have tightened year after year due to the annual growth of the board production capacity. (See Figures 23 and 24.)

705 Tampella Annual Report 1987.

706 It is a technical fact that if processes or equipment are designed too big in relation to the optimum flow rates, it generates runnability problems and quality issues for the board machine, due to bacterial accumulation in the short circulation and increased instable process controls. Similarly, an incorrectly dimensioned process significantly limits the headbox's optimum operations. This results in poor cross-direction profiles and machine-direction pulsations and, as a consequence, the board quality suffers on a full-basis weight scale.

707 Enso-Gutzeit Annual Report 1994.

708 Enso-Gutzeit Annual Report 1995.

ment activity accounted for 33 per cent of Espanola's investments during the financial crises between 1958 and 1995, and two-thirds of those activities took place in 1991 and 1992, as presented in Table 14. This result makes evident that the timing of the economic crises was not an essential variable for the investment decisions of Espanola's production unit, as presented in Figure 35.

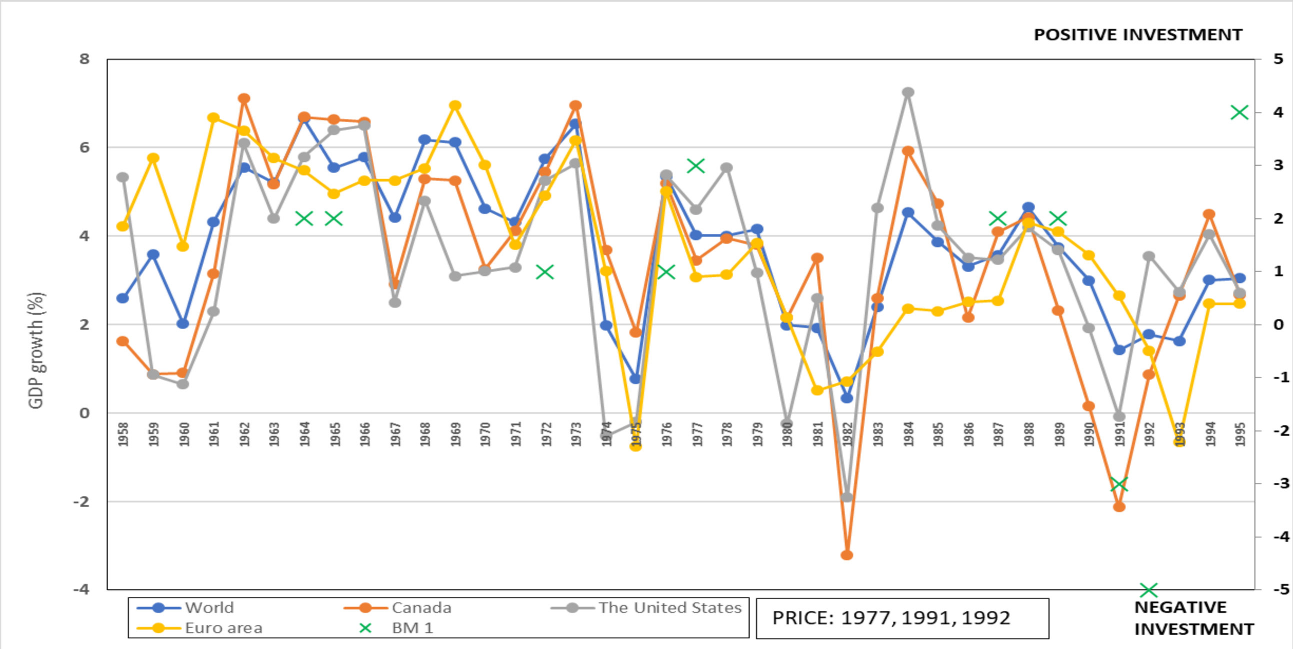
Table 14 Espanola's investments during the economic crises measured by GDP.[709]

Years of economic crises				Investments		% of all Investments
World	USA	Canada	Euro	BM1	Sum	(Total 10)
1958		1958			0	0
	1959	1959			0	0
1960	1960	1960			0	0
1967	1967	1967			0	0
	1969				0	0
1970	1970	1970			0	0
1971	1971		1971		0	0
1974	1974				0	0
1975	1975		1975		0	0
			1977	1	1	33
			1978		0	0
1980	1980	1980	1980		0	0
1981	1981		1981		0	0
1982	1982	1982	1982		0	0
			1983		0	0
		1986			0	0
	1990	1990			0	0
1991	1991	1991	1991	1	1	33
1992			1992	1	1	33
1993			1993		0	0
				3	**3**	100.0
All machine line investments				10	10	
% of recession timing investments				**30.0**	**30.0**	

Sources: Tampella Annual Reports from 1958 to 1995, http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960.

709 http://data.worldbank.org from 1961 to 1995: Definition for GDP: 'An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources."

Figure 35 World Gross Domestic Product growth, GDP[710] vs Espanola's investments from 1958 to 1995.



Sources: Tampella Annual Reports from 1958 to 1995, http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

80 per cent of Espanola's investments were *positive*, and 20 per cent were *negative*. Second, 80 per cent of Espanola's investments or operational performance activities took place in a good market situation, and 20 per cent took place in a weak market situation. Third, only 10 per cent of Espanola's *positive investment*s or operational performance activities took place in a weak market situation.[711] It is evident that, first, most of Espanola's investments were *positive*, which is an excellent result. However, secondly, Espanola was unsuccessful in terms of the optimum investment timing. In consequence, the mill lost plenty of production due to the investment's shutdowns, as presented in Table 15.

710 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

711 We define the performance of the investment or operational activity as either a positive or negative function. The definition is based on the calibration model, as presented in Annex One. Second, we define activity timing based on a good market situation or weak market situation. Third, we define the quantity of the optimum investment, which means the positive investment takes place at the same time as there exists a weak market situation

The world's and the Finnish producers' prices of packaging board in terms of other paper and paperboard were irrelevant to the investment activities or timing in the Espanola production unit, as 100 per cent of Espanola's investment activities were carried out at higher than 800 USD/mt (def. 1995) board prices. The world's and Finnish producers' prices of wrapping packaging board were irrelevant to the investment activities or timing in Espanola's production unit, as 80 and 90 per cent of Espanola's investment activities were carried out at higher than 800 USD/mt (def. 1995) board prices.

Table 15 Statistics of Espanola mill's *positive investment*s and *negative* markets between 1958 and 1995.

	Investments of Espanola (pcs)			Investments of Espanola (%)		
BM 1	all	positive	negative	all	positive	negative
	10	8	2		80.0	20.0
	Market status (pcs)			market status (%)		
	all	good	weak		good	weak
	10	8	2		80.0	20.0
	Positive Investment activity and negative market status					
	all	(pcs)			(%)	
	10	1			10.0	
Investments vs world prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800	all	< 800	> 800
	10	0	10		0.0	100.0
Investments vs Finland prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
	10	0	10		0.0	100.0
Investments vs world Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
	10	2	8		20.0	80.0
Investments vs Finland Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
	10	1	9		10.0	90.0

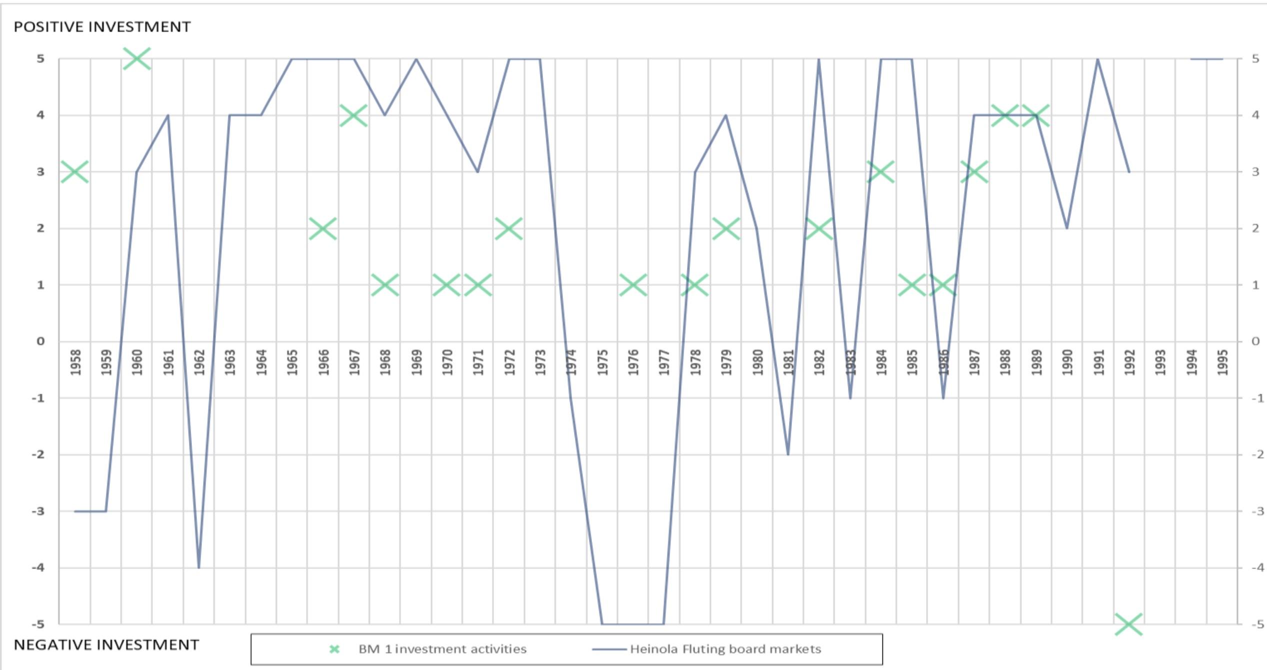
Sources: Tampella Annual Reports from 1958 to 1995, http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.3.6 Heinola Fluting's unsuccessful timing

This section analyses the timing of Heinola Fluting's investments and operational performance activities in relation to the market demand, product prices, financial downturns, production volumes and quality of packaging board grades. During the dynamic board market in 1958, the company bought a 120-hectare industrial site from the city of Heinola, established a new fluting board mill, and started to build employee apartments and block buildings in 1958.[712] The 90,000 t/a board machine used semi-cellulose pulp as its raw material.[713] The board machine start-up was problematic in December 1960, and the work continued the next year.[714] A very significant and extensive *positive investment* activity's cost estimate was 6,300 million old FMK.[715]

In 1966, the start-up of the kraft plant reduced fibre losses by half, making it a significant *positive investment* activity due to the high cost savings.[716] Despite the weakening of the financial downturn in Europe's large export markets, the demand for corrugated boxes clearly grew in 1967. Thus, Heinola's factory represented a significant *positive investment* activity that increased capacity by 30 per cent. In the following years, further *positive investment*s activities took place to improve the process and the quality of the final product, as presented in Figure 36. These investment activities included the Pandia cooking line of the semi-pulp mill, sludge treatment and a thickening pool.[717]

Figure 36 Heinola Fluting's investment activities and board market demand during the years 1958 to 1995.



Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on

712 Tampella Annual Report 1958.
713 Tampella Annual Report 1980.
714 Tampella Annual Report 1960.
715 *Paper and Timber Journal* 1968, No. 2, p. 82.
716 Tampella Annual Report 1966.
717 Tampella Annual Report 1968.

the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

At the beginning of 1970, the markets were challenging, especially in the EEC.[718] The following year, the management started to work to increase production capacity. In 1972, modifications worth FIM 6.322 million marks were executed.[719] The investment timing was excellent, as the following year saw higher demand than production capacity, and even the paper mill achieved a new production record. Unfortunately, there were already signs of weakening markets based on cyclical downturns. In October, the excellent order book changed, and within a few months, production shutdowns took place in magazine paper and fluting.[720]

In 1975, the price level of Heinola Fluting collapsed by 75 per cent from the year before, and between 1975 to 1977, the production operating rate was as low as 53–78 per cent. As a consequence, employee layoffs took place.[721] In 1978, the demand slowed after a prolonged recession and the mill achieved a 95 per cent operating rate, even though there was still overcapacity in the market. In the mid-1970s, the investments were significantly *positive activities*.[722]

In the early 1980s, the demand for corrugated board was satisfactory, and with almost a full operating rate, several production records were achieved.[723] In 1984, the capacity was 164,000 t/a.[724] The demand for corrugated board increased, and hence, prices also rose. The restrictions on Eastern exports and the advantage of Swedish competitors led to a decline in cartonboard orders.

There were plenty of significant *investment activities*, such as a new process computer, a boiler with increased drying capacity, dust burn and fluidised bed (FIM 299 million), and an information system for human resources and financial management.[725] The largest one was Heinola Fluting's rebuild, including a headbox, wire section, press, drying section drives, one drying group, and a winder. The project target was to increase the capacity of the semi-cellulose mill, a new recovery boiler, a more effective water treatment plant, board machine annual production capacity of 220,000 tons, and better quality of the corrugated board.[726]

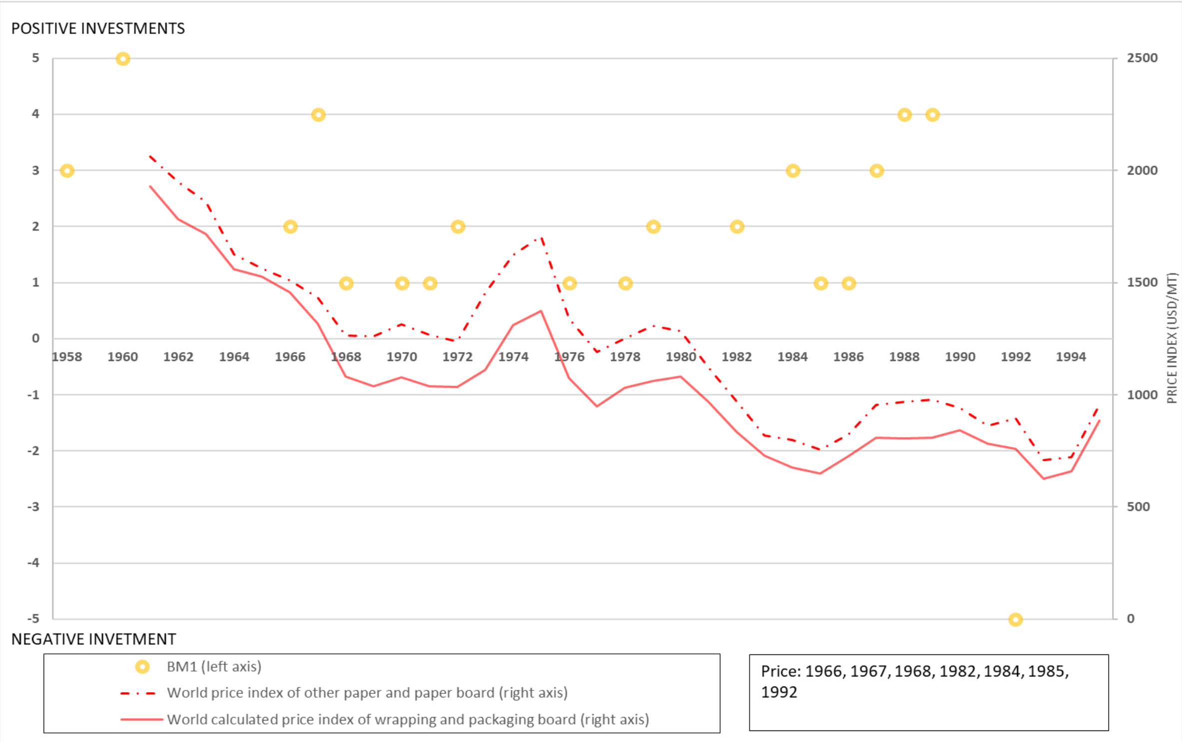
At the end of 1990, the forestry unit had a full rationalisation program due to weak demand, but there were no needs to make any shutdowns at the Heinola

718 Tampella Annual Report 1971.
719 Tampella Annual Report 1972.
720 Tampella Annual Report 1974.
721 Tampella Annual Reports from 1975 to 1977.
722 The board machine's efficiency investments included the moisture control of the DCS system and the recovery boiler's modification (FIM 12.8 million). The rebuild of the automatic reel wrapping line improved profitability (FIM 4.3 million).
723 Tampella Annual Report 1982.
724 Tampella Annual Report 1984.
725 Tampella Annual Report 1982.
726 Tampella Annual Report 1988, *Paper and Timber Journal* 1990, No. 1, pp. 10–12.

Fluting mill. In the spring of 1993, the owner changed to Enso-Gutzeit.[727] In 1993, the board mill reached a new production record of 230,000 tons/a. In a good market situation, the prices rose by 40 to 60 per cent, and the net sales increased by 72 per cent, up to FIM 458 million.[728] The following year, revenue grew by 28 per cent and product prices by 26 per cent. The mill operation rate remained at an excellent level, as it was 96 per cent.[729]

At Heinola fluting, 36.8 per cent of the investment activities were implemented when the market price was low. During low market price, all investment activities occurred at the end of the 1960s and in 1982, 1984 to 1985 and 1992. As a whole, we can conclude that the end products' price was not an essential factor for the investment decision-making at Heinola Fluting, as presented in Figure 37.

Figure 37 Heinola Fluting's investment activities and the world price index per million ton of other paper and paper board and the world calculated price index per million tonne of wrapping and packaging board (Def. 1995) between 1958 to 1995.



Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: Price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities

727 Enso-Gutzeit acquired all shares of Tampella Forest Oy and Tambox Europe Oy. From the beginning of the next year, the entire packaging and corrugated board businesses were merged into Pakenso Oy.
728 Enso-Gutzeit Annual Report 1994.
729 Enso-Gutzeit Annual Report 1995.

include investments and activities that are relevant to performance, whose details are presented in Annex 4.

The Heinola Fluting test-liner mill allocated 47.4 per cent of its activities during the global financial downturns. The individual investment activities were distributed evenly so that each individual investment accounted for 11 per cent of all investments between 1958 and 1995, as presented in Table 16. The average of the other Tampella business units accounted for 8.1 per cent. This result indicates first that the test-liner's order backlog was still good during the financial downturns in 1967, 1969, 1970, 1971, 1982, 1986 and 1992. Second, it indicates that the investments took place despite a strong order backlog, as in 1978, thus losing production due to the investment's shutdowns, as is presented in Figure 38.

Table 16 Heinola Fluting's investments during the economic crises measured by GDP.[730]

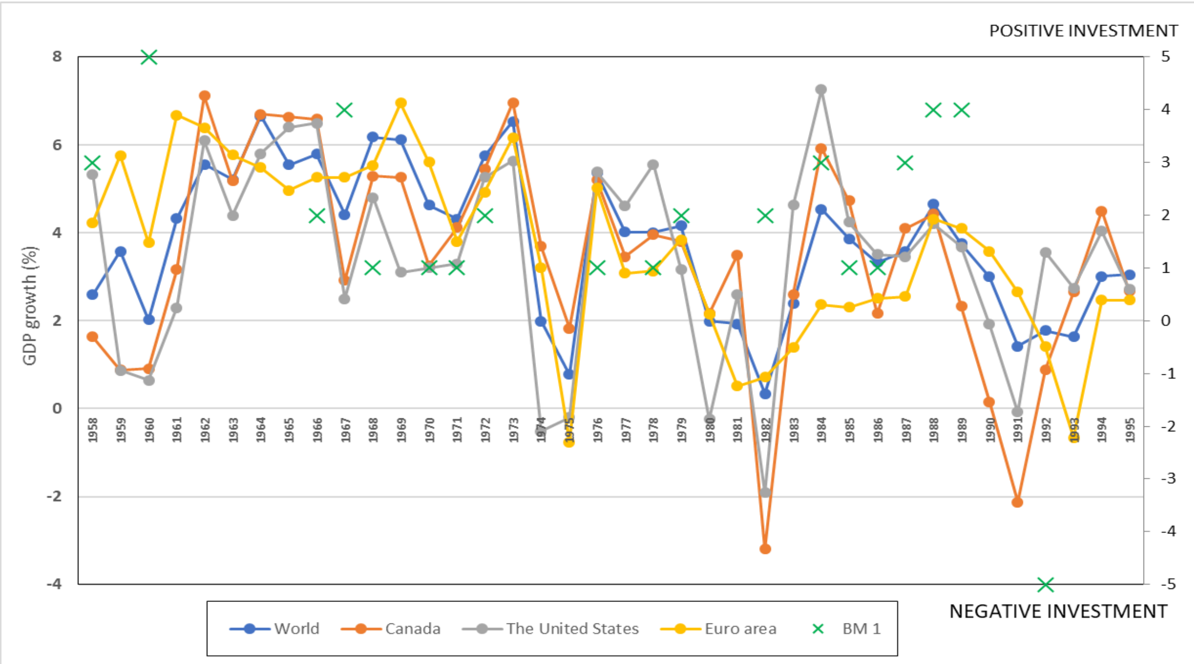
Years of economic crises				Investments		% of all Investments
World	USA	Canada	Euro	BM1	Sum	(Total 19)
1958		1958		1	1	11
	1959	1959			0	0
1960	1960	1960		1	1	11
1967	1967	1967		1	1	11
	1969				0	0
1970	1970	1970		1	1	11
1971	1971		1971	1	1	11
1974	1974				0	0
1975	1975		1975		0	0
			1977		0	0
			1978	1	1	11
1980	1980	1980	1980		0	0
1981	1981		1981		0	0
1982	1982	1982	1982	1	1	11
			1983		0	0
		1986		1	1	11
	1990	1990			0	0
1991	1991	1991	1991		0	0
1992			1992	1	1	11
1993			1993		0	0
				9	**9**	100.0
All machine line investments				19	19	
% of recession timing investments				**47.4**	**47.4**	

730 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995.

As the management of the Heinola Fluting mill steadily utilised the economic cycle to carry out the mill's investments throughout the period considered (i.e. between 1958 and 1995), on the other hand, it made sense from a cash flow management perspective.

Figure 38 World Gross Domestic Product growth, GDP[731] vs Heinola Fluting's investments from 1958 to 1995.



Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

First, at Heinola Fluting, 94.7 per cent of all its investments were *positive*, and only 5.3 per cent were *negative*.[732] Second, 84.2 per cent of all Heinola Fluting's invest-

731 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

732 In this section, we first define the performance of the investment or operational activity, as either a positive or a negative function. The definition is based on the calibration model, as presented in Annex One. Second, we define activity timing based on a good market situation or weak market situation. Third, we define the quantity of the optimum investment, which means that the positive investment takes place at the same time as there exists a weak market situation.

ments or operational performance activities took place in a good market situation, and 15.8 per cent took place in a weak market situation. Third, 15.8 per cent of all Heinola Fluting's *positive investment*s or operational performance activities took place in a weak market situation. It is evident that, first, most of Heinola Fluting's investments were *positive* activities. However, Heinola Fluting was unsuccessful in terms of optimum investment timing. As a consequence, they lost significant production due to the investment's shutdowns, as presented in Table 17.

The price of the other paper and paperboard products did not affect Heinola Fluting's investment activities. This is evident in that 89.5 per cent of the investment activities took place at higher than 800 USD/mt (def. 1995) prices of the world's other paper and paperboard, and 94.7 per cent of the investment activities took place at higher than the Finnish producers' prices of the other paper and paperboard. Furthermore, the price of the wrapping and packaging did affect Heinola Fluting's investment activities. This is evident in that 78.9 per cent of the investment activities took place at higher than 800 USD/mt (Def. 1995) prices of the world's wrapping and packaging prices, and 73.7 per cent of the investment activities took place at higher than the Finnish producers' prices of wrapping and packaging. The result obtained means first that after the investment shutdown, the profit margin per each produced carton tonne will substantially be reduced with the lower price level; the financial losses caused by 21.1–26.3 per cent of the investment activities are significantly higher than the 73.7–78.9 per cent of the investment activities. Secondly, it means that the payback time of the investment will be weakened.

Table 17 Table 17. Statistics of Heinola Fluting's *positive investments* and *negative* markets between 1958 and 1995.

BM 1	all	positive	negative	all	positive	negative
	19	18	1		94.7	5.3
	Market status (pcs)			market status (%)		
	all	good	weak		good	weak
	19	16	3		84.2	15.8
	Positive Investment activity and negative market status (pcs) and (%)					
	all	(pcs)			(%)	
	19	3			15.8	
Investments vs world prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800	all	< 800	> 800
	19	2	17		10.5	89.5
Investments vs Finland prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
	19	1	18		5.3	94.7
Investments vs world Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
	19	4	15		21.1	78.9
Investments vs Finland Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
	19	5	14		26.3	73.7

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.3.7 Political intervention and wise leadership: Cases of Eurocan and Pineville

Political interference in a company's operations is usually a challenging issue for a profitable business.[733] That is the reason why this section focuses on analysing the timing of Eurocan Kitimat's and Pineville's investments and operational performance activities in relation to the market demand, product prices, financial crises, production volumes and quality of packaging board grades. The market data means packaging board data, because Eurocan Kitimat's products were kraft-liner and sack paper.

Eurocan Pulp and Paper Ltd. Kitimat was a joint venture between a large number of large Finnish companies, including Enso-Gutzeit, Myllykoski

733 Baysinger and Woodman 1982, p. 40.

Papermill Oy, Kymi Oy, and Tampella.[734] Tampella was part of the group that signed the final agreement with the British Columbia authorities on Tree Farm license for 21 years in 1966.[735] Construction began in 1968 on cellulose, kraft paper, and test-liner machines. The primary machines and types of equipment were also partially ordered from Tampella. It was very important for the company to get a machinery reference from North America.[736] The significant and large *negative investment activities* were the start-ups and the related corrections of technological failures between 1969 and 1972. The modifications became very expensive also for Tampella; an additional investment value was FIM 53.1 million. In 1969, Tampella and Kymi owned 24.25 per cent, Enso-Gutzeit 48.5 per cent and the Canadians 3 per cent of the shares in Eurocan Pulp and Paper Ltd.[737] Besides, after the repair of the pulp mill, sawmill, and paper mill, the start-up was also delayed due to employee disorder in October 1972.[738] Although Tampella's workshop sold its products to Eurocan Kitimat, the only *positive activity* was the strategic decision to divest all the shares of Eurocan Pulp and Paper Kitimat to Kymi Corporation in March 1976.[739] The market for other paper and board grades remained good throughout the 1960s until 1974, as is presented in Figure 39. Throughout the 1960s, Canadian production was higher than that of Finnish production but lower than that of the Americans. Nevertheless, Eurocan Kitimat focused on the North American market.

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734 Näsi et al. 2001, p. 41, Tampella Annual Reports 1965, 1969, 1976, Oy Tampella AB Board meeting memo 8.1.1976 §3A, *Talouselämä Journal* 1969 Vol. 39. See Ahvenainen 2006, Elka, Mikkeli.

735 Tampella Annual Report 1966.

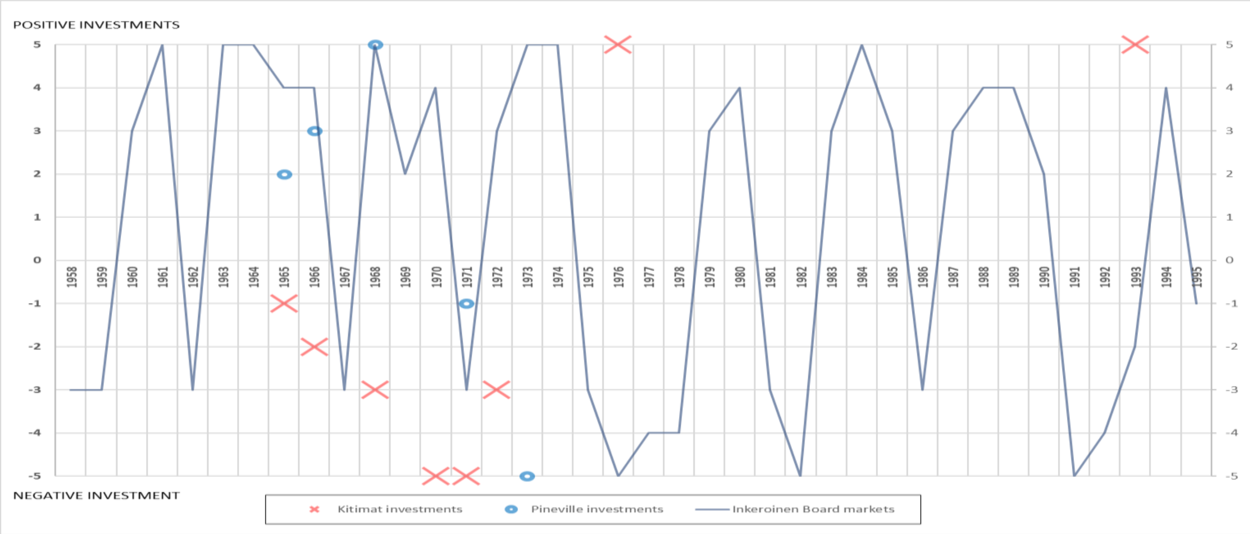
736 Hoffman 2019, p. 168. Tampella received a board machine order for the United States.

737 *Talouselämä* 25.9.1969, No. 39. Tampella Annual Report 1969.

738 Tampella Annual Report 1972.

739 Oy Tampella AB board meeting memo 8.1.1976 §3A.

Figure 39 Eurocan Pulp and Paper Ltd. Kitimat's and Pineville Kraft Corporation's investments activities and board market demand between 1958 and 1995.



Source: Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

According to Tampella's top management, the main reason for the Eurocan Kitimat project was the cost of kraft-liner production in Finland, as there existed uncertainties due to the availability and the price competition of domestic wood.[740] Another intended aim was to enter the difficult North American market.[741] There existed plenty of reasons which did not support Kitimat's investment decision in Canada. First of all, the local competition in newsprint and its price development did not support the newsprint investment decision, as Canadians had been the largest newsprint producers and the Americans the second largest, as is presented in Figure 17.[742] It is evident that during the 1960s, the newsprint prices were globally decreasing and only the Canadian producers made a price increase (50 USD/mt in 1969).[743] Besides, the Americans were the largest producer of the other paper and paperboard throughout the reference period, and the production of both packaging board grades was at least a third of the world production over the reference period, as presented in Tables 8 and 9. The U.S. production facilities were logistically close enough to respond to the increasing competition on that continent, and their production capacity was large enough to dominate the local Canadian price level.[744]

740 Ojala 2001, p. 41, Pakkanen 2011, p. 324. See Ahvenainen 1992.
741 Ojala 2001, p. 41.
742 Ahvenainen 1974, p. 4.
743 See Figure 25.
744 Kuhlberg 2012, pp. 117–120.

Figure 40 Eurocan Pulp and Paper Kitimat's and Pineville Kraft Corporation's investment activities and world price index (Def. 1995) per million ton of other paper and paperboard and world calculated price index per million ton (Def. 1995) of wrapping and packaging board during years 1958–1995.

Sources: Tampella Annual Reports from 1958 to 1995, http://www.fao.org from 1958 to 1995. Note 1: Price index is calculated by export value per export quantity (deflated 1995). Note 2: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

It is evident that Eurocan Kitimat had other higher-value options for the paper grade than kraft-liner and sack paper. From the portfolio management and the production flexibility's point of view, North America's printing and writing grades' price structure and Canada's equivalent local market would have sided with P&W-grades over newsprint, for example, because Canadians were the biggest newsprint producers. Furthermore, Tampella would have been capable of building a P&W-grade paper machine line through Eurocan Kitimat's joint venture with the support of other business associates, because, since 1968, Finnish producers produced more P&W grades than Canadian producers, as presented in Figure 18.

I can conclude from the Tampella Kitimat project that the actual local competition situation based on the demand of the alternative grades was not taken sufficiently into account – excluding newsprint – in the investment decision from Tampella's forest businesses' point of view. On the other hand, from Tampella's metal industries' point of view, Eurocan Kitimat's project had a *positive* impact, because part of the project's primary machines were ordered from Tampella, which created the needed board machine references in North America.

Tampella decided to also participate in the construction of a North American wood-processing plant together with Enso-Gutzeit Oy and the American

Bodcaw Company to secure available wood.[745] Consequently, they established a company called the Pineville Kraft Corporation in Pineville, Louisiana, in 1965; Tampella participated in a 20 per cent holding. The intention was that Tampella would supply the board machine for 225,000 tons/year. Delivery of this machine took place in 1968.[746]

The Pineville Kraft Corporation's joint venture activities were generally *positive*, as the investment project was implemented well. It is based on the fact that the project implementation was on schedule with successful start-up. It is evident as the construction work took place in 1966, the production was successfully in Autumn 1968, and the next year production was already 212 000 t/a.[747] It meant that Tampella's machinery workshop gained an important and highly successful reference for a 225,000 t/a kraft-liner machine on the American continent. The most important item was that Tampella got access to the North American market at very low risk by the joint venture. It was evident already in 1968 that the Pineville product market was half in the Americas and half in Europe.[748] The risks of the joint venture were minimised by the small production quantity of the plant. The initial investments were manageable, as Tampella's investment portion was only USD 3 million in USD 38 million transactions. Due to the aforementioned low investment costs, Tampella managed better in their continuous and serious cash flow challenges. From 1968 to 1973, the Pineville mill's performance was good, despite many weeks shutdown in 1971 caused by turbine damage and the following year's price regulation in the United States. In 1973, Tampella's management sold the holding to International Paper as the reference was no longer needed.

To summarise in the context of market demand, Tampella's Pineville investment project was a successful one as the mill unit was productive, located in the middle of the local market area, and reduced the risk of local and global market downturns by spreading half of their markets abroad. On the basis of these factual pieces of evidence, the sale of 20 per cent shares of Pineville ownership in 1973 represented a significant *negative activity*. The overall picture I have is that market demand did affect the investment activities, and the management took into consideration the local competition and the kraft-liner market situation in their strategic decision-making process. In general, Tampella's top management indicated a market orientation attitude in Pineville project.

In Eurocan Kitimat, 25 per cent technology investment activities and in Pineville 20 per cent of the technology investment activities were allocated during global financial downturns. There was no time cyclicality, as all investment during the financial crises took place in 1970 and 1971. These results show that the company's management did not utilise the timing of the financial crises in its investments, as presented in Table 18 and Figure 41.

745 Tampella Annual Report 1965.
746 Tampella Annual Report 1966.
747 Tampella Annual Report 1969.
748 Tampella Annual Report 1969.

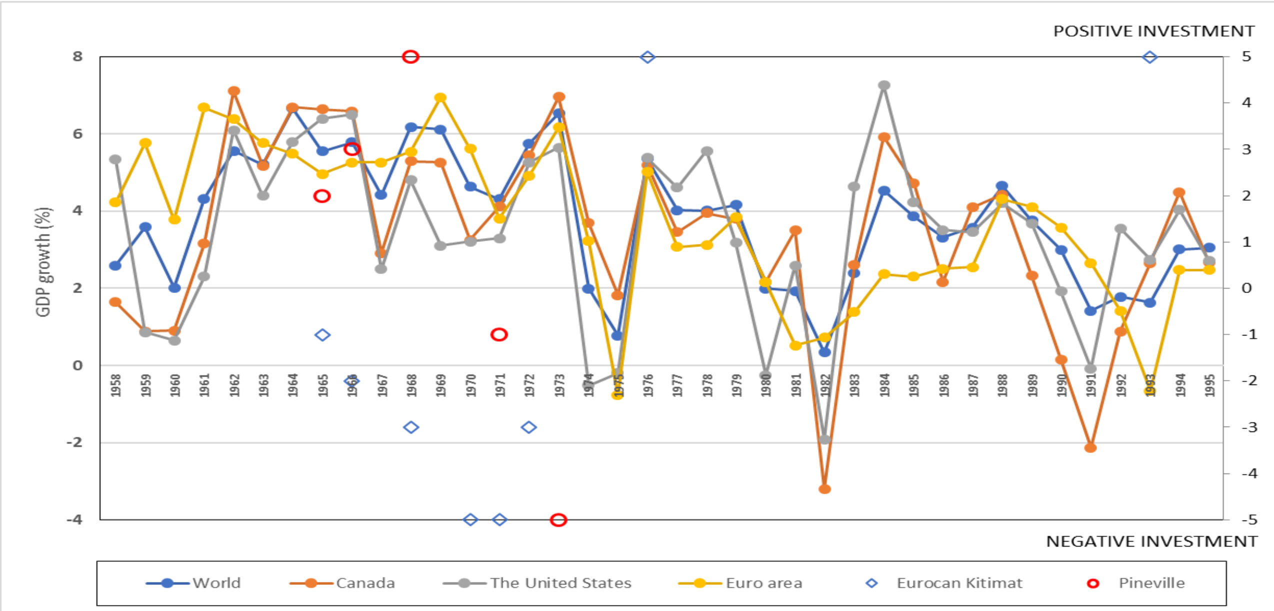
Table 18 Eurocan Pulp and Paper Kitimat's and Pineville Kraft Corporation's investments during the economic crises measured by GDP.[749]

Years of economic crises				Investments			% of all Investments
World	USA	Canada	Euro	Kitimat	Pineville	Sum	(Total 13)
1958		1958				0	0
	1959	1959				0	0
1960	1960	1960				0	0
1967	1967	1967				0	0
	1969					0	0
1970	1970	1970		1		1	33
1971	1971		1971	1	1	2	67
1974	1974					0	0
1975	1975		1975			0	0
			1977			0	0
			1978			0	0
1980	1980	1980	1980			0	0
1981	1981		1981			0	0
1982	1982	1982	1982			0	0
			1983			0	0
		1986				0	0
	1990	1990				0	0
1991	1991	1991	1991			0	0
1992			1992			0	0
1993			1993			0	0
				2	**1**	**3**	100.0
All machine line investments				7	5	13	
% of recession timing investments				**28.6**	**20.0**	**23.1**	

Sources: Tampella Annual Reports from 1958 to 1995, http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960.

749 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

Figure 41 World Gross Domestic Product growth, GDP[750] vs Eurocan Kitimat's and Pineville's investments from 1958 to 1995.



Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

14.3 per cent of Eurocan Kitimat's investments were *positive*, and 85.7 per cent were *negative*. 85.7 per cent of its related activities took place in a good market situation and 14.3 per cent in a weak market situation.[751] It is evident that most of Eurocan Kitimat's investments were *negative* activities, and it utilised economic downturns unsuccessfully in terms of the optimum investment timing, as presented in Table 19.

For Pineville Kraft Corporation, 60 per cent of all its investments activities were *positive* and 40 per cent were *negative*. Furthermore, one hundred per cent of Pineville's related activities took place in a good market situation and 0 per cent in a weak market situation. It is evident that a significant quantity of

750 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

751 We define the performance of the investment or operational activity as either a positive or a negative function. The definition is based on the calibration model, as presented in Annex One. Second, we define activity timing based on a good market situation or weak market situation. Third, we define the quantity of the optimum investment, which means the positive investment takes place at the same time as there exists a weak market situation.

Pineville's investments were *positive*, but unsuccessful in terms of the optimum investment timing, as presented in Table 19.

The market price did not affect Eurocan Kitimat's and Pineville's investment activities. One hundred per cent of the investment activities took place at higher than 800 USD/mt (Def. 1995) prices of the world's other paper and paperboard, and 100 per cent of the investment activities took place at higher than Finnish producers' prices of the other paper and paperboard, as presented in Table 19.

Table 19 Table 19. Statistics of Eurocan Pulp and Paper Kitimat's and the Pineville Kraft Corporation's mill's *negative* investments and *negative* markets during 1958–1995.

	Investments (pcs)			Investments (%)		
	all	positive	negative		positive	negative
Eurocan Kitimat	7	1	6		14.3	85.7
Pineville	5	3	2		60.0	40.0
Total	12	4	8		33.3	66.7
	Market status (pcs)			market status (%)		
	all	good	weak		good	weak
Eurocan Kitimat	7	6	1		85.7	14.3
Pineville	5	5	0		100.0	0.0
Total	12	11	1		91.7	8.3
	Positive Investment activity and negative market status (pcs) and (%)					
	all	(pcs)			(%)	
Eurocan Kitimat	7	1			14.3	
Pineville	5	0			0.0	
Total	12	1			8.3	
Investments vs world prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Eurocan Kitimat	7	0	7		0.0	100.0
Pineville	5	0	5		0.0	100.0
Total	12	0	12		0.0	100.0
Investments vs Finland prices of other paper and paperboard (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Eurocan Kitimat	7	0	7		0.0	100.0
Pineville	5	0	5		0.0	100.0
Total	12	0	12		0.0	100.0
Investments vs world Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Eurocan Kitimat	7	0	7		0.0	100.0
Pineville	5	0	5		0.0	100.0
Total	12	0	12		0.0	100.0
Investments vs Finland Wrapping paper and packaging prices (usd/mt) and (%)						
	all	< 800	> 800		< 800	> 800
Eurocan Kitimat	7	1	6		14.3	85.7
Pineville	5	1	4		20.0	80.0
Total	12	2	10		16.7	83.3

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: [-5 to +5] values, which are based on event analysis, define the positive or negative status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.3.8 The timing of the technology change

In the above, I analysed the time dependence of technology change at the plant level concerning market demand, market prices, financial downturns, production volumes, and production quality. Based on the above variables, the optimum investments or operational performance activities were determined. In the following, the plant-level data is summarised at the corporation level to analyse how these determinants affected the diversified conglomerate level. Thus, the question is, how did the timing of the technology change affect the conglomerate Tampella during the period?

Overall, Tampella's management did not take market demand into account in the timing of investment or operational performance activities in the different production units. Only 32 per cent of the technological activities of all production units took place during low market demand in the forest business and high demand in the machinery workshop business, as would have been the most optimal case. The Finnish local mill units took the market demand into account better than the international mill units during their investment activities, excluding Heinola Fluting, which was at the lower level of the international mill units. Anjalankoski's average was 44.1 per cent, Inkeroinen's was 34.5 per cent, Eurocan Kitimat's was 28.6 per cent, and both Espanola's and Pineville's were 20 per cent. The machinery workshop made 53.3 per cent of its internal investments during a period of good paper and board demand, as the total metal units accounted for 52.6 per cent. This means that about half of the machinery workshop's investments tied their resources to a situation in which the resources should have been available for the forest units' investment projects. This result indicates the lack of managerial competence to prioritise resources according to needs, even as the machinery workshop reorganised and centralised operations more often than other units, as presented in Table 20.[752] It is worth noting that the forest industry's prevailing practice of capital investment is to allocate investments in advance from one to three years, due to a shortage of internal and external resources, the delivery time of major equipment, funding arrangements, and the environmental and operating permits for the processes, as presented in Table 20.

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752 The machinery workshop accounted for 38.9 per cent of all investments or operational performance activities, which were based on the reshaping of organization structures, including resources. In this dissertation, the dynamic capability of the managerial competence's influence on the investments has been explained.

Table 20 The optimum capital investment activities concerning market demand, price, economic cycle, production volumes and production quality.

	Demand (pcs) (low)[1,4]	Price (pcs) (low)[1]	Economic cycle (pcs) (low)[1]	Production quantity (pcs) (local low)[1]	Production quality (pcs) (local low)[1]	Production total (pcs)[2]	Investment activities (pcs)[3]
Anjalankoski PM 1	5	6	9	9	6	15	14
Anjalankoski PM 2	6	3	6	9	6	15	13
Anjalankoski PM 3	4	2	5	7	2	9	7
Anjalankoski total	15	11	20	25	14	39	34
Inkeroinen BM 1	4	4	7	9	5	14	11
Inkeroinen BM 2	4	4	7	10	5	15	11
Inkeroinen BM 3	6	3	10	13	5	18	14
Inkeroinen BM 4	6	4	11	15	11	26	16
Inkeroinen Pilot machine 1	0	1	1	0	1	1	**1**
Inkeroinen Pilot machine 2	0	2	3	0	5	5	5
Inkeroinen total	20	18	39	47	32	79	58
Workshop4	8	5	7	17	3	20	15
Workshop R&D center and Pilot pm1	2	1	2	4	3	7	4
Workshop total	10	6	9	21	6	27	19
Espanola	2	5	3	9	5	14	10
Heinola Fluting	3	7	9	16	8	24	19
Eurocan Pulp and Paper Kitimat	2	3	2	8	5	13	7
Pineville Kraft Corporation	1	3	1	5	2	7	5
Total (pcs)	53	53	83	131	72	203	152

	Demand (%) (low)[1,4]	Price (%) (low)[1]	Economic cycle (%) (low)[1]	Production quantity (%) (local low)[1,2]	Production quality (%) (local low)[1,2]	Production total (%)[2]	Investment activities (%)[3]
Anjalankoski PM 1	35.7	42.9	64.3	60.0	40.0	7.4	9.2
Anjalankoski PM 2	46.2	23.1	46.2	60.0	40.0	7.4	8.6
Anjalankoski PM 3	57.1	28.6	71.4	77.8	22.2	4.4	4.6
Anjalankoski total	44.1	32.4	58.8	64.1	35.9	19.2	22.4
Inkeroinen BM 1	36.4	36.4	63.6	64.3	35.7	6.9	7.2
Inkeroinen BM 2	36.4	36.4	63.6	66.7	33.3	7.4	7.2
Inkeroinen BM 3	42.9	21.4	71.4	72.2	27.8	8.9	9.2
Inkeroinen BM 4	37.5	25.0	68.8	57.7	42.3	12.8	10.5
Inkeroinen Pilot machine 1	0.0	100.0	100.0	0.0	100.0	0.5	0.7
Inkeroinen Pilot machine 2	0.0	40.0	60.0	0.0	100.0	2.5	3.3
Inkeroinen total	34.5	31.0	67.2	59.5	40.5	38.9	38.2
Workshop[4]	53.3	33.3	46.7	85.0	15.0	9.9	9.9
Workshop R&D center and Pilot PM1[4]	50.0	25.0	50.0	57.1	42.9	3.4	2.6
Workshop total	52.6	31.6	47.4	77.8	22.2	13.3	12.5
Espanola	20.0	50.0	30.0	64.3	35.7	6.9	6.6
Heinola Fluting	15.8	36.8	47.4	66.7	33.3	11.8	12.5
Eurocan Pulp and Paper Kitimat	28.6	42.9	28.6	61.5	38.5	6.4	4.6
Pineville Kraft Corporation	20.0	60.0	20.0	71.4	28.6	3.4	3.3
Total average	**32.0**	**40.1**	**55.5**	**57.6**	**42.4**	100.0	100.0

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995. Note 1: The forest plants' optimal investment timing is during low market demand, low product prices, low economic cycle, low local production quantity and quality. Note 2: Figure only for production quantity and quality, since related activity can be shared. Note 3: Original quantity of the technical activities. Note 4: Machinery workshop's optimal investment timing is high forest industry's market demand. Note 5: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

From the perspective of market price, Tampella's management did not significantly take into account changes in the market prices of newsprint or board in the timing of the investment at the plant level. The optimum investment activity should take place when the market price is lower than during the past two years and there are no further market signs about further decline of the market price.[753] If the two following years have less than 50 USD/mt *negative* or *positive* price variations, it is defined as normal noise, and it does not change the aforementioned interpretation rules. During the years 1958–1995, 40.1 per cent of all the mills' investment activities took place perfectly in relation to the market prices of the newsprint and board. Anjalankoski's PM 1 utilised the timing of 42.9 per cent of its investment activities perfectly, and the whole unit's average remained as weak as 32.4 per cent. Inkeroinen's best production lines were BM 2 and BM 3, where 36.4 per cent of the investment activities were implemented when the market price was low. The total of Inkeroinen's result was 31 per cent. 42.9 per cent of Eurocan Pulp and Paper Kitimat's and 60 per cent of Pineville Kraft Corporation's investment activities took place when the end products' price was low. Inkeroinen's pilot PM 1 accounted for 100 per cent of the investment activities, which took place when the market prices were already decreasing but the demand was still high.[754]

The first result shows that it is difficult, if not almost impossible, to predict the price of end products in time, due to fluctuations in the international markets.[755] Secondly, Tampella stayed in the paper and board products, where it focused on increasing capacity and reducing unit costs. Thus, Anjalankoski and Inkeroinen's production units played a significant role in the quantity of investments. It can be stated that the plants implemented continuous investments and technical improvements without possibilities or interest to consider a financial downturn or low market demand. Therefore, the result of the analysis shows that the end products' price was not an essential factor in Tampella's investment activities.

From a long-term point of view, the decreased newspaper price did not affect the investment activities in a way that it would have changed the product portfolio to higher value-added products, even the continued global decline in the price of individual products of paper or board grades indicates a change in the industry one way or another. The significant change of the newspaper end users' purchasing habits was due to the vis-a-vis change in the competitiveness of competitors, improved production efficiency or the current increased capacity on the market.[756] Finally, the fall in newsprint prices changed Tampella's portfolio as late as 1989, when the new Tamedia product family was launched on the market. During the years 1988–1989, the price of coated woodfree paper was

753 Between 1958 and 1995, the price development of the newsprint is presented in Figure 15, of the other paper and paperboard in Figure 27, and of the wrapping and packaging board in Figure 29.
754 That result is based on the single management's decision.
755 Alajoutsijärvi et al. 2000, pp. 36–37.
756 Pelham and Wilson 1996, pp. 27–43, Järvinen et al. 2012b, pp. 307–343.

as high as 2700 DEM/ton and, in 1992, as low as 1500 DEM/ton. In 1992, the newspaper's market prices further declined.

The end products' market prices did not affect the investment timing. This is evident, as Anjalankoski's integration had 73.5 per cent of the investment activities over 800 USD/mt (def. 1995) and 26.5 per cent less than 800 USD/mt (def. 1995) of the world's FOB prices (Def. 1995). When looking at the market prices of the other paper and paperboard in the world, in Inkeroinen 98.3 per cent of the investment activities took place at higher than the 800 USD/mt (def. 1995) price level, whilst this share was 100 per cent in Espanola and 94.7 per cent in the workshop, 89.5 per cent at Heinola Fluting, and 100 per cent at Kitimat and Pineville. When looking at the market prices of the wrapping and packaging board in the world, in Inkeroinen 84.5 per cent of the investment activities took place at higher than the 800 USD/mt (def. 1995) price level. This number was 89.5 per cent for the workshop, 100 per cent for Eurocan Kitimat and Pineville, 80 per cent Espanola and 78.9 per cent for Heinola Fluting, respectively.

From the perspective of the economic cycle, the comparison of paper machines showed that from the investment activities at the Anjalankoski mill, 46.2–71.4 per cent were done during global financial downturns. It was an excellent performance, as the latest PM 3 utilised the recessions by 71.4 per cent. The comparison between plants showed that Inkeroinen's plant allocated 67.2 per cent and Inkeroinen's pilot machine one allocated 100 per cent of the technology investment activities during financial downturns. Anjalankoski plant's corresponding figure was 58.8 per cent. Low recession utilisation took place with the investment activities of Heinola Fluting (47.4 per cent), Espanola (30 per cent), Eurocan Kitimat (28.6 per cent) and Pineville (20 per cent). As the machinery workshop utilised only 46.7–50 per cent investment activities during the global recession, it means that the company committed resources when they should have been tied in one way or another to acute businesses to increase the cash flow. As a whole, Tampella utilised financial downturns in just over half of its investment activity, which accounted for 55.5 per cent, as presented in Table 20.

Analysing the regularity of the investments' timing in the relation to the economic crisis precisely per year that Tampella's investments took place, most of the mills had no time cyclicality, as presented in Table 21. This is evident in that 1.2–10.8 per cent of the investment activities took place steadily during the economic downturns between 1958 and 1995. Anjalankoski's mill utilised the financial downturns evenly with between 5 to 15 per cent of all investments, Inkeroinen 2.6 to 12.8 per cent, the machinery workshop 11 to 22 per cent, Espanola 33 per cent, Heinola Fluting 11 per cent, Eurocan Kitimat 50 per cent and Pineville 100 per cent. After the economic recessions of 1958 and 1960, the machinery workshop carried out its investment activities during economic downturns in 8-to-10-year cycles until 1990.

Table 21 Tampella's investments during financial downturns measured by GDP.[757]

Years of economic downturns				Anjalankoski	Inkeroinen	Workshop	Espanola	Heinola Fluting	Eurocan Kitimat	Pineville	All	All
World	USA	Canada	Euro	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(pcs)	(%)
1958		1958		10.0	7.7	11.1	0.0	11.1	0.0	0.0	7	8.4
	1959	1959		10.0	7.7	0.0	0.0	0.0	0.0	0.0	5	6.0
1960	1960	1960		0.0	10.3	11.1	0.0	11.1	0.0	0.0	6	7.2
1967	1967	1967		0.0	0.0	0.0	0.0	11.1	0.0	0.0	1	1.2
	1969			10.0	2.6	0.0	0.0	0.0	0.0	0.0	3	3.6
1970	1970	1970		0.0	12.8	0.0	0.0	11.1	50.0	0.0	7	8.4
1971	1971		1971	5.0	10.3	11.1	0.0	11.1	50.0	100.0	9	10.8
1974	1974			5.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1.2
1975	1975		1975	0.0	10.3	0.0	0.0	0.0	0.0	0.0	4	4.8
			1977	10.0	0.0	0.0	33.3	0.0	0.0	0.0	3	3.6
			1978	5.0	5.1	0.0	0.0	11.1	0.0	0.0	4	4.8
1980	1980	1980	1980	10.0	5.1	0.0	0.0	0.0	0.0	0.0	4	4.8
1981	1981		1981	5.0	2.6	11.1	0.0	0.0	0.0	0.0	3	3.6
1982	1982	1982	1982	0.0	2.6	11.1	0.0	11.1	0.0	0.0	3	3.6
			1983	10.0	7.7	0.0	0.0	0.0	0.0	0.0	5	6.0
		1986		0.0	2.6	0.0	0.0	11.1	0.0	0.0	2	2.4
	1990	1990		5.0	5.1	22.2	0.0	0.0	0.0	0.0	5	6.0
1991	1991	1991	1991	0.0	5.1	0.0	33.3	0.0	0.0	0.0	3	3.6
1992			1992	15.0	2.6	22.2	33.3	11.1	0.0	0.0	8	9.6
1993			1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
Total (pcs)				20	39	9	3	9	2	1	83	100
All investments (pcs)				34	58	19	10	19	7	5	153	100
Investments during economic downturns				**58.8**	**67.2**	**47.4**	**30.0**	**47.4**	**25.0**	**20.0**	**54.2**	100

Sources: http://data.worldbank.org from 1961 to 1995, http://www.ggdc.net/maddison from 1958 to 1960, Tampella Annual Reports from 1958 to 1995.

From the market perspective, the production quantity will be seen as an optimum capital investment activity when the competitor does not dominate local markets of the specific paper grade. Canadian and American companies dominated the competition in the newsprint grades, and the U.S. companies dominated the board grades in North America and Canada as well. Accordingly, all investments

757 http://data.worldbank.org from 1961 to 1995: Definition for GDP: "An annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources".

in that specific market area are classified as sub-optimum activities for Tampella. Secondly, as long as there was the top management's decision to stay in the newsprint grades, it was smart to try to dominate the markets by scale economies. Tampella's expansion of the newsprint grades responded to the competition especially in the year 1977, when the Americans took a share of the European markets of newsprint by having lower sales prices based on lower manufacturing costs. The company's maintenance-related activities are defined as production-quantity activities, as these repairs maintained the existing production at the least capability level. In the machinery workshop, the research and development centre and the pilot machine investments are considered both quantity and quality activities, based on the fact that the machinery supplier needed its own pilot facilities for confidential customer trials and its own equipment and process development work. The balance of the furnish amount changes is mainly due to the changes in the integration's production capacity, which many times also significantly improved the end products' quality as well. Hereby the investment activities of the furnish were common investments for all the machines in the production unit, unless otherwise mentioned. Worthy of note is that the different types of wood fibre and their chemical or mechanical treatment are directly comparable in the end products' quality. For example, Scandinavian spruce with semi-chemical treatment is well suited for the quality of sack paper, mechanical pulp suits well for the production of SC and LWC, and European recovered paper is excellent for newsprint's manufacture.[758] From the production-quality perspective, an optimum capital investment activity is defined when there exists a direct impact on the end products' quality due to the technology change.

Sixty per cent of Anjalankoski's PM 1 and PM 2's technological investment activities increased capacity, and 40 per cent increased the quality of the end products. This result is very logical, as the increase in capacity investment in old machine lines also often includes quality investment-enhancing activities. It is due to old machines have a lack of advantage of technology. 77.8 per cent of PM 3's activities increased capacity, and 22,2 per cent focused on quality improvements. This is an interesting result, since the price development of newsprint was mainly decreasing in all markets, and Tampella's forest units' main annual arguments were about successful quality improvements. This result is due to the decision to produce newspaper on a new paper machine, where there was no precise qualitatively value-added technology based on the same furnish in the market in 1983; the technology focused primarily on developing the newsprint paper machine speeds from suppliers. The issues mentioned above indicate that during PM 3's start-up, the forests units' portfolio management was not progressive and the qualitative development depended on the suppliers' latest technology.

From the perspective of production quantity, 57.7–72.2 per cent of the technology investment activities increased capacity, and 27.8–42.3 per cent improved the board quality in Inkeroinen. From the point of view of Tampella's

758 See Gullichsen and Paulapuro 2000, Retulainen et al. 2002, pp. 457–467, Chagaev and Zou 2007, pp. 17–23.

forest units, the Inkeroinen's pilot machines were all quality-improvement investments. Anjalankoski's and Inkeroinen's factory units did not differ much in terms of capacity or quality investments. The other board units' technological investment activities that increased capacity accounted for 64.3 per cent in Espanola, 66.7 per cent at Heinola Fluting, 61.5 per cent at Eurocan Kitimat and 71.4 per cent in Pineville. The domestic units made more quality-based investments than foreign ones. The machinery workshop accounted for 85 per cent of the technology investment activities, which were based on increased capacity, which was the highest at Tampella as a whole. The research centre and the pilot paper machine both accounted for 57.1 per cent. The quality-based investment activities were 15 per cent in the production facilities and 42.9 per cent in the research centre and the pilot paper machine. The steady capacity and the quality investment activities in the metal unit's research centre and pilot machine reflected the fact that the pilot machine must be able to drive high speed and, at the same time, produce quality end products. This creates credibility from the point of view of the suppliers' marketing reference.

The analysis between Tampella's various units indicates that 44.1 per cent of Anjalankoski's *positive investment*s or operational performance activities took place in a weak market situation, as Anjalankoski PM 2 accounted for 53.8 per cent, PM 1 accounted for 35.7 per cent, and PM 3 accounted for 42.9 per cent. 29.3 per cent of Inkeroinen's *positive investment* activities took place in a weak market situation, as BM 1 accounted for 36.4 per cent. From the point of view of timing, the low performance was in Inkeroinen's two pilot machines, Pineville, Espanola, Heinola Fluting and Eurocan Kitimat.

In the machinery workshop, *positive investment*s or operational performance activities accounted for 53.3 per cent in its research centre, and the pilot plant accounted for 50 per cent, which took place in a good market situation. The workshop unit's total performance accounted for 52.6 per cent of activities. It is essential to keep in mind that, first, forest units should always maximise production capacity and minimise all investment shutdowns in a good market situation. Second, the machinery workshop implements their investments at the same time when the forest units have maximised their operation rate. The forest units were unsuccessful in terms of optimum investment timing. Besides, the workshop unit was a bit better than the forest units, but it was not good either, as presented in Table 22.

Table 22 The optimum timing of the technology change from 1958 to 1995.

	All investments	Positive and weak demand	
	(pcs)	(pcs)	(%)
Anjalankoski PM 1	14	5	35.7
Anjalankoski PM 2	13	7	53.8
Anjalankoski PM 3	7	3	42.9
Anjalankoski total	34	15	44.1
Inkeroinen BM 1	11	4	36.4
Inkeroinen BM 2	11	3	27.3
Inkeroinen BM 3	14	5	35.7
Inkeroinen BM 4	16	5	31.3
Inkeroinen Pilot machine 1	1	0	0.0
Inkeroinen Pilot machine 2	5	0	0.0
Inkeroinen total	58	17	29.3
Workshop[1]	15	8	53.3
Workshop R&D Center and Pilot pm1[1]	4	2	50.0
Workshop total[1]	19	10	52.6
Espanola	10	1	10.0
Heinola Fluting	19	3	15.8
Eurocan pulp and Paper Kitimat	7	1	14.3
Pineville Kraft Corporation	5	0	0.0
Total	152	47	30.9

Source: Tampella Annual Reports from 1958 to 1995.[759] Note 1: The optimum timing of the workshop investments is defined as a *positive investment and positive market*. Note 2: The optimum timing of paper and board plants investment is defined as a *positive investment* and weak market. Note 3: [-5 to +5] values, which are based on event analysis, define the *positive or negative* status of the market demand and investment activities. The definition is based on the calibration model, as presented in Annex One. The positive or negative investment activities include investments and activities that are relevant to performance, whose details are presented in Annex 4.

4.4 Exploring the market-orientation behaviour

4.4.1 The dominating demand-pull and technology push

As presented in Table 23, this part of the analysis focuses on investment decisions and operational performance decision-making factors, because many academics find market demand for products is a more important factor than capital costs.[760] The market demand variables are used to demonstrate the relevance of factors to technological decision-making. This analysis is divided into three sections, as all variables are analysed in the same way: first, summarising all the market factors

759 The machinery workshop's optimum timing equals the *positive* market demand and the forest units' equal weak market demand.

760 Lundgren 1998, p. 79.

based on the investments or operational performance activities. Second, the distribution of a single market factor between different production units is determined. It defines Tampella's senior management's customer-orientation attitude and the decision-making among the various production units. Third, the distribution of market factors among one production plant is analysed. It is defined as a single production plant and the mill's managerial customer-orientation attitude and culture.

Table 23 The market demand factors amount of activities, the distribution between different units, and the distribution within the individual unit (N=252).

The market demand factors and amount of activities	**activities**	**Anjalankoski**	**Inkeroinen**	**Workshop**	**Heinola F**	**Espanola**	**Eurocan Kitimat**	**Pineville**
Based on demand-pull	**142**	**29**	**31**	**28**	**31**	**13**	**6**	**4**
Based on technology push	**81**	**11**	**30**	**14**	**17**	**6**	**2**	**1**
Cooperation with end customers and suppliers	**6**	**1**	**0**	**5**	**0**	**0**	**0**	**0**
Product differentiation	**23**	**7**	**4**	**8**	**0**	**4**	**0**	**0**
Total	**252**	**48**	**65**	**55**	**48**	**23**	**8**	**5**
The market demand factor distribution between different units		**%**	**%**	**%**	**%**	**%**	**%**	**%**
Based on demand-pull		**20.4**	**21.8**	**19.7**	**21.8**	**9.2**	**4.2**	**2.8**
Based on technology push		**13.6**	**37.0**	**17.3**	**21.0**	**7.4**	**2.5**	**1.2**
Cooperation with end customers and suppliers		**16.7**	**0.0**	**83.3**	**0.0**	**0.0**	**0.0**	**0.0**
Product differentiation		**30.4**	**17.4**	**34.8**	**0.0**	**17.4**	**0.0**	**0.0**
Total		**19.0**	**25.8**	**21.8**	**19.0**	**9.1**	**3.2**	**2.0**
The market demand factors within the individual unit	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Based on demand-pull	**56.3**	**60.4**	**47.7**	**50.9**	**64.6**	**56.5**	**75.0**	**80.0**
Based on technology push	**32.1**	**22.9**	**46.2**	**25.5**	**35.4**	**26.1**	**25.0**	**20.0**
Cooperation with end customers and suppliers	**2.4**	**2.1**	**0.0**	**9.1**	**0.0**	**0.0**	**0.0**	**0.0**
Product differentiation	**9.1**	**14.6**	**6.2**	**14.5**	**0.0**	**17.4**	**0.0**	**0.0**
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. Market data is presented in Annex 4.

The market demand-pull (56.3 per cent) dominated and technology supported (32.1 per cent) the management's decision-making, as can be seen in Table 23. This result can be considered as an achievement by Tampella's management, as their paper and board plants primarily took responsibility for developing their portfolios rather than the machinery workshop. On the other hand, this should be the research and development function in the head office, due to important customer collaboration and centralised resources. The analyses of the end-customer collaboration (2.4 per cent) and product differentiation (9.1 per cent), however, prove that market information was not eventually exploited to the extent that it would have generated significantly different and new products developed with the end customers.

Roughly 19–25.8 per cent of Tampella's domestic investment activities were based on market demand factors and 2–9.1 per cent with foreign production units. It proves that management followed and gained information on market demand and customer needs, and this information was used primarily to benefit domestic plants: Inkeroinen had the highest activity (25.8 per cent), although Anjalankoski (19 per cent) was the largest plant in the company. In part, this is because the firm's board producers centralised technology development at the pilot facility in Inkeroinen. This is evident, as the value of technology push accounted for 37 per cent and co-operation with end customers and suppliers zero per cent in Inkeroinen. Similarly, the significantly higher activity of all market variables in domestic factories demonstrates the concentration of technology in Finland, primarily the development of board technology and, secondly, newsprint. It is based on the fact that Inkeroinen and Heinola Fluting were board producers, and the machinery workshop focused on board grade, according to the TVW agreement.

Between 1958 and 1995, the majority of the firm's forest business investments were implemented by its own machinery workshop unit, as it was also the leading equipment supplier. The workshop's active customer-orientated operation was based on the fact that paper and board machine supplies prefer long-lasting and confidential supplier-customer cooperation and the culture to develop new or improve existing products. In this activity, it is essential for the machinery workshop supplier to own pilot facilities for confidential customer trials. This cooperation was further strengthened through in-house collaboration in the diversified conglomerate structure of Tampella. It was considered to be self-explanatory, as the firm's technology knowledge was concentrated in that unit.

On the other hand, it is an interesting result that the machinery workshop did not have the highest quantity of technological activities, given that the workshop played such a central role in the technological development of the company (although, as this dissertation demonstrates, this development declined significantly in the late 1960s). The result below explains at least part of the issue. Furthermore, the machinery workshop's market demand factors of customer cooperation (83.3 per cent) and product differentiation (34.8 per cent) indicates significant customer orientation for technology development. This means that the workshop received information from international customers about the types of paper and board machines needed for paper and board manufacturing. However, this information could not be utilised at the company's mills due to old paper and board machines. In other words, the core issue was the capability of the company's top management to make a needed and significant strategic decision.

When looking at the results, I should remember the diversity of the machinery workshop's operations with plenty of different business segments and the different nature of the businesses; the machinery workshop sold products based on direct customer orders, but the forest units sold their products either at the level of the warehouse or as direct customer orders.

The development of newspaper also took place in Anjalankoski. An indication of that is that 20.4 per cent of its investments or operational performance activities were based on the demand-pull. The dynamism of market demand in newsprint and packaging board affected approximately the same amount of investments or operational performance activities in Anjalankoski, Inkeroinen and Heinola Fluting. The results show that Anjalankoski's position was more independent, for example, in product development. This is evident, as it developed its Hi-Fi newspaper products in co-operation with its customers;[761] the market

[761] Oy Tampella Ab board meeting 8.4.1972.

factor of the product differentiation represented 30.4 per cent of its investment activities, as presented in Table 23.

The market demand factors' analysis per production plant specifies how the individual production unit's decision-making of the investments or operational performance activities differs from the top management of the head office's decision-making. In Anjalankoski, 60.4 per cent of its investments or operational performance activities were based on demand-pull, 22.9 per cent based on technology push, 2.1 per cent based on cooperation with end customers and suppliers, and 14.6 per cent based on product differentiation. The positive result is that Anjalankoski's mill followed and responded to the market demand fluctuations in more than half of its technological activities, having constant concern about the performance of the production machinery and increasing the capacity of its newspaper production as needed. Negative was the share of other market demand factors, as customer co-operation represented only 2.1 per cent of activities and product differentiation 14.6 per cent of the individual production line's investments and operational performance activities. This latter was limited by Anjalankoski's unit results in profitability and the development of technological know-how.

In Inkeroinen, 47.7 per cent of its investments and individual production line activities were based on demand-pull and 46.2 per cent of activities based on technology push. The results show that market demand and technology affected approximately at the same magnitude as technological decision-making. This was, in turn, based on the dominant position of the machinery workshop in the technology transfer within the company, and intense and prolonged concentration of the machinery workshop's development for the board-grade technology. In terms of co-operation with Inkeroinen's customers, co-operation was non-existent. The phlegmatic customer interface also affected the fact that only 6.2 per cent of the investments or individual production line's operational performance activities were based on product differentiation.

The results of the machinery workshop show that the market demand was considerably broader in terms of its various business functions than, for example, in the forest business: 50.9 per cent of the workshop's investments and operational performance activities were based on demand-pull, 25.5 per cent on technology push, 9.1 per cent on cooperation with end customers and suppliers, and 14.5 per cent on product differentiation. This means that the market demand fluctuations had a very rapid impact on the downsizing or extensions of the workshop's production facilities, regarding both investments and operational performance activities.[762] As a consequence, Tampella's management minimised the negative impact of these fluctuations on workshop operations and profitability by diversifying the metal unit's products into a wide range of industries, such as forest, heavy metal, mining, rock drilling, and power. The product differentiation was a great achievement by Tampella's management, but it also added leader-

762 In the forest business, the impacts of short-term market disturbances can be minimised by control of the stock quantities.

ship, technology management, and cash flow challenges, as the scope of the diversified operations was extremely challenging. Thus, Tampella was a typical case of a diversified firm facing challenges from its various lines of businesses.

At Heinola Fluting, 64.6 per cent of its investment and operational performance was based on demand-pull, whereby market information was the dominant factor in the market context. 35.4 per cent of its related activities were based on technology push, whereby the technology supported other operational functions in line with market demand fluctuations. For many years, the market demand was good and, as a result, the production operation rate reached a high level; consequently, new production records were reached as well. For example, the 1967 expansion rebuild was due to strong market demand. Similarly, due to weak market demand, Heinola Fluting's mill was looking for new market areas. Unfortunately for Heinola Fluting, it did not manage or was not allowed to manage the products' portfolio development and new product development. The evidence is clear that none of the investments or operational performance activities were based on product differentiation. The development of new products and various packaging solutions would have been accelerated through customer cooperation, but this was not the way Heinola Fluting acted at all, as this analysis shows: none of the investments or operational performance activities were based on cooperation with end customers and suppliers. The machinery workshop's role in the development of Heinola Fluting's performance was a positive thing, as the machinery workshop's technology and engineering experts supported Heinola Fluting to achieve record production during several years. The negative point was that the machinery workshop concentrated perhaps too much and too long in the development of board grades, which also constrained Heinola Fluting's long-term portfolio development.

In Espanola, in turn, 56.5 per cent of the investments and operational performance activities were based on demand-pull; thus, Tampella's management followed and gained information on the market behaviour that dominated the technology decision-making in Espanola. As 17.4 per cent of the investments and the individual production line's operational performance activities were based on product differentiation, Espanola reacted to market demand variations well. For example, in 1977 the portfolio was expanded by a former rebuild start-up, and in 1987 the mill focused on folding box board.[763] In Espanola, none of its investments or operational performance activities were based on cooperation with end customers and suppliers, and 26.1 per cent were based on technology push. This indicates the machinery workshop's dominant position in terms of technology changes.

At Eurocan Kitimat, seventy-five per cent of its investments and operational performance activities were based on demand-pull. This was due to Tampella's management's optimistic expectations for a successful investment project and a good order backlog of kraft board and sack paper. None of the investments or operational performance activities were based on cooperation with end customers and external suppliers due to the dominant position of Tampella's machinery

763 Tampella Annual Reports 1977 and 1987.

workshop. As Tampella divested Eurocan Kitimat already in 1976, one may claim that 11 years in a forest industry's capital investment project is a short time.[764]

The conclusions are that Tampella's management did not take into account the importance of market demand from the perspective of portfolio management and decided to focus further on uncoated board grades at Eurocan Kitimat. It is a symptom of conservative decision-making that management repeats previous decisions and strictly refrains from changing its previous strategy, despite changes in the competitive environment and the available technology. The behaviour of the company mentioned above is evident, as none of the investments or operational performance activities were based on product differentiation.

The Pineville plant was primarily keen to operate based on market conditions, and minor activities were based on technology push. In 1973, the very fast divestment of Tampella's ownership and the fact that none of the investments or operations were based on product differentiation proves that the only reason for joint venture participation was major machinery delivery.

4.4.2 Understanding cost efficiency and pricing

In order to understand the importance of business variables in a firm's ability to make a profit from a customer and market perspective, I focus on cost efficiency and pricing as a part of decision-making.[765] The most important factors are summarised in Table 24 below. Table 24 shows the quantity of the market price factors based on the investments or operational performance activities; the distribution of a single market price factor between different production units is determined, and the distribution of market price factors among one production plant.

764 Tampella Annual Report 1976.
765 Lucas 1975, p. 1140.

Table 24 The number of the market's price factors' activities, the distribution between different units, and the distribution within the individual unit (N=79).

The market price factors and amount of activities	activities	Anjalankoski	Inkeroinen	Workshop	Heinola F	Espanola	Eurocan Kitimat	Pineville
Understanding pricing dynamics and mechanisms	27	7	7	0	6	5	1	1
Consumers' buying habits change	1	1	0	0	0	0	0	0
End product cost efficiency	46	8	14	4	6	5	5	4
Multiproduct production	5	3	2	0	0	0	0	0
Total	79	19	23	4	12	10	6	5
The market price factor distribution between different units		%	%	%	%	%	%	%
Understanding pricing dynamics and mechanisms		25.9	25.9	0.0	22.2	18.5	3.7	3.7
Consumers' buying habits change		100.0	0.0	0.0	0.0	0.0	0.0	0.0
End product cost efficiency		17.4	30.4	8.7	13.0	10.9	10.9	8.7
Multiproduct production		60.0	40.0	0.0	0.0	0.0	0.0	0.0
Total		24.1	29.1	5.1	15.2	12.7	7.6	6.3
The market price factors within the individual unit	%	%	%	%	%	%	%	%
Understanding pricing dynamics and mechanisms	34.2	36.8	30.4	0.0	50.0	50.0	16.7	20.0
Consumers' buying habits change	1.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0
End product cost efficiency	58.2	42.1	60.9	100.0	50.0	50.0	83.3	80.0
Multiproduct production	6.3	15.8	8.7	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. Market data is presented in Annex 4.

The company's production facilities focused on improving the profitability of the end product, which is based on knowing the cost structure of its end products compared to its major competitors. As presented in Table 24, the mills focused strongly on understanding the cost efficiency of the end product (58.2 per cent) and the pricing dynamics and mechanisms (34.2 per cent). Based on the above, it can be assumed that the management of the company received sufficient information on the price of the final product from the market for possible decision-making. Tampella's management understood the mechanisms of dynamic pricing and made the decision to improve the end products' cost structure. This is most likely a part of the reason that Tampella did not change its strategy from newspaper and board production for decades. As a result, the machinery workshop did not develop so-called swing paper – or board machines.[766] Unfortunately, for the second time, utilisation of the information obtained was not realised in the best possible way, based on the low amount of market pricing factors of the consumers' changes in buying habits (1.3 per cent) and multi-product production (6.3 per cent). As shown in this dissertation, Anjalankoski's plant changed its newsprint portfolio only when forced to do so by customers' changes in buying habits. Respectively, the machinery workshop's portfolio was limited to focusing on board customers for too long, due to the TVW agreement.

As a basis for investment or operational performance activities, in the domestic production units, market price was much more frequently taken into account than in foreign units. It means that the interest of Tampella's management was much more frequently situated on domestic and the European market prices

766 Norman and Thisse 1999, pp. 363–365.

than those in North America and Canada. This result proves the firm's primary reason to get into the North American markets – to obtain a new reference for Tampella's machinery workshop. The distribution of market price factors between different production plants proves that market prices affected most of the domestic units; 24.1 per cent of all investments and operational performance activities in Anjalankoski and 29.1 per cent in Inkeroinen were related to these factors. However, at Heinola Fluting, this share was 15.2 per cent, which indicates the different cost structure and competitive environment there, compared to the cartonboard business.

Understanding pricing dynamics and mechanisms accounted for 22.2–25.9 per cent of all investments and individual operational performance activities in the domestic forest business, compared to 3.7 per cent at Kitimat and in Pineville. 8.7–17.4 per cent of all production unit investments and operational performance activities were based on end product cost efficiency, excluding Inkeroinen, where it accounted for as much as 30.4 per cent of activities. Multi-product production accounted for 60 per cent in Anjalankoski and 40 per cent in Inkeroinen of investments and operational performance activities. First, this is an indication of the fact that they were only the units that produced the coated grades among other grades. Second, the price fluctuations had an impact on the technological activities in Inkeroinen more than in Anjalankoski, as the management focused on board cost structure considerably more than any other grades. Third, market price was not such an essential factor for the workshop's investments or operational performance activities, compared to other production units.

42.1 per cent of all Anjalankoski's investments and individual production lines' operational performance activities were based on end product cost efficiency, 36.8 per cent were based on understanding pricing dynamics and mechanisms, and 15.8 per cent were based on multi-product production. It was a positive issue that Anjalankoski's production unit's good understanding of pricing supported the cost structure of the product, thus forming a functional entity to increase profitability by management decision-making. Besides, the multi-product production supported the variables mentioned above with the individual technology investments, but unfortunately it was too little from the perspective of overall portfolio management and too late from a higher value-added products point of view. In any case, this means that the management of Anjalankoski's production unit followed and responded to the market information on newspaper. Sadly, the reaction did not happen until the markets were forced to react – in the year 1983. First, the new PM 3 was announced to be capable of producing improved newspaper, SC and LWC grades, so this machine was the so-called flexible swing concept.[767] Second, in 1989, PM 2 was modified to be able to produce coated magazine paper, so this machine was capable of producing higher value-added products.[768] Before these two investment projects, the management did not respond to the falling newsprint prices, even though the prices declined year after year, excluding the individual fluctuations in price of a few years. This

767 Röller and Tombak 1989, p. 14.
768 Tampella Annual Reports 1989 and 1990.

is evident in the fact that only 5.3 per cent of the investments and the individual production lines' operational performance activities were based on changes in the consumers' buying habits. That mentioned change in customer behaviour was based on the development of IT technology.[769] In consequence, it caused the most substantial negative transition in the paper industry.

In Inkeroinen, 60.9 per cent of the investment and individual production lines' operational performance activities were based on end product cost efficiency and 30.4 per cent on understanding pricing dynamics and mechanisms. Inkeroinen's production units' good understanding of product pricing was based on an efficient cost structure in the production. It means that many technological activities improved both the quality and the capacity of the usage of fibre raw materials and energy consumption. As a result, the end product price was a competitive one. There was no direct need for changes in the consumers' buying habits, which is also found in the analysis of the result that none of the investments or operational performance activities in the individual production line were based on changes in consumers' buying habits. Tampella's workshop had good knowledge of and equipment for fibre treatment, which improved the quality of the fibres. As a consequence, this contributed to a significant development of the new products. It is also evident as only 8.7 per cent of the investments and operational performance activities were based on multi-product production.

All of the machinery workshop's investments and operational performance activities were based on the end products' cost efficiency, as the workshop's machinery tools had more automation and investments became much more expensive.

At Heinola Fluting, fifty per cent of its investments and individual production lines' operational performance activities were based on end product cost efficiency and 50 per cent based on understanding of pricing dynamics and mechanisms. Cost efficiency was improved, for example, by the rebuilds of the semi-chemical pulp mill and board mill rebuilds, thereby achieving cost efficiency by increasing capacity. Smaller investments increased the efficiency of the board machine, fibre treatment, and the power plant. The cost-efficiency was also improved by the new information technology systems on financials and human resources in 1982.[770] The aforementioned technological activities supported the pricing of products very significantly, as price understanding and market price estimations were very challenging, especially in the early 1960s. For example, in 1965 the fluting market prices slightly increased; in 1967 it had strong demand, but until the end of the year export prices decreased due to the economic downturn.

Fifty per cent of Espanola's investments and individual production lines' operational performance activities were based on end product cost efficiency and 50 per cent on understanding pricing dynamics and mechanisms. It means that the production unit operated very well in terms of the local market, and in that

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769 Jalava et al. 2007, p. 301.
770 Tampella Annual Report 1982.

sense Tampella's management was wise when they set up a joint venture to minimise negative effects of fluctuations in both price variations and price regulations by the local government.

83.3 per cent of Eurocan Kitimat's and 80 per cent of Pineville's investments and individual production lines' operational performance activities were based on end product cost efficiency, whereas 16.7 per cent and 20 per cent, respectively, were based on understanding of pricing dynamics and mechanisms. It means that technological activities aimed at achieving cost efficiency, which generated flexibility in the pricing of the products.

4.4.3 Importance of timing

The timing of investments was a crucial factor both in the forest industry and Tampella's machinery workshop. As described in Chapter 2 above, the different business units had to, a certain extent, different rationales in investments during the high and low economic cycles. It is essential to understand that this section does not define the success of timing in the company's investments or operational performance activities. However, this section determines the production plants' understanding of the local markets and its relation to the importance of the firm's investment timing. Table 25 shows first the number of a financial downturn's factors based on investments or operational performance activities. Second, the distribution of a financial downturn factor between different production units is determined. Third, the distribution of financial downturn factors among one production unit is analysed.

Table 25 The quantity of financial downturn factors' activities, the distribution between different units, and the distribution within the individual unit (N=107).

The financial crises' factors and amount of activities	activities	Anjalankoski	Inkeroinen	Workshop	Heinola F	Espanola	Eurocan Kitimat	Pineville
Understanding the local markets' sensitivity	17	3	6	0	2	1	3	2
Strong market position	19	7	3	1	4	0	2	2
Diversification of the sales areas	5	1	1	0	0	1	1	1
Timing of business cycles to adopt new technology	66	12	33	7	6	2	3	3
Total	107	23	43	8	12	4	9	8
The financial crises' factor distribution between different units		%	%	%	%	%	%	%
Understanding the local markets' sensitivity		17.6	35.3	0.0	11.8	5.9	17.6	11.8
Strong market position		36.8	15.8	5.3	21.1	0.0	10.5	10.5
Diversification of the sales areas		20.0	20.0	0.0	0.0	20.0	20.0	20.0
Timing of business cycles to adopt new technology		18.2	50.0	10.6	9.1	3.0	4.5	4.5
Total		21.5	40.2	7.5	11.2	3.7	8.4	7.5
The financial crises' factors within the individual unit	%	%	%	%	%	%	%	%
Understanding the local markets' sensitivity	15.9	13.0	14.0	0.0	16.7	25.0	33.3	25.0
Strong market position	17.8	30.4	7.0	12.5	33.3	0.0	22.2	25.0
Diversification of the sales areas	4.7	4.3	2.3	0.0	0.0	25.0	11.1	12.5
Timing of business cycles to adopt new technology	61.7	52.2	76.7	87.5	50.0	50.0	33.3	37.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. Market data is presented in Annex 4.

The distribution of financial downturn factors between different production units shows that financial downturns clearly affected the domestic units. In Inkeroinen, financial downturn accounted for 40.2 per cent and in Anjalankoski 21.5 per cent of all investments and operational performance activities. The financial downturns of all other production units were significantly less affected: at Heinola Fluting it was 11.2 per cent, in the foreign units 3.7–8.4 per cent, and at the machinery workshop 7.5 per cent. This means, first, that the financial downturns were taken into account much more in Inkeroinen's and Anjalankoski's investments or operational performance activities, compared to other production units. This reflects Tampella's management interest in developing these units more, compared to other units, which is directly proportional to the number of technological activities engaged in. Furthermore, both plants were the biggest in terms of their size in Tampella. Inkeroinen accounted for 35.3 per cent, while Anjalankoski and Eurocan Kitimat represented 17.6 per cent of all investments and operational performance activities, which were based on the understanding the local market sensitivity. This means that Tampella's management tried to understand the sensitivity and operations of the local markets as well. At the machinery workshop, the technology investments or operational performance activities were independent of the local market.

Tampella's management presumably felt that the company had such a strong market position, especially in the newspaper segment, that they did not have to worry about the sensitivity of the local markets. This is shown in the fact that in Anjalankoski, 36.8 per cent of all investments and operational performance activities were based on the strong market position. In the board business, strong market position accounted for 21.1 per cent of all investments and operational performance activities at Heinola Fluting, 15.8 per cent in Inkeroinen, and 10.5 per cent in Eurocan Kitimat and Pineville. This reflects the product-specific orientation. By focusing on just certain products, they aimed at achieving a sufficient market position by increasing capacity. This is a surprising result for Eurocan Kitimat and Pineville, as the local market already had a large capacity of cartonboard before the investment decisions took place. In all production units, excluding the machinery workshop and Heinola Fluting unit, 20 per cent of all investments and operational performance activities were based on diversification of the sales areas. Already in the 1960s, the machinery workshop market area comprised more than twenty different countries, so they did not need a separate regional approach, as they already had established global sales functions. However, none of the machinery workshop's investments or operational performance activities were based on diversification of the sales areas. The result of Heinola Fluting, as none of its activities were based on diversification of sales, indicates the inability to act according to market dynamics. It means that regional decentralisation was needed to develop a packaging application with the local customers, due to the existing fluting market not always being good enough.

Comparing the different production units, Inkeroinen accounted for 50 per cent and Anjalankoski 18.2 per cent of all investments and operational performance activities, which were based on the timing of business cycles to adopt new technology. The corresponding values for the other Finnish business units were 9.1 per cent and 10.6 per cent, and the foreign units accounted for 3 per cent to 4.5 per cent. This result reflects that Inkeroinen's production unit was the most active plant in the technology development context. Its investments and operational performance activities were about twice that of the second unit, Anjalankoski. This amount of activities also means a large amount of capital and time-resourcing dedicated to that unit. Based on earlier pieces of evidence, it can be stated that Tampella's top management relied on the continuous development of Anjalankoski and Inkeroinen, which were also the largest production plants in the company.

The distribution of the financial crises factors among one production unit indicates that 61.7 per cent of all investments and operational performance activities were based on the timing of business cycles to adopt new technology, 17.8 per cent on a strong market position, 15.9 per cent on understanding the sensitivity of the local market, and 4.7 per cent on diversification of the sales areas. This result means that Tampella's management drew attention to timing without taking a stance on the timing success; this was most clear when compared to other financial crisis determinants. The strong newsprint and cartonboard market position brought high cost efficiency and supplier reliability for the customers. On the other hand, Tampella's leadership became too narrowly focused at looking at both the market and the technology, so that required change in the situation did not allow for sufficiently significant changes. In this context, the inability was linked to Tampella's government. Some production units understood the importance of local market sensitivity, but among Tampella's top management it was ignored. That was precisely what happened in the Eurocan Kitimat investment project, which was a total failure.

From the point of view of the individual production units, 52.2 per cent of all Anjalankoski's investments and individual production lines' operational performance activities were based on the timing of business cycles to adopt new technology, 30.4 per cent on a strong market position, 13 per cent on understanding the sensitivity of the local market, and 4.3 per cent on diversification of sales areas. In Anjalankoski, the timing of business cycles to adopt new technology was an essential element that was supported by a strong market position. This arrangement worked profitably for quite a long time. The breakthrough moment took place in 1983, as investment in PM 3 was implemented without any marked portfolio changes.[771] Tampella's leadership had all the market information available, which would have led to other thoughts than refraining from producing newspaper. Secondly, they did not learn from the failure of the Eurocan Kitimat investment, especially in the market context. This is to say that refraining from newsprint and awareness of a strong market position weakened Anjalankoski's future development than a more wide-ranging and more effective use of existing information about competitors and customers' behaviours.

In Inkeroinen, the timing of the business cycles to adopt new technology was an essential element, and it was also supported by an understanding of the

771 Oy Tampella Ab Board of Directors' meeting memo 20.9.1979.

sensitivity of the local market. This is evident as 76.7 per cent of all Inkeroinen's investment and individual production lines' operational performance activities were based on the timing of the business cycles to adopt new technology, 7 per cent on a strong market position, 14 per cent on understanding the sensitivity of the local market, and 2.3 per cent on diversification of sales areas. As a first point, Tampella's management was spending time and capital in the Inkeroinen unit, so that board grade development activities were centralised there. Second, the managers learned to have a continuous development attitude to adopt new technology in Inkeroinen, as the number of activities there was higher than in other production units. Evidence of the importance of the local market for Tampella's board businesses was the implementation of Espanola's joint venture and Heinola Fluting's mill.

87.5 per cent of all the machinery workshop's investments and operational performance activities were based on the timing of the business cycles to adopt new technology, 12.5 per cent on a strong market position, whereas understanding the sensitivity of the local market or diversification of sales areas did not play any role in the machinery workshop. In the workshop, the timing of the business cycles to adopt new technology was an essential element, which was supported by a strong market position.

Heinola Fluting's distribution of the financial factors is very similar to Inkeroinen, with the difference that Heinola Fluting reinforced its existing market position rather than picking up new market areas. 50 per cent of Heinola Fluting's total investments and individual production lines' operational performance activities were based on the timing of the business cycles to adopt new technology, 33.3 per cent on a strong market position, 16.7 per cent on understanding of the local market sensitivity, whereas none of these activities were based on diversification of sales areas.

The timing of the business cycles to adopt new technology had meaning in Espanola's performance, as it was supported by understanding the local market sensitivity and diversification of sales areas. Namely, 50 per cent of all Espanola's investments and individual production lines' operational performance activities were based on the timing of the business cycles to adopt new technology, none were based on strong market position, 25 per cent was based on the understanding of the local market sensitivity, and 25 per cent was based on diversification of sales areas.

For Eurocan Kitimat and Pineville, all financial cycles factors were distributed very evenly; that was based on the fact that the local mill management in both units understood the importance of the local market for a long-term profitable business. Unfortunately, Tampella's management did not understand or was not able to understand the importance of the local markets due to their short period of ownership in these two production units. In the case of Eurocan Kitimat, one third of all investments or operational performance activities of individual production lines were based on the timing of the business cycles to adopt new technology, 22.2 per cent on a strong market position, one-third on understanding of the local market sensitivity and 11.1 per cent on diversification of sales areas. In Pineville, 37.5 per cent of all investments or individual performance lines' operational performance activities were based on the timing of the business cycles to adopt new technology, one-fourth on the strong market position, similarly one-fourth on understanding of the local market sensitivity, and 12.5 per cent on diversification of sales areas.

4.4.4 Integrated technology, quality, scale and scope

In the following section, I study more closely the production quantity and quality factors.[772] The purpose is to find out the nature of the technological development between the different plant units and whether the activities focused on one-time capacity increases or continuous technical improvements. Table 26 shows first the production quantity and quality factors based on investments or operational performance activities. Secondly, the distribution of production quantity and quality factors between different production units is determined. Third, the distribution of production quantity and quality factors among one production plant is analysed.

Table 26 The production quantity and quality factors' amount of activities, the distribution between different units, and the distribution within the individual unit (N=286).

The production quantity and quality factors and amount of activities	**activities**	**Anjalankoski**	**Inkeroinen**	**Workshop**	**Heinola F**	**Espanola**	**Eurocan Kitimat**	**Pineville**
Capacity expansion by technological development	**84**	**14**	**30**	**7**	**17**	**11**	**3**	**2**
Manufacturing flexibility	**15**	**7**	**5**	**0**	**2**	**1**	**0**	**0**
Scale and scope management	**82**	**15**	**22**	**11**	**19**	**9**	**3**	**3**
Product cost structure	**23**	**3**	**16**	**1**	**1**	**2**	**0**	**0**
Continuous quality improvements	**82**	**25**	**34**	**3**	**7**	**9**	**3**	**1**
Total	**286**	**64**	**107**	**22**	**46**	**32**	**9**	**6**
	286							
The production quantity and quality factors' distribution between different units		**%**	**%**	**%**	**%**	**%**	**%**	**%**
Capacity expansion by technological development		**16.7**	**35.7**	**8.3**	**20.2**	**13.1**	**3.6**	**2.4**
Manufacturing flexibility		**46.7**	**33.3**	**0.0**	**13.3**	**6.7**	**0.0**	**0.0**
Scale and scope management		**18.3**	**26.8**	**13.4**	**23.2**	**11.0**	**3.7**	**3.7**
Product cost structure		**13.0**	**69.6**	**4.3**	**4.3**	**8.7**	**0.0**	**0.0**
Continuous quality improvements		**30.5**	**41.5**	**3.7**	**8.5**	**11.0**	**3.7**	**1.2**
Total		**22.4**	**37.4**	**7.7**	**16.1**	**11.2**	**3.1**	**2.1**
The production quantity and quality factors within the individual unit	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Capacity expansion by technological development	**29.4**	**21.9**	**28.0**	**31.8**	**37.0**	**34.4**	**33.3**	**33.3**
Manufacturing flexibility	**5.2**	**10.9**	**4.7**	**0.0**	**4.3**	**3.1**	**0.0**	**0.0**
Scale and scope management	**28.7**	**23.4**	**20.6**	**50.0**	**41.3**	**28.1**	**33.3**	**50.0**
Product cost structure	**8.0**	**4.7**	**15.0**	**4.5**	**2.2**	**6.3**	**0.0**	**0.0**
Continuous quality improvements	**28.7**	**39.1**	**31.8**	**13.6**	**15.2**	**28.1**	**33.3**	**16.7**
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. Market data is presented in Annex 4.

The results of the comparison between different production plants prove that development in terms of production capacity and quality was centralised to Inkeroinen and Anjalankoski. This is evident in that its distribution of the production quantity and quality factors accounted for 37.4 and 22.4 per cent. As the domestic plants had a significantly higher quantity of activities than the foreign units, I can

772 Williams et al. 1995, pp. 25, 31.

conclude that operations in terms of production quantity and quality were centralised to Finland. This is evident, as domestic plants accounted for 16.1–37.4 percent, excluding the machinery workshop,[773] and foreign plants for 2.1–11.2 per cent. Notwithstanding that the machinery workshop accounted only for 7.7 per cent of the investments and operational performance activities based on production quantity and quality, it must be recalled that it represented at least as strong a role as the forest industry in the Tampella corporation.

This result indicates that, first, Tampella's forest management strategy was to grow the board business primarily and the newspaper operations secondarily. Second, this strategy required time and money, so the company's management support was sufficient. Third, the level of competence was also good in Inkeroinen, as the operation of the board machine is partially more demanding due to a broader basis weight range, more stock components, often more forming plies, and the lower machine direction tensile strength. Recalling the previous result, it is interesting to note that in manufacturing flexibility, Anjalankoski accounted for 46.7 per cent, Inkeroinen for 33.3 per cent, Heinola Fluting for 13.3 per cent, and Espanola for 6.7 per cent of all investments or operational performance activities. This result shows that the newspaper units were more actively utilising the potential of the available advantage technology to expand their portfolio with the qualitative change potential; however, this activity was much more limited within the board grades.

Tampella's forest industry strategy was clearly to dominate the European markets by producing sufficient capacity. This was done by continuing to manufacture bulk products for as long as possible without ignoring the higher-value products, such as liquid-packaging boards. This is evident in the scale and scope management, as the board business operations in Inkeroinen accounted for 26.8 per cent, Heinola Fluting for 23.2 per cent and Espanola for 11 per cent of all investment and operational performance activities based on scale and scope. This same strategy was also implemented in the newspaper business: in Anjalankoski 18.3 per cent of all technology-related activities were based on scale and scope management. Eurocan Kitimat's and Pineville's joint venture investment projects are considered to have been based on scale and scope management due to new capacity. The workshop did not need to make continuous capacity investments, as those activities were mainly single-stage machine purchases. For this reason, its share of scale and scope management activities was only 13.4 per cent.

Product cost structure was shown in 69.9 per cent of all investments and individual production lines' operational performance activities implemented in Inkeroinen, 13 per cent in Anjalankoski, 8.7 per cent in Espanola, and 4.3 per cent in the machinery workshop and at Heinola Fluting. This was because the technological activities of Anjalankoski's mills improved the cost structure of the end product based on the increased capacity. The technology concentrated by Inkeroinen made it possible to introduce new technology, which positively impacted the final cost of the product structure as well. These included, for example, the

773 The machinery workshop is not included due to the different nature of the investments.

fibre treatment and power plant types of equipment, which were also utilised by other board mills at Heinola Fluting and Espanola, respectively. The continuous quality improvements were very similar: 41.5 per cent of Inkeroinen's, 30.5 per cent of Anjalankoski's, 8.5 per cent of Heinola Fluting's, 11 per cent of Espanola's, 3.7 per cent of Eurocan Kitimat's, 1.2 per cent of Pineville's, and 3.7 per cent of the machinery workshop's investments and operational performance activities were based on continuous quality improvements.

There were three equally distributed production and quality determinants for all investments and operational performance activities in Tampella: capacity expansion by technological development accounted for 30.4 per cent, scale and scope management accounted for 29.7 per cent, and continuous quality improvements accounted for 26.1 per cent of all activities. The proportion of other components for technology activities were low, as 8.3 per cent was based on product cost structure and 5.4 per on manufacturing flexibility. In the market demand context, this result means that the forest industry, which increased its production capacity and improved end product quality, was based on Tampella's machinery workshop's technology knowledge. The priority was to add capacity by means of significant individual investments, and the qualitative development took place through individual equipment or related process-continuous modifications or other activities.

The board manufacturers Inkeroinen and Eurocan Kitimat stressed the need for continuous quality development, so that the increase in capacity was as significant as quality development at the same time. This is evident from the fact that 31.8 per cent of Inkeroinen's investments and operational performance activities were based on continuous quality improvement and 28.0 per cent on capacity expansion by means of technological development. Scale and scope management supported these factors and accounted for 23.4 per cent and product cost structure for 15.0 per cent of activities. Low manufacturing flexibility value accounted for 4.7 per cent, which indicates that the company did not see the swing concept (i.e. multi-product production by the same board machine line) as a sensible alternative. This also took place at Eurocan Kitimat, as one third of all investments and operational performance activities were based on scale and scope management, another third on capacity expansion by means of technological development, and again one-third on continuous quality improvements. All of Tampella's other board manufacturers and the workshop prioritised quantity before quality. 41.3 per cent of Heinola Fluting's investments and operational performance activities were based on scale and scope management, 37 per cent on capacity expansion by means of technological development, and 15.2 per cent on continuous quality improvements. Espanola focused primarily on capacity expansion, which accounted for 34.4 per cent of activities. Secondly, they focused equally on capacity and quality, as both had 28.1 per cent of all investments and operational performance activities based on scale and scope management and continuous quality improvements. 50 per cent of Pineville's investments and operational performance activities were based on the management of scale and scope, 33.3 per cent on capacity expansion by means of technological development, and only 16.7 per cent on continuous quality improvements. 50 per cent of the machinery workshop's investments and operational performance activities were based on the management of scale and scope, 31.8 per cent on capacity expansion by means of technological development, and only 13.6 per cent on continuous quality improvements.

The newsprint manufacturer Anjalankoski stressed the need for continuous quality development more than Inkeroinen, as 39.1 per cent of its investments and operational performance activities were based on continuous quality improvement and 23.4 per cent on scale and scope management. These factors were well supported: capacity expansion by means of technological development accounted for 21.9 per cent, and the product cost structure accounted for 4.7 per cent. As low manufacturing flexibility accounted for 10.9 per cent, it indicates that the company had some multi-product production by the same paper machine line.

4.4.5 Balancing between demand and production capacity

The comparison between Tampella's different business units in Table 27 indicates first that technological decision-making was centralised and co-ordination was based in Finland. This is evident in that the domestic plants' activities were multiple, compared to the number of foreign production plants. The total share of three plants – Inkeroinen, Anjalankoski, and Heinola Fluting – accounted for 70.7 per cent of all investments or operational performance activities. The respective figures of the market factors accounted for 33.4 per cent of activities in Inkeroinen, 20.7 per cent in Anjalankoski and 16.6 per cent at Heinola Fluting. At the foreign production plants, the corresponding figures accounted for only 3.3–9.3 per cent. Second, this result indicates that Tampella's forest units' strategy was to dominate the European markets by continuing in the manufacturing of certain bulk products based on Inkeroinen and Anjalankoski.[774] Third, it is a good result that all domestic production units had evenly between 19–25.8 per cent of activities based on market demand. This indicates that the related production units, including the machinery workshop, understood the importance of monitoring the fluctuations in global demand.[775] Fourth, the price and the timing of the business cycles were the most important, first for Inkeroinen and secondly for Anjalankoski. For instance, Inkeroinen's investments or operational performance activities, which were based on financial downturns, were about twofold those of the Anjalankoski unit. Fifth, despite the cost benefits based on the large capacities of newsprint and board grades, the strong concentration of activities in the manufacture of board and newsprint also constituted a long-standing obstacle to the development of other grades and machinery concepts. This is evident, as Inkeroinen, Anjalankoski, and Heinola Fluting dominated the quantity of the activities, which were based on production quantity and quality.

774 Johanson 1977, pp. 30–31.
775 Alajoutsijärvi et al. 2012, pp. 77–89.

Table 27 The market factors' amount of activities, the distribution between different units and the distribution within the individual unit (N=724).

All market factors and amount of activities	activities	Anjalankoski	Inkeroinen	Workshop	Heinola F	Espanola	Eurocan Kitimat	Pineville
The demand	252	48	65	55	48	23	8	5
The price	79	19	23	4	12	10	6	5
The financial crises	107	23	43	8	12	4	9	8
The production quantity	204	39	73	19	39	23	6	5
The production quality	82	21	38	3	9	7	3	1
Total	724	150	242	89	120	67	32	24
All market factors' distribution between different units		%	%	%	%	%	%	%
The demand		19.0	25.8	21.8	19.0	9.1	3.2	2.0
The price		24.1	29.1	5.1	15.2	12.7	7.6	6.3
The financial crises		21.5	40.2	7.5	11.2	3.7	8.4	7.5
The production quantity		19.1	35.8	9.3	19.1	11.3	2.9	2.5
The production quality		25.6	46.3	3.7	11.0	8.5	3.7	1.2
Total		20.7	33.4	12.3	16.6	9.3	4.4	3.3
All market factors distribution within the individual unit	%	%	%	%	%	%	%	%
The demand	34.8	32.0	26.9	61.8	40.0	34.3	25.0	20.8
The price	10.9	12.7	9.5	4.5	10.0	14.9	18.8	20.8
The financial crises	14.8	15.3	17.8	9.0	10.0	6.0	28.1	33.3
The production quantity	28.2	26.0	30.2	21.3	32.5	34.3	18.8	20.8
The production quality	11.3	14.0	15.7	3.4	7.5	10.4	9.4	4.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. Market data is presented in Annex 4.

Market demand was the most significant determinant of decisions, as it accounted for 34.8 per cent of the activities. In practice, it meant that Tampella's management followed and gained information about the markets and customer needs, which were at least partly used for the company's benefit. It indicates the managerial market orientation attitude, as the management did its best to keep supply and demand in balance. Furthermore, Tampella was also a very technology-orientated company, which is evident in the fact that the production quantity and production quality calculated together accounted for 39.5 per cent of the investment or operational performance activities. The low value of the production quality means that it was not given enough attention before the change in the competitive market environment forced a reaction.

The importance of taking both time and price into account was low, as the economic downturns accounted for only 14.8 per cent of activities and price accounted only for 10.9 per cent of the investments or operational performance activities. The market's price insignificance is interesting, as it determines the profitability of the company. Knowing how paper and board prices fell from 1958 to 1995, I assume that meaningful price increases were not achieved during that period. This means that Tampella did not dominate the market prices, as no one did in the forest industry. In conclusion, as Tampella's management did not take into account the impact of market prices on investment products, this increased their lack of cash flow. In the pulp and paper industry, failure to allocate investment at the optimum time usually increases the company's investment costs. First of all, equipment is generally always more expensive due to increased demand in the economic upturn. Besides, investment in a good market will always increase the downtime cost, as installation of the equipment will be considerably more expensive than downtime due to lost sales. From the resource perspective, the risk of an investment project grows during good demand, as it is more challenging to acquire skilled human resources and schedules are tighter due to lost sales.

Anjalankoski's mill followed and responded to the market fluctuations in more than half of its technological activities, having constant concern about the performance of the production machinery and increasing the capacity of its newspaper production according to demand. As a consequence, 32 per cent of the technology activities were based on demand, and 26 per cent based on production quantity. Less significant was the share of other market factors, such as price, which accounted for 12.7 per cent, and production quality, which accounted for 14 per cent. The low importance of the price lower reduced the potential for profitability. The low importance of production quality limited further development of technical know-how and technology because of the existing lack of customer co-operation and product differentiation. As only 15.3 per cent of the technology activities were implemented during a recession, the timing of the investments or operational performance activities had a secondary meaning in the Anjalankoski unit. It meant that the management did not understand the importance of the timing.

In Inkeroinen, production quantity accounted for 30.2 per cent and demand for 26.9 per cent of the technology decision-making and activities. This development was, first, based on the machinery workshop's dominant position in terms of technology transfer and development within the company. Second, it was based on the fact that the in-house machinery workshop implemented the majority of Tampella's forest business investments, as it was usually the supplier for the major equipment. It was considered to be the self-explanatory way to operate in Tampella due to the machinery workshop focusing its technological know-how and development on the board grades. The customers' co-operation was less significant, as production quality accounted for 15.7 per cent and price for 9.5 per cent of these activities. 17.8 per cent of the technology activities were done during a recession, so the timing of the investments or operational performance activity had little meaning in Inkeroinen as well.

The results of the machinery workshop show that demand was the most important market factor. This is evident in that 61.8 per cent of the investments and operational performance activities were based on demand, and 21.3 per cent on production quantity. This result means that the market demand fluctuations had a very rapid impact on the downsizing or extensions of the machinery workshop's production facilities. Namely, 9 per cent of the machinery workshop's investments and technology activities were done during a low business cycle, so timing mattered. As a consequence, Tampella's management minimised the negative impact of the market fluctuations by diversifying its products into a wide range of industries, such as forest, heavy metals, mining, rock drilling, and power functions. The product differentiation was a great achievement by the company's management, but at the same time it generated significant challenges of leadership skills, cash flow control, scale and scope management, profitability operations and technology development. Thus, Tampella was a typical example of a diversified firm engaged in heavy industries.

The purchasing costs of the machinery workshop's tools increased year after year due to increased automation. All of the machinery workshop's investments and operational performance activities were based on the end products' cost efficiency.

Forty per cent of Heinola Fluting's investment and operational performance, in turn, were based on demand, and 32.5 per cent on production quantity. These are evident because, during many years, the market demand was so good that as a result, the production operation rate reached a high level and, as a consequence, new production records were reached as well. Similarly, due to weak market demand, Heinola Fluting was looking for new market areas without any success. Heinola Fluting did not manage or was not allowed to manage the product portfolio development and new product development; this is based on the fact that 7.5 per cent of investments and operational performance activities were based on production quality and 10 per cent on price. The machinery workshop's role in the development of Heinola Fluting's performance was a positive thing, as the machinery workshop's technology and engineering experts supported Heinola Fluting to achieve several years of record-level production. The negative point was that the machinery workshop focused too much and too long on the development of board grades, which also constrained Heinola Fluting's long-term portfolio development. Ten per cent of the technology activities were done during financial downturns, so the timing of the investments or operational performance activity had a secondary meaning in the Heinola Fluting unit. The cost efficiency improved by increasing capacity, by improved efficiency of the board machine and by the new information technology systems of financial and human resources. The aforementioned technological activities significantly supported the pricing of products, as price understanding and market price estimations were challenging especially during the early 1960s.

In Espanola, management followed and gained information on market demand (34.3 per cent) and price (14.9 per cent) that dominated technology decision-making. For instance, this is evident as the mill responded to customer requirements to improve board quality in 1977. The production unit operated very well in terms of the local market dynamics.

28.1 per cent of all Eurocan Kitimat's investments and operational performance activities were done during a low business cycle, and one-fourth of these activities were based on demand. The financial crises are divided into three subfactors, which explains the result: understanding the local markets' sensitivity, the strong market position, and timing of business cycles to adopt new technology. It means that the local management made investments and operational performance activities that were first market-orientated and, secondly, technologically. In other words, this result reflects the fact that the transfer of technology took place from Finland and the local management tried to survive despite their major technological problems. 18.8 per cent of its technology activities were based on price and on production quantity, which is due to the fact of the local management's understanding of pricing dynamics and the importance of the end products' cost efficiency. Due to very significant technological problems, resources were allocated to get rid of the existing machinery failures. As a consequence, the production quality activities remained low during the early years, which is evident in that only 9.4 per cent of the activities were based on production quality.

The conclusions are that Tampella's management did not take into account the importance of market demand from the perspective of portfolio management and decided to focus further on the board grades. The local mill management's attitude, however, was the reverse, as it was customer-orientated. Tampella's management behaviour reflected conservative decision-making, whereby management repeats previous decisions and strictly refrains from changing its previous strategy, despite changes in the competitive environment and available technology. This is evident, as none of the investments or operational performance activities were based on product differentiation.

One-third of Pineville's investments and operational performance activities were done during financial downturns, and 20.8 per cent of these activities were based on demand, price, and production quantity. Pineville's result is very similar to Eurocan Kitimat, as the financial crises are explained by understanding the local markets' sensitivity, the strong market position, and the timing of business cycles to adopt new technology. The mill management saw market conditions to be important, as 80 per cent of Pineville's investments and individual production lines' operational performance activities were based on demand-pull. Twenty per cent of the mill's investments and operational performance activities were based on technology push and none were based on cooperation with end customers and external suppliers. This means first that the production line started well enough, so there was no need for any further technological activities. Second, Tampella's top management did not prioritise Pineville's development, and their only reason for the joint venture and participation was major machinery delivery from Finland. This is evident in that 4.2 per cent of its technology activities were based on production quality and none were based on product differentiation.

4.4.6 Centralised operations and conservative decision-making

The factual and counterfactual evidence above witnesses that Tampella's top management lacked market orientation in its decision-making. The overall picture I have is that market factors did not affect or only marginally affected the timing and quality of the investment activities concerning Anjalankoski, Inkeroinen, Espanola, Kitimat, Pineville, and the machinery workshop. The analysis of the market variables demonstrates how important it is to get information on the market and to understand its importance in the decision-making of technology investments and operational performance activities.

Market demand was taken into account much better in the home country. The technological decision-making was centralised and co-ordinated based on Finland because the number of the domestic unit's activities were multiple compared to the number of foreign production units. This kind of production and development concentration was typical of the Nordic forest industry companies until 2000.[776] In the case of foreign investments, the different market factors contributed very little to the technological decision-making, so the management did not exploit the market information. Tampella's management focused much more on domestic and European market demand than that in North America and Canada, based on the quantity of technology activities and market prices. The investments and operational performance activities of the individual mill units – Inkeroinen, Anjalankoski, and Eurocan Kitimat – were based on understanding the local market sensitivity. They understood how critical and essential the behaviour of the local markets would be for profitable businesses. Nevertheless, Tampella's top management ignored it, and that was one primary reason why the Eurocan Kitimat investment project was a failure. The company lacked the knowledge and the commitment of their foreign customers in the development process of Tampella's transactions; the company's periodic profitability weakened, and control of cash flow turned out to be too challenging.

From the strategy perspective, Tampella's forest business units' ambition was to dominate the European markets by producing sufficient capacity. This was done by continuing in the manufacturing of bulk products for as long as possible without ignoring higher value products, such as, for instance, liquid packaging boards. Significant investments of the forest business units were based on scale and scope management. On a positive note, Tampella's management's realisation of scale economics reinforced the existing market position by improving production costs. As a consequence, Tampella's management felt that it had a strong market position, especially in newspaper production, so that they did not have to worry about the sensitivity of the local market. In the board business, Heinola Fluting, Inkeroinen, Eurocan Kitimat and Pineville's investments and operational performance activities were also based on a strong market position. It reflects the product-specific orientation; by focusing on just certain products they aimed at achieving a sufficient market position by increasing capacity. This happened in Inkeroinen, despite the fact that the old machines' dimensions in terms of the speed and width significantly limited its capacity development and profitability.

Also, it is a surprising result for Eurocan Kitimat and Pineville, as the local market in North America already had great capacity in cartonboard before the investment decisions took place. The strong newsprint and kraft board market position brought high cost efficiency and supplier reliability for customers. One of the management's exploitation strategies was to continuously and actively improve the product quality. This offers proof about the management's understanding that technological change was needed, based on market demands. Unfortunately, the needed major technology and strategy changes never happened, because of a lack of market-orientated strategy, the too-narrow product portfolio of the forest and metal units, lack of attention to the competitive environment, and technology domination by Tampella's machinery workshop.

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776 Sajasalo 2006, p. 223.

Tampella's management marginally drew attention to the timing of business cycles to adopt new technology, most clearly compared to other financial crisis determinants, without taking a stance on the timing success and profitability of the investment project. The timing of business cycles to adopt new technology was essential for Inkeroinen's production unit, as it was the most active one. Its investments or operational performance activities were about twofold compared to the Anjalankoski unit, the secondmost active one. First, the high quantity of activities means that the employees' activity and commitment were excellent, which further improved the competencies and knowledge. Second, the company invested in a large amount of capital and time. Based on earlier pieces of evidence, it can be stated that Tampella's top management relied in the first instance on continuous development of Inkeroinen and, secondarily, Anjalankoski.

From the portfolio perspective, in all production units, excluding the machinery workshop and the Heinola Fluting unit, only 20 per cent of their investments and operational performance activities were based on diversification of sales areas. Already in the 1960s, the workshop market area comprised more than twenty different countries, so they did not need a separate regional approach, as they had already established global sales operations. For this reason, none of the workshop's investments and operational performance activities were based on diversification of sales areas. Heinola Fluting's investment activities indicate an inability to act according to market dynamics. This means that regional decentralisation was needed to develop the packaging application with local customers, due to the existing fluting market not always being good enough.

Utilisation of the market and the neglect to commit end customers into development can be interpreted as one of the primary reasons why the company's portfolios were extended too late and too narrowly, especially in relation to newsprint, board, and machinery concepts. The management of the portfolio did not succeed in the long term, because there was not sufficient response in time, or the magnitude of changes needed in the market. Multi-product production had some impact on both Anjalankoski's and Inkeroinen's technology activities, and only Anjalankoski was affected by the changes in the consumers' buying habits. From the perspective of manufacturing flexibility, the newspaper units more actively utilised the potential of the available advantage technology to expand their portfolio in newspaper, where the qualitative change potential was, however, much more limited than with the board grades. Anjalankoski and the machinery workshop were much more active in product differentiation compared to the other production units. The low value of product differentiation of Eurocan Kitimat and Pineville indicate that, first, Tampella's strategy was to focus on initially developing new products domestically and then the importance of the local market demand for portfolio management. Second, the strategy of Tampella's forest unit was to primarily grow the board business and, secondly, the newspaper operations. The company's management support was sufficient in terms of the time and capital given to the board technology businesses.

From the perspective of product profits, Tampella's management understood the mechanisms of dynamic pricing and made decisions to improve the end products' cost structure. First, the cost factor impact on investments and individual operational performance activities was based on the end products' cost efficiency and an understanding of pricing dynamics and mechanisms in all of Tampella's production units. For example, the Anjalankoski mill improved the products' cost structure by means of increased capacity. Inkeroinen improved it through the available technology and knowledge, which made it possible to introduce new technology to the mill. Second, a large quantity of the continuous quality improvements took place at the Anjalankoski and Inkeroinen mills due to the centralised resources and knowledge in Finland. Third, the price fluctuations had an impact on the technological activities in Inkeroinen more than in Anjalankoski, because the company's management followed the board cost structure considerably more actively than any other grade's cost structure. This can be one reason why Tampella did not switch its strategy away from the production of newspaper. It is possible that as a result, the machinery workshop did not invest more in the development of machine concepts for other paper grades.

From the machinery workshop's perspective, the dependence on market factors was considerably lower due to many reasons. For instance, its investments were possible to implement alongside ongoing production. Furthermore, it was strongly influenced by product diversification, as it had plenty of different business segments. The machinery workshop had a different business nature because it sold products based on direct customer orders, while the forest units sold their products based on either warehouse quantities or direct customer orders. Besides, the machinery workshop did not need to make continuous capacity investments, like those based on single-stage machine purchases.

Utilisation of the market and neglect of customer-committed development can be interpreted as one of the primary reasons why the machinery workshop's portfolios were extended too late and too narrowly, especially in terms of machinery concepts. The powerful machinery workshop's concentration on the technology of the board industry was primarily due to the lack of dialogue with non-board customers and, secondly, the agreement with Valmet. For examples as late as in 1987, the machinery workshop delivered Tampella's first SC-paper machine to St. Marys Paper Inc. in Canada based on the fact that Rauma Repola was a minority shareholder in the company of the purchaser.[777] The lack of customer-orientation management first limited the board machines' speed and width development, compared to the development of other paper and board grades manufactured by the other machine suppliers. However, it should be remembered that within the equipment of the board machines and stock preparations, Tampella represented decades of excellent know-how. Secondly, its own forest unit businesses were affected negatively, since the development of the machinery workshop's technology was lagging behind its competitors in terms of speed, width, and the portfolio. Thirdly, as the machinery workshop focused on customers and the technology of the board and pulp machines, large numbers of potential customers of other paper and board grades were eliminated. As a result,

777 *Talouselämä Journal* 1987, No. 23.

the negative fluctuations of market demand and international economics were reflected more strongly in Tampella's annual earnings.

The management of Tampella's machinery workshop made an excellent effort to make use of external actors or suppliers through various cooperation agreements to exchange technical and scientific information and design alternatives. On the other hand, these agreements also limited the development of Tampella's machinery workshop significantly. In the machinery workshop's management, a great deal of resources were invested in the development of technology, especially for the board machines, by building several pilot machines to meet the challenges of the future concerning market demand, alternative technologies and the changes of the competitive environment.

4.5 The essential capability factors

The reader needs to remember the constant change of the environment in the forest industry's competition, which has undoubtedly contributed to management decision-making. In the context of Tampella's performance between 1958 and 1995, the dominant changes took place in the international competition, the purchasing habits of the customers, the liberalisation of the markets and banking system, the national laws, and the institutional regulations.[778] Furthermore, in the context of the management's capability, the opportunities, constraints, and preferences and behaviour of the directors and the shareholders were different in the different periods.[779] Based on the aforementioned dynamic parameters, I frame the analysis of the organization's capability to focus on dynamic capability, which is very critical to the company's short- and long-term success in the context of investment.[780] The purpose of this analysis is to identify the main dynamic capability factors in the organization that attracted the attention of Tampella's management within its various operating units.[781]

As mentioned earlier, the academic determination of dynamic capability is not straightforward. For this reason, this analysis involves a large number of related variables. As presented in Table 33, first I define the dynamic capability in relation to four factors which have an impact on organizational decision-making: the top management's capability, managerial competence, the development of human resources, and information. This allows us to analyse the decision-making roles and activities of the executives and the middle managers, as well as if

778 Hjerppe 1989, pp. 53–60, Koskenkylä et al. 1994, p. 14, Lehtiö 2004, p. 174. Dodgson et al. 2008, p. 99, Hoffman 2019, p. 150, Paavonen 2019, p. 90.

779 Chandler 1994, p. 594, Cheffins 2015. Compare Lamberg 2005, pp. 109–110 for Enso-Gutzeit's dual relationship with the State.

780 Mowery and Rosenberg 1979, pp. 105, 111, Nickey 1999, pp. 55–60, Cohendet and Llerena 2003, p. 286, Teece 2007, p. 1346.

781 Kimberly and Bouchikhi 1995, p. 17.

they were capable of sensing favourable business opportunities, making successful decisions, controlling the implementation of decisions, and making needed alignments.[782] Within this core process of the leading operations for long-term survival, the critical decision-making determinants are also the multiplicity of personnel and the sharing of information.

Secondly, I further divide the four factors mentioned above, as presented in Table 33. The top management's capability is divided into seven factors, which are an evaluation of the organizational capabilities and competencies, long-term commitment and company culture, failure to commit employees to the company, commit employees to the company, routines of the debt control problem, failure to estimate agreement consequences, and knowledge and culture to combine joint venture and sales activities.[783] The managerial competence is divided into six factors, which are understanding and sensing business opportunities, reshaping organizational structures (including resources), making decisions and actions without delay, managing threats, managing the needs of the technology, and managing the social ability to absorb technology.[784] The development of human resources is divided into three factors, which are focused on the organization of population, the lack of needed resources, and securing needed resources for the future. The information factor is defined as the development of the information system.[785]

The distribution of a single dynamic capability factor between different production plants reflects first that Tampella's head office and machinery workshop dominated the technology-related decision-making: the head office's activities accounted for 50.4 per cent, as presented in Table 28. Furthermore, it also indicates that the firm's priority was to develop domestic newsprint and board units, and the Espanola unit. The machinery workshop, at 18 per cent, was more independent to make technological and organization-related decisions compared to the forest units, but less than the head office. The machinery workshop's autonomous position was based on different industry-specific transactions and the national culture of the metal industry.[786]

782 Porter 1991, pp. 102–103, 111, Chandler Jr. 1991, pp. 33–34, Zahra and Covin 1993, p. 470, Zollo and Winter 2002, p. 340, Pajunen 2005, pp. 16–18, 33, Sirmon et al. 2007, p. 288, Teece 2007, p. 1326, Stendahl and Roos 2008, p. 672.

783 Abernathy and Clark 1985, p. 5. Harrison and March 1984, p. 39, Hannan and Freeman 1993, p. 201, Magee 1997, p. 239, Kruger and Dunning 1999, p. 1132, Zahra et al. 1999b, p. 201, Armitage and Conner 2001, pp. 486–488, Becker et al. 2005, p. 781.

784 Eisenhard and Martin 2000, pp. 1110–1114, Calantone et al. 2002, p. 522, Hult et al. 2004, p. 436, Teece 2007, pp. 1344–1345.

785 Hannan and Freeman 1993, pp. 7–10, Sydow and Koch 2009, p. 696.

786 Sajasalo 2006, p. 213.

Table 28 The quantity of the investment and operational performance activities based on the dynamic capability factors, the distribution between different units, and distribution within the individual units (N=339).

The dynamic capability factors and amount of activities	activities	HQ	Anjalankoski	Inkeroinen	Workshop	Heinola Fluting	Espanola	Eurocan Kitimat	Pineville
Top Management capability	99	72	0	0	22	2	3	0	0
Managerial competence	216	83	25	17	34	17	16	12	12
Development of human resources	20	12	3	0	5	0	0	0	0
Information	4	4	0	0	0	0	0	0	0
Total	339	171	28	17	61	19	19	12	12
The dynamic capability factors' distribution between different units		%	%	%	%	%	%	%	%
Top Management capability		72.7	0.0	0.0	22.2	2.0	3.0	0.0	0.0
Managerial competence		38.4	11.6	7.9	15.7	7.9	7.4	5.6	5.6
Development of human resources		60.0	15.0	0.0	25.0	0.0	0.0	0.0	0.0
Information		100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		50.4	8.3	5.0	18.0	5.6	5.6	3.5	3.5
Dynamic capability factors distribution within the individual units	%	%	%	%	%	%	%	%	%
Top Management capability	29.2	42.1	0.0	0.0	36.1	10.5	15.8	0.0	0.0
Managerial competence	63.7	48.5	89.3	100.0	55.7	89.5	84.2	100.0	100.0
Development of human resources	5.9	7.0	10.7	0.0	8.2	0.0	0.0	0.0	0.0
Information	1.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Report and internal meeting memos from 1958 to 1995. The organization data is presented in Annex 5.

The pattern of the head office's dominating role being supported by the workshop's minor one was repeated, as 72.7 per cent of the head office and 22.2 per cent of the workshop's investments or operational performance activities were based on the top management's capability. Similar behaviour of the organization is evident, as the development of human resources was as high as 25 per cent of the machinery workshop's activities and 60 per cent for the head office. Fifteen per cent of Anjalankoski's activities were based on the development of human resources, which indicates actions to secure future employees. Tampella's organizational information activities were centralised in the head office.

From the point of view of managerial competence, the head office accounted for 38.4 per cent and the machinery workshop for 15.7 per cent of all investments or operational performance activities. The production units accounted for 5.6–11.6 per cent of activities. From the decision-making perspective, the result indicates that organization-related decisions took place in the headquarters, which then allocated to all production units. Furthermore, local management decision-making was subject to very similar activities regardless of the mill location or products. This result supports the motivation to improve organizational efficiency by the centralisation of common activities.[787]

From the perspective of the individual operation units, the top management's capability in the head office accounted for 42.1 per cent of activities, while 48.5 per cent was based on managerial competence, 7 per cent on the development of human resources and 2.3 per cent on information. The importance of middle management's competencies proves the central role of the head office in the different units' operations. This position was based on the centralisation of critical functions, such as investments and human resource development, in the head office.

787 Korhonen 2006, p. 50.

In the machinery workshop, 36.1 per cent of its investments or operational performance activities were based on the top management's capabilities, 55.7 per cent on managerial competence and 8.2 per cent on the development of human resources. This result indicates that the machinery workshop's managerial actions, which focused on technological development in the engineering context, were more important than the top management's actions in developing the machinery workshop from the point of view of strategy. The aforementioned managerial behaviour was partly based on strong centralisation of several vital functions, such as investments and employee development, in the head office.

The managerial competence in the production units accounted for 84.2–100 per cent of activities. This logical result proves the middle management's critical role in the firm's day-to-day operations in the production facilities.

4.5.1 The firm's most critical decisions

The analyses of the top management's capability focus on defining the board's and the executives' activities to secure employees' organizational competencies and commitment, and to manage the firm's debt, joint ventures and different strategy agreements. Table 29 presents these factors.

Table 29 The quantity of the investment and operational performance activities based on top management's capability factors, the distribution between different units and the distribution within the individual units (N=99).

The top management capability factors and amount of activities	activities	HQ	Anjalankoski	Inkeroinen	Workshop	Heinola Fluting	Espanola	Eurocan Kitimat	Pineville
Evaluation of the organizational capabilities and competencies	49	44	0	0	2	0	3	0	0
The long-term commitment and company culture	12	9	0	0	3	0	0	0	0
Failure to commit employees to the company	9	1	0	0	7	1	0	0	0
Committing employees to the company	17	9	0	0	7	1	0	0	0
The routines of the debt control problem	8	8	0	0	0	0	0	0	0
The failure to estimate agreement consequences	1	1	0	0	0	0	0	0	0
The knowledge and culture to combine JV and sales activities	3	0	0	0	3	0	0	0	0
Total	99	72	0	0	22	2	3	0	0
									R
Top management capability factors between different units		%	%	%	%	%	%	%	%
Evaluation of the organizational capabilities and competencies		89.8	0.0	0.0	4.1	0.0	6.1	0.0	0.0
The long-term commitment and company culture		75.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0
Failure to commit employees to the company		11.1	0.0	0.0	77.8	11.1	0.0	0.0	0.0
Committing employees to the company		52.9	0.0	0.0	41.2	5.9	0.0	0.0	0.0
The routines of the debt control problem		100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The failure to estimate agreement consequences		100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The knowledge and culture to combine JV and sales activities		0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Total		72.7	0.0	0.0	22.2	2.0	3.0	0.0	0.0
The top management capability factors within the individual units	%	%	%	%	%	%	%	%	%
Evaluation of the organizational capabilities and competencies	49.5	61.1	0.0	0.0	9.1	0.0	100.0	0.0	0.0
The long-term commitment and company culture	12.1	12.5	0.0	0.0	13.6	0.0	0.0	0.0	0.0
Failure to commit employees to the company	9.1	1.4	0.0	0.0	31.8	50.0	0.0	0.0	0.0
Committing employees to the company	17.2	12.5	0.0	0.0	31.8	50.0	0.0	0.0	0.0
The routines of the debt control problem	8.1	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The failure to estimate agreement consequences	1.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The knowledge and culture to combine JV and sales activities	3.0	0.0	0.0	0.0	13.6	0.0	0.0	0.0	0.0
Total	100.0	100.0	0.0	0.0	100.0	100.0	100.0	0.0	0.0

Sources: Tampella Annual Reports and internal meeting memos between 1958 and 1995. The organization data is presented in Annex 5.

The comparison between business units indicates that the top management's capability was mainly based on the activities by the head office and the machinery workshop, as the former accounted for 72.7 per cent and the latter accounted for

22.2 per cent. The production units accounted for less than 3 per cent of all investments or operational performance activities. This result proves that the decision-making on operations was concentrated in the head office. The analyses indicate that the firm's top management and executives were more active than the production units in evaluating organizational capabilities and competencies, creating a long-term company culture and routines for survival, and committing employees to the company.[788] This means that the top management focused on critical organizational items to secure the firm's resources. Furthermore, the results prove that the head office was responsible for the firm's debt, including related transactions' consequences. This is evident in that the factors mentioned above accounted for 52.9–100 per cent of activities.

The top management of the machinery workshop was independent, especially in the decision-making on strategy and sales.[789] This is shown in the fact that all activities in the factor of knowledge and the culture to combine joint ventures and sales activities were concentrated in the top management. Besides, the machinery workshop's management failed to commit their employees to the company. This is evident, as 77.8 per cent of the activities were based on the failure to commit employees to the company and 41.2 per cent were based on committing employees to the company.

From the perspective of the individual operational units, the dominant top management capability factor was the evaluation of organizational capabilities and competencies, which accounted for 49.5 per cent of all activities. The factors of committing employees to the company and long-term commitment and company culture represented 17.2 and 12.1 per cent of all activities. This indicates that the top management paid attention to the organization's capabilities, competencies and committed resources. Unfortunately, executives did not focus enough on the critical items - the quantity of the debt, and joint venture and sales activities. This is evident with only 8.1 per cent of all activities were based on the routines of the debt control problem, and only 3 per cent of all activities on the knowledge and culture to combine joint venture and sales activities.

The headquarters focused on securing the company's capabilities, competencies and available resources, as 61.1 per cent of its activities were based on an evaluation of the organizational capabilities and competencies, and 12.5 per cent of its activities on committing employees to the company. As only 12.5 per cent of its activities were based on long-term commitment and company culture, it indicates that the head office's decision-making focused more on securing short-term than long-term operations. The activities mentioned above were, for instance, to manage the balance between production and demand in the forest businesses, maintain a constant order backlog in the machinery workshop by sales activities and by internal or external political decisions,[790] and short-term actions

788 Chandler Jr. 1991, p. 48.
789 Dess and Davis 1984, pp. 476–477.
790 These included a new board machine for Inkeroinen and joint ventures for fibre supply and for machinery deliveries to Eurocan Kitimat and Pineville Kraft.

to manage increased debt and related costs. The most critical issue was debt control to secure the company's survival in the long term by increasing cash reserves for periods of financial downturns. The executives repeated past actions many times to deal with the substantial debt and only between 1958 and 1962 was the debt ratio below 120 per cent, considered satisfactory.[791] The lack of needed activities to manage debt is evident, as the related factor accounted only for 11.1 per cent of the head office's activities. From the firm's long-term performance perspective, it is evident that Tampella's executives implemented new investments[792] without solving the debt problem, as the firm's gearing rate was continuously weak between 1958 and 1995.[793] Already in 1973, the director Sucksdorff highlighted the fact that the firm had to improve its funding status by reducing investments and improving operational performance.[794]

The headquarters' dominant position directly reflected on the production units' behaviour, as none of Anjalankoski's, Inkeroinen's, Eurocan Kitimat's or Pineville's organizational activities were based on any of the factors of the top management's capabilities. Only Espanola's and Heinola Fluting's production units were exceptions. All of Espanola's activities were based on an evaluation of the organizational capabilities and competencies. This indicates that Espanola was authorised to make independent decisions at a specified period, for instance, during the local economy or market crisis, which were due to the board price reductions, increased inflation and customs taxes in Spain. The management of Heinola Fluting focused on controlling and securing employee availability, which is evident as half of its activities were based on the failure and another half on the success to commit employees to the company.

In the machinery workshop, the management focused on employee commitment, as its failure and success both accounted for 31.8 per cent. Furthermore, 13.6 per cent of activities were based on long-term commitment and company culture and, secondly, on knowledge and the culture to combine joint ventures and sales activities. The management did minor organizational decisions and operations to improve capabilities and competencies, which is evident as only 9.1 per cent of activities were based on an evaluation of organizational capabilities and competencies. The machinery workshop's management failed to control debt, as none of the activities were based on the routines of the debt control problem or the failure to estimate agreements' consequences. It means that the top management focused on organization-related cost reductions instead of the changes in the firm's business strategy or reduction of investments.[795]

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791 Tampella Annual Reports from 1958 to 1995.
792 See Figure 5.
793 See Figure 8.
794 Director Sucksdorff's letter to board members 2.2.1973, Tampella Elka archives, Mikkeli.
795 Oy Tampella Ab board meeting memo 8.4.1972.

4.5.2 The roles and competencies of middle management

Another determinant, managerial competence, highlights the individual investments or technology performance activities by the middle management.[796] Their working environment was framed and guided by the executives' strategies and decisions, but for their part they were responsible for developing technology and the end products' quality together with the people of the market, production and research.[797]

A comparison between business units indicates that the head office accounted for 38.4 per cent and the workshop 15.7 per cent of all activities based on managerial competence. The production units accounted for 5.6–11.6 per cent of all activities, as presented in Table 30. The head office had a critical role in three managerial competence factors: understanding and sensing the business opportunities, making decisions and actions without delay, and managing threats. The factors mentioned above accounted for 45.5–70.8 per cent of all activities compared to the machinery workshop and production units. The result above indicates substantial centralised operations, such as reorganizations, since 1973. The production units' low quantities of organizational activities indicate that they were focused on implementing the head office's decisions.

Table 30 The quantity of investment and operational performance activities based on the managerial competence factors, the distribution between business units and the distribution within the individual units (N=216).

The managerial competence factors and amount of activities									
Managerial competence	activities	HQ	Anjalankoski	Inkeroinen	Workshop	Heinola Fluting	Espanola	Eurocan Kitimat	Pineville
Understanding and sensing the business opportunities	82	40	9	3	20	4	2	1	3
Reshaping organization structures including resources	23	8	1	1	8	2	1	1	1
Decisions and actions without delay	22	10	1	2	0	3	2	2	2
Managing threats	24	17	2	0	2	0	1	2	0
Managing the needs of the technology	39	7	5	7	4	4	4	4	4
Managing the social ability to absorb technology	26	1	7	4	0	4	6	2	2
Total	216	83	25	17	34	17	16	12	12
The managerial competence factors between different units		%	%	%	%	%	%	%	%
Understanding and sensing the business opportunities		48.8	11.0	3.7	24.4	4.9	2.4	1.2	3.7
Reshaping organization structures including resources		34.8	4.3	4.3	34.8	8.7	4.3	4.3	4.3
Decisions and actions without delay		45.5	4.5	9.1	0.0	13.6	9.1	9.1	9.1
Managing threats		70.8	8.3	0.0	8.3	0.0	4.2	8.3	0.0
Managing the needs of the technology		17.9	12.8	17.9	10.3	10.3	10.3	10.3	10.3
Managing the social ability to absorb technology		3.8	26.9	15.4	0.0	15.4	23.1	7.7	7.7
Total		38.4	11.6	7.9	15.7	7.9	7.4	5.6	5.6
The managerial competence factors within the individual units	%	%	%	%	%	%	%	%	%
Understanding and sensing the business opportunities	38.0	48.2	36.0	17.6	58.8	23.5	12.5	8.3	25.0
Reshaping organization structures including resources	10.6	9.6	4.0	5.9	23.5	11.8	6.3	8.3	8.3
Decisions and actions without delay	10.2	12.0	4.0	11.8	0.0	17.6	12.5	16.7	16.7
Managing threats	11.1	20.5	8.0	0.0	5.9	0.0	6.3	16.7	0.0
Managing the needs of the technology	18.1	8.4	20.0	41.2	11.8	23.5	25.0	33.3	33.3
Managing the social ability to absorb technology	12.0	1.2	28.0	23.5	0.0	23.5	37.5	16.7	16.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. The organization data is presented in Annex 5.

796 Miles and Snow 1986, pp. 64–65, Rothwell 1992, pp. 236–237, Hannan and Freeman 1993, pp. 7–10, Chandler 1994, p. 594, Alajoutsijärvi et al. 2012, p. 293, Ojansivu et al. 2013, p. 1326.

797 Child 1972, p. 17, Armour and Teece 1980, pp. 470–474, Williams et al. 1995, p. 31, Williams and Edge 1996, pp. 875–877, Hammedi et al. 2011, pp. 662–679, Zarrabi and Vahedi 2012, p. 26.

The headquarters was responsible for managing the changes of the business and financial market environment, as it accounted for 70.8 per cent, and production units accounted for only 0–8.3 per cent of all activities, based on managing threats. In consequence, they also proceeded in decisions and actions without delay, which is evident as it accounted for 45.5 per cent of all activities. The production units had only a minor role in making critical business decisions or acting on related actions without delay, as all production units had 4.5–13.6 per cent of all activities. This result indicates that the headquarters was capable of making quick decisions, such as employee lay-offs or rewards. In the 1960s, there were no delays in implementing new investment projects after the top management's decisions. Later, year by year, the delays were increased.[798]

Based on the obtained results, Tampella centralised risk management operations in the head office and, secondly, the production units had a low risk management approach. Some of the production units had a minor role in managing the threats; in Anjalankoski, Espanola and Eurocan Kitimat, this accounted for 4.2–8.3 per cent of all activities. At Eurocan Kitimat, the primary related activity focused on solving the existing problems of new machinery and related processes in 1971. This is also evident in that Inkeroinen, Heinola Fluting and Pineville did not have any investments or operational performance activities based on managing threats. Interestingly, the machinery workshop accounted for only 8.3 per cent of all activities based on the managing threads. They focused more, for instance, on production flexibility, standardisation, and engineering programs, but not risk management,[799] customer credits or investment projects. The one core constraint of profitable business was the quantity of the machinery workshop's customer credits.[800]

The analysis shows that the production units dominated the technology needs and acted as the principal agents for the technology absorption into the company, which were further supported by the head office. The technology-related factors accounted for 7.7–26.9 per cent of all activities in the production units, which indicates strong local mill-level commitment to absorb and manage technology. For instance, the mills successfully developed new grades, improved work productivity and increased production flexibility. On the other hand, in the case of technology adoption disturbances, the mills faced weak start-ups, unsolved quality issues and weak cost structure. The same result was also reflected at the head office and the machinery workshop, which accounted for 3.8 and 0 per cent of all activities based on managing the social ability to absorb the technology. Inkeroinen's board mill and the headquarters both accounted for 17.9 per cent of all activities based on managing the needs of the technology. This result reflects the desire of the firm's top management to focus its technological know-how on board-grade production. The other production units accounted for 10.2–12.8 per cent of investments or operational performance activities based on managing the needs of the technology.

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798 Tampella Annual Reports from 1958 to 1995.
799 Black et al. 2017, pp. 1–58.
800 Tampella Annual Reports 1962, 1963, 1966, 1968 and 1969.

The analysis result of the managerial competence factors distribution per production unit indicates that the management made many efforts to sense and understand the international business environment since 1958, as the factor of understanding and sensing new business opportunities accounted for 38 per cent of all activities. A combined value of technology accounted for 30.1 per cent of all activities, as the factors of managing the needs of the technology accounted for 18.1 per cent and managing the social ability to absorb technology for 12 per cent. This means that the management understood the equal importance of technology and business operations for the company's long-term success.

The management did not pay so much attention to the organizational operations, decisions implementation and threats, as related factors accounted for only 10.2–11.1 per cent of all activities. The interpretation of this result is both positive and negative. The conclusion is negative in that middle management should implement reorganization according to the top management's decisions; they did not, as reorganization activities accounted for only 10.6 per cent. It can be, however, regarded as a positive item based on the statement that middle management focused more on daily production, which improves cash flow through higher production efficiency. On the other hand, the top management's decisions might have been insignificant in situations where major strategic decisions should have taken place. For instance, in 1972, the head of the machinery workshop Forss's statement indicates weak decision-making:

> *The only way to improve machinery workshop's profitability will be the reduction of the machinery workshop's costs by the white-collars' decentralisation, disability pension and layoffs.*[801]

As decisions and actions without delay were accounted for only 10.2 per cent of all activities, it indicates that the middle management was not capable of making or not allowed to make rapid decisions. The low value of the managerial competence to manage the risks may indicate the lack of the risk management culture. From the perspective of the head office, the result proves that it did not focus on technology needs, and managing technology accounted for only 9.6 per cent of the head office's activities. The centralised headquarters organization paid attention to understanding and sensing business opportunities, and managing threats, which accounted for 48.2 and 20.5 per cent of its activities. The negative impact of organization centralisation is evident, as only 12 per cent of its activities were based on making decisions and actions without delay, and 9.6 per cent of its activities were based on the factor of reshaping organization structures, including resources.

The aforementioned negative performance is evident as the headquarters did not respond to continued weak revenue in time. Besides, the organization

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801 Oy Tampella Ab management meeting memo 8.4.1972.

had every chance to learn from its past decisions and the consequences. The history of the critical concerns proves the opposite: control of debt,[802] a very late shift from newsprint and kraft board to higher value-added grades, the machinery workshop's limited development of new machinery technology, and the harmful national co-operation agreements. This top management's behaviour is strange, as, for instance, CEO Grotenfelt's stated already in 1970:

We could sell much more MF and MG grades to paper merchants and converters as we do nowadays. Furthermore, we are 20 years behind in technological development, because our portfolios do not have coated grades.[803]

From the perspective of the production units, the analyses indicate three significant issues. First, they focused primarily on technology development and absorption, and secondarily on organization. This is evident, as the technology-related factors to absorb or manage the needs of the technology comprised 16.7–37.5 per cent of their activities, excluding the machinery workshop. The production units' strong technology orientation is also evident, as the factor of reshaping organization structures, including resources, accounted for only 4–11.8 per cent of their activities. Second, the production units' management supported technology development significantly, along with understanding of the business opportunities, in Anjalankoski, Inkeroinen, Heinola Fluting, and Pineville. This is evident, as the factor of understanding and sensing the business opportunities were 17.6–36 per cent of their activities. Third, the local mill management of Heinola Fluting, Espanola, Eurocan Kitimat, and Pineville faced daily operational challenges, which required an immediate response. This is proven, as making decisions and actions without delay accounted for 12.5–17.6 per cent of their activities, compared to Anjalankoski and Inkeroinen, in which these activities accounted for 4 and 11.8 per cent, respectively.

For the machinery workshop, first of all, its management made a lot of sales efforts and activities to find new businesses, which indicates the market-orientated behaviour. This is evident, as 58.8 per cent of its activities were based on the factor of understanding and sensing business opportunities. The technology-related factors accounted for only 0–11.8 per cent of its activities, which indicates low importance of developing its manufacturing machines. The research and pilot facilities did not require as much effort as the business transactions did. On the other hand, the latest external technologies were not absorbed, as there existed no direct activities based on the factor of the social ability to absorb the technology. The top management primarily focused many times on the reorganization of the sales functions, but not the technology-related organization.[804] This is evident, as the factor of reshaping organization structures, including resources, accounted for as high as 23.5 per cent of activities in the machinery workshop.

802 Oy Tampella Ab management meeting memo 8.4.1972. Banks were concerned about the debt burden and financial situation.
803 CEO N.G. Grotenfelt's memos from 1954 to 1970, Elka archives, Mikkeli.
804 Tampella Annual Reports 1966, 1969, 1972–74, 1976, 1979, 1981, 1983, 1986–87, 1990 and 1992.

From the risk management perspective, the machinery workshop was not capable of managing the short- and long-term risks. The debt represented a continuous short-term threat, which remained unsolved during the entire lifetime of the firm. The long-term threat was the lack of management's vision of future technology requirements for their customers' needs and requirements. This is evident, as only 5.9 per cent of the machinery workshop's activities were based on managing threats.

Most of Eurocan Kitimat's activities focused on problem-solving in the technology context, which took both time and money. This is first evident as half of its activities were based on technology-related factors; second, 16.7 per cent of its activities were based on risk management, and 16.7 per cent of its activities were based on decision-making without delays. The organization-related activities were a secondary issue for Eurocan Kitimat, as only 8.3 per cent of its activities were based on the factor of reshaping organization structures, including resources. Pineville's management focused, in the order of priority, on technology development, business transactions, and decision-making without delay. This is evident in that the technology-related factors accounted for 50 per cent, sensing the business accounted for 25 per cent and decision-making accounted for 16.7 per cent of its investments or operational performance activities.

As Table 30 shows, the behaviour of the production units differed from each other. In Anjalankoski, the activities in order of priority focused on technology, the organization and risk management. This is evident, as both the needs and absorbing of technology accounted together for 48 per cent, organization accounted for 36 per cent, and managing risks accounted for 8 per cent of its activities. In Inkeroinen and Pineville, the management focused, in order of priority, on technology, organization and daily operations. This is evident, as both factors of technology needs and absorption accounted for 64.7 per cent, organization accounted for 17.6 per cent, and making decisions and actions without delay accounted for 11.8 per cent of its activities in Inkeroinen. In Pineville, both factors of technology needs and absorption accounted for 50 per cent, organization accounted for 36.3 per cent, and making decisions and actions without delay accounted for 16.7 per cent of its activities. Heinola Fluting's and Espanola's behaviour was equal to Inkeroinen, so that the technology-related activities dominated the organization and making daily decisions and actions without delay. At Eurocan Kitimat, the management focused, in order of priority, on technology, daily operations and organization. This is evident, as both factors of technology needs and absorption accounted for 50 per cent, making decisions and actions without delay accounted for 33.4 per cent, and organization accounted for 16.6 per cent of its activities.

4.5.3 Employee development

A comparison between the business units indicates in order of priority that the head office dominated the development of the human resource factors.[805] This accounted for 60 per cent, the machinery workshop for 25 per cent, and Anjalankoski for 15 per cent of all activities, as presented in Table 31, indicating substantial centralised operations to manage and develop the firm's resources by means of the headquarters' operations. Furthermore, the result indicates that the machinery workshop partly developed their resources both by itself and by the headquarters.[806] The result mentioned above is also logical and evident, as the headquarters' factors of the organization population and securing needed resources for the future accounted for 100 per cent and 83.3 per cent of all activities. At times, Anjalankoski and the machinery workshop required skilful and specific resources, as they reported a lack of needed resources. This is evident in that the factors mentioned above accounted for 42.9 per cent and 57.1 per cent of all activities. This result indicates a degree of failure in the firm's centralised development of human resources in Anjalankoski and at the machinery workshop.

Table 31 The quantity of investment and operational performance activities based on the development of the human resources, the distribution between business units and the distribution within the individual units (N=20).

Development of human resources factors and amount of activities	activities	HQ	Anjalankoski	Inkeroinen	Workshop	Heinola Fluting	Espanola	Eurocan Kitimat	Pineville
Focusing on organization population	7	7	0	0	0	0	0	0	0
The lack of needed resources	7	0	3	0	4	0	0	0	0
Securing needed resources for future	6	5	0	0	1	0	0	0	0
Total	20	12	3	0	5	0	0	0	0
Development of human resources factors distribution between units		%	%	%	%	%	%	%	%
Focusing on organization population		100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The lack of needed resources		0.0	42.9	0.0	57.1	0.0	0.0	0.0	0.0
Securing needed resources for future		83.3	0.0	0.0	16.7	0.0	0.0	0.0	0.0
Total		60.0	15.0	0.0	25.0	0.0	0.0	0.0	0.0
Development of human resources factors within the individual units	%	%	%	%	%	%	%	%	%
Focusing on organization population	35.0	58.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The lack of needed resources	35.0	0.0	100.0	0.0	80.0	0.0	0.0	0.0	0.0
Securing needed resources for future	30.0	41.7	0.0	0.0	20.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0

Sources: Tampella Annual Reports and internal meeting memos between 1958 and 1995. The organization data is presented in Annex 5.

Analyses of the human resources' development within the individual units indicate that the human resources development was implemented holistically, which is evident from the even distribution of the result across all three factors: the organization population accounted for 35 per cent, the lack of needed resources 35 per cent, and securing needed resources 30 per cent of all activities. Despite the centralised operations of the headquarters, Anjalankoski and the machinery workshop continuously reported about their lack of skilled employees. This is evident, as Anjalankoski had 100 per cent of its activities and the machinery workshop 80 per cent of its activities based on the factor of the lack of needed

805 Hannan and Freeman 1993, pp. 7–10, Abramovitz 1993, pp. 217–243, Sydow and Koch 2009, p. 696.

806 Yang 2012, pp. 43–44.

resources. The primary issue was that the company's centralised organization was not successful in respect to each business unit's development of the resources, especially in the machinery workshop, as they did not have enough resources year after year. A similar failure of human resource development is evident, as all production units had 0 per cent of their activities based on the focus on the organization population and the secure needed resources for the future. As a result, the middle management was not authorised to secure available resources for the future in the production units, excluding the machinery workshop, as it accounted for 20 per cent of its activities, which was based on securing needed resources for the future.

4.5.4 Information processing

The comparisons between the business units and within the individual units both indicate a centralised and robust operation by headquarters, which was responsible for the overall sharing of information within the company. The factor of the information development system accounted for 100 per cent of all activities, as presented in Table 32. The low activities of information can be interpreted as indicating that the information system was not the primary interest of the management.

Table 32 The quantity of the investment and operational performance activities based on the information factors, the distribution between business units and the distribution within the individual units (N=4).

Information factors and amount of activities	activities	HQ	Anjalankoski	Inkeroinen	Workshop	Heinola Fluting	Espanola	Eurocan Kitimat	Pineville
The development of the information system	4	4	0	0	0	0	0	0	0
Total	4	4	0	0	0	0	0	0	0
Information factors distribution between different units		%	%	%	%	%	%	%	%
The development of the information system		100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Information factors within the individual units	%	%	%	%	%	%	%	%	%
The development of the information system	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Sources: Tampella's Annual Reports and internal meeting memos between 1958 and 1995. The organization data is presented in Annex 5.

4.5.5 The dominant hierarchical organization

As presented in Table 33, the results follow the structure of the hierarchical organization, that is, management executing the decisions of the executives: managerial competence was the major dominating factor at 63.7 per cent, whereas the top management's capability was 29.2 per cent. Low activities in the development of human resources indicate that it was not the company's primary focus. The lack of the employee development partly limited the technology transfer and technology development, which were both critical requirements for Tampella. As information accounted for only 1.2 per cent of all activities, it proves its low importance for the top management's decision-making. This is also evident in CEO N.G. Grotenfelt's closing of the company's information journal *Tänään* in 1975.[807]

Table 33 The distribution of dynamic capability factors (N=339).

			Evaluation of the organizational capabilities and competencies	49.5
			The long-term commitment and company culture	12.1
			Failure to commit employees to the company	9.1
	Top Management capability	29.2	Committing employees to the company	17.2
			The routines of the debt control problem	8.1
			The failure to estimate agreement consequences	1.0
			The knowledge and culture to combine JV and sales activities	3.0
			Understanding and sensing the business opportunities	38.0
			Reshaping organization structures including resources	10.6
	Managerial competence	63.7	Decisions and actions without delay	10.2
			Managing threats	11.1
The dynamic capabilities			Managing the needs of the technology	18.1
			Managing the social ability to absorb technology	12.0
			Focusing on organization population	35.0
	Development of human resources	5.9	The lack of needed resources	35.0
			Securing needed resources for future	30.0
	Information	1.2	The development of the information system	100.0

Sources: Tampella Annual Reports and internal meeting memos from 1958 to 1995. The organization data is presented in Annex 5.

807 Tampella internal memo 20.8.1975.

5 CONCLUSION

On the basis of the factual and counterfactual evidence, Tampella's corporate history proves that the most significant factors for the firm's bankruptcy were the state-controlled forest cluster, political spheres, national banks and top management's organizational capabilities, as presented in Picture 16. In the diversified conglomerate Tampella, the top management's challenges were significant as, at the same time, they represented both a purchaser and an equipment supplier in the conservative pulp and paper industry's competitive environment.[808] Another challenge was that a majority of the technology investment and strategy decisions had a nonergodic and significant path-dependent nature in an organizational, technological and political context.[809] It is evident that in both Tampella's forest units and machinery workshop, the top management's past decisions and related actions determined future business strategy and framed technological alternatives. The strong technological dependence on the forest and metal industries significantly affected the firm's life cycle.

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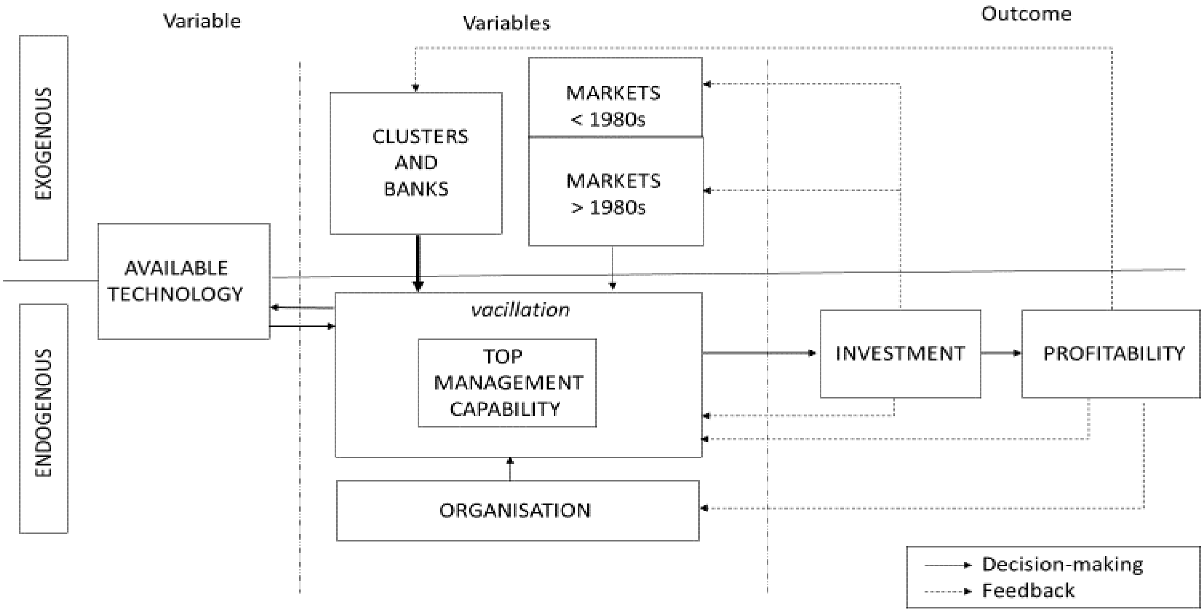
808 Hoskisson 1987, p. 641.
809 Kimberly and Bouchikhi 1995, p. 17, Mintzberg 2001, pp. 89–93, Lamberg et al. 2004, pp. 335–365, Sydow and Koch 2009, pp. 689–709.

Picture 16 A conceptual model based on the analyses of the decision-making and feed-back processes in the context of the top management's organizational capability.



Tampella is an excellent example of several variables' interaction, as the firm's technological development was based on the collaboration of national clusters, top management leadership and managerial operations. The primary reason for the stagnation of its technological development and, later on, the entire firm's collapse was the firm's *cluster-related* cooperation agreements and institutions.[810] This was a common approach for Finnish companies to make agreements between machine manufacturers to obtain and learn of technology and improve machinery manufacturing knowledge. From a national point of view, the significant cooperation between the companies in the different sectors, the Finnish government and institutions increased the technological development and the value of Finnish industry exports and the national Gross Domestic Product.[811] For instance, in France, institutional activity was considered as one of the reasons for the slow development of national technology.[812] Some firms had success better than others; for some, the cluster-related operations were even devastating.[813] For the operation of a national machinery workshop in the forest industry, the cluster activities in question led to the success of individual companies, such as Valmet, and the destruction of others, such as Tampella.[814] Another fundamental reason was that the firm's top management did not set a clear goal for the machinery workshop to evaluate its technological goodness in terms of the machines' speed

810 Lilja et al. 1992, pp. 142, 148, David 1994, pp. 217–218, Lamberg and Ojala 2001, p. 156, Sajasalo 2003, p. 151, Fellman and Shanahan 2018, p. 657.
811 Lamberg and Ojala 2001, pp. 159–162, Jalava et al. 2007, p. 301, Jensen-Eriksen and Ojala 2015, p. 549, Särkkä et al. 2018, p. 281.
812 Gutiérrez-Poch 2018, pp. 183–184.
813 Kenney and von Burg 1999, pp. 67–103, Jensen-Eriksen and Ojala 2015, p. 525.
814 Toivanen 2005, p. 166.

and width, which indicates that technology was not integrated into the firm's strategy.[815]

Another core reason for the firm's collapse was its *debt*, which had constituted significant critical risks for its long-term survival already since the 1970s.[816] One of the stumbling blocks of the company was the independence of the investments made by the forest industry, in particular, regardless of the company's ability to make a profit. Furthermore, the firm's tragedy consisted of the financing of the forest units' and machinery workshop's transactions. In the company's forest industry, the capital investments for the technology and the strategy transactions were both expensive and significant path-dependent matters in the long term. It was expensive, as the major equipment and related process devices purchased were expected to last for the next 30 years. It was also a complicated matter due to the international competition, which created continuous market dynamics by production overcapacity, fluctuation of market prices and the continuous quality requirements of the end products. From the machinery workshop's perspective, financing the customer's major equipment during the project period created significant challenges in terms of liquidity in the entire company.

The members of the board, the executives, the banks and the auditors knew of the firm's increased amount of debt and cash-flow status, as these were indicated repeatedly in the internal meetings and annual balance sheets.[817] The debt generation was primarily due to the top management's decisions, which were partly due to the loose financing policy of national financing institutions for the Finnish forest industry.[818] For instance, the firm's new owner SKOP in the early 1980s immediately commanded intensive investments, which collapsed the capital turnover and the equity ratio from satisfactory to weak, as presented in Figure 9.[819] The continuous debt issue allowed banks to take the firm's ownership and, later on, all leadership.[820] The national banks' aggressive strategic moves changed the ownership of several Finnish companies, including Tampella. The primary reason for the firm's bankruptcy was that it became a victim in the power struggle between SKOP and Union Bank when they aimed to expand their ownership in Finnish industrial companies at the end of the 1980s.[821]

The management cannot be blamed for trying, as it made many organizational efforts to improve operations in all Tampella's units, as seen in the results of the analyses. The top management was periodically capable of generating high turnover, but the capability to manage financials and create continuously profitable business was weak due to organizational cognitive limitations, routines and

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815 Orlikowski and Gash 1994, p. 18.
816 Hambrick and Daveni 1988, p. 20, Lilja et al. 1992, p. 145.
817 Tampella Annual Reports from 1958 to 1995.
818 Sajasalo 2006, p. 215.
819 Skippari 2005, p. 143.
820 Chandler 1994, p. 338. In Britain, the banks' and the government's intervention took place due to technology changes in shipbuilding and railroad equipment.
821 Hyytinen et al. 2002, p. 39, Honkapohja 2012, pp. 1–25, MaCartney et al. 2020, pp. 1–24.

an inability to learn from the past.[822] There was an insufficient response to the seriousness of the issues, even though the signs of the firm's debt and poor performance, newspaper sales margin reduction, and cyclical order book of the machinery workshop were apparent very early on. Even the firm's gearing rate was continuously weak between 1958 and 1995. The executives repeated past actions many times to deal with the substantial debt, without long-standing success after 1962, and also implemented new investments without solving the debt issue since the 1970s.[823]

From the firm's endogenous perspective, the executives and top management had limited organizational capability, as they did not interpret or utilise the information of the business cycles, markets and prices, even though this should always be a fundamental determinant for new investment decisions.[824] Several scholars highlight the importance of the external environment's information and internal capabilities and skills, which together create critical factors for a firm's strategies and success.[825] Although the top management received common information and produced it also in-house (for instance, for Eurocan Kitimat's investment project), it did not sufficiently influence the firm's strategic decisions. One of the reasons for the Kitimat project's failure was because the central equipment technology represented the most challenging technology on the market in terms of speed and width, and when initially supplied in 1968 it did not work as required. This is evident, as Kitimat's kraft- and test-liner machines supplied by Tampella had a speed advantage between 1968 and 1973, and a width advantage up to 1996, compared to competitors of its respective board grades. The executives' past experiences and their interpretations of the competitive environment had a significant influence on the firm's performance via business and manufacturing strategies, for instance, such as the technology integration into the firm's businesses.[826] As a consequence, the debt management and development of the portfolio and paper and board machine technology were locked in over a long period.[827]

Another example of the top management's business understanding was the nonergodic TVW agreement in 1969, which primarily restricted the firm's technological development in the machinery workshop and also framed the end

822 Chandler Jr. 1991, p. 49, Levinthal and March 1993, p. 110, Kimberly and Bouchikhi 1995, p. 17, Lane and Lubatkin 1998, p. 474, Zahra et al. 1999a, p. 185, Feldman 2003, pp. 748–749, Hamel and Välikangas 2003, p. 54. In *Aamulehti* 14.11.1991, p. 19, the CEO of Solidium and Sponda (holding companies owned by the Central Bank of Finland), Veli Korpi, explained that the seasonal variations of economics were the major reason for Tampella's weak profitability.

823 Tampella internal memo 12.03.1973 on competitor analysis of gearing rate, return on investments, capital turnover and turnover.

824 Barney 1986a, pp. 1237–1240, Adner and Levinthal 2002, pp. 1–29.

825 Dess and Davis 1984, p. 477, Porter 1985a, pp. 77–78, Rosenberg 1994, p. 74, Zahra et al. 1999b, p. 191, Lamberg and Ojala 2001, pp. 165–166, Teece 2007, pp. 1322–1326, Eloranta et al. 2010, p. 90.

826 Kuran 1988, p. 167, Williams et al. 1995, p. 25, Daniels 1996, p. 1258, Jensen-Eriksen and Ojala 2015, p. 539.

827 Cohen and Levinthal 1990, pp. 135–138, Arthur 1994, pp. 13–32, Sydow and Koch 2009, pp. 689–709.

products' portfolio development in the paper and board production units from the perspective of paper and board machine technology. The latter was most influenced by the fact that the production units mainly bought their major technology from the firm's machinery workshop, up to the beginning of the 1980s. As a result of the TVW agreement, the cartonboard, kraft- and test-liner machines manufactured by Tampella's machinery workshop had higher machine speed than the global markets between 1958 and 1991. After that, the cartonboard and kraft- and test-liner machines' speed development stagnated. The situation was the opposite of the newsprint machines throughout the analysis period.[828] From the perspective of the machines' width, development was on the same page as the major global machinery suppliers in the newsprint, cartonboard, kraft- and test-liner, woodfree and coated woodfree machines (excluding tissue) until 1981. Unfortunately, this know-how was not utilised in the firm's paper and board mills due to strong path dependence after 1969.829

At the same time, Tampella's business sectors without similar agreements remained successful (for instance, the side mining and energy products). From the perspective of portfolio development, the influence of Finpap's sales cartel was significant; due to that, the development of new paper grades did not take place until the market forced that.[830] It can be stated that the firm's performance had the features of technological determinism with the social and ruling élite context.[831]

For years, the firm's top management did not make significant decisions that would have changed the firm's strategies. Instead, the top management made many decisions regarding the organization's capabilities, competencies and committed resources; these were important but secondary for the firm's survival. For instance, Tampella's productivity was only better than Kymi Oy and Enso-Gutzeit between 1958 and 1967, as presented in Figure 14. One primary reason was the organizational bureaucracy, which grew from time to time by increasing the power of the central administration and the board of directors. As a result, the company's real need for change did not take place, even though its debt increased steadily. This situation was illustrated well at the firm's long-term planning meeting in 1979:[832]

Profitability has improved, but permanent change requires renewal and maintenance programs, substantial investment in new development projects, and revision of the organization.

828 See Table 2.
829 Average design width is calculated value (average) from Europe (excluding the Nordic countries), the Nordic countries, North and Latin America, and Asia.
830 On the relationship between Kymiyhtiö and Finpap, see Ojala 2001, pp. 39–40. See Heikkinen 2000.
831 Williams and Edge 1996, p. 866, Lamberg and Laurila 2005, p. 1825.
832 Tampella internal memo 27.6.1979: PTS meeting on long-term planning for 1980–84.

The firm's short-term profitability improved primarily by increasing production efficiency in the mill facilities. From the investment perspective, after the 1960s, those projects' delays increased year by year due to the slowness of decision-making.

The fundamental leadership problem was primarily due to Tampella's executives, the board and top management, not being capable of successfully challenging the prevailing practice of Finnish businesses, which already had long history of strong political and business spheres and an élite tone.[833] The significant fact is that the interference of powerful Finnish individuals and the Finnish state's politics influenced critical decision-making and even business operations.[834] For instance, during the 1980s, the turnover of three CEOs and four chairmen of the board took place, which challenged the firm's organization by means of a new leadership culture and centralised operations of the head office.

The firm's endogenous machinery workshop had more independent operations, which allowed it to be more liberal in technology and organization-related decisions compared to the forest units, but less than the head office. Its autonomous position was based on the different industry-specific transactions and the national collaboration of the metal industry. Its top management's operations were significantly independent, as it focused on organization culture, short- and long-term employee commitment, joint venture agreements, and sales operations. Despite its independent status, it developed its resources both by itself and with the head office's centralised operations. The machinery workshop's middle management made significant sales efforts and activities to find new businesses, which indicates the market-orientated behaviour. It indicates the managers' pro-activity to understand the capabilities of technology, which normally generates new advantage technology.[835] The aforementioned direct sales activities were not enough to increase the top management's understanding of its customers' future needs and requirements. The top management's organizational decision-making was primarily sales-driven rather than technology-driven. Accordingly, it was not focused on absorbing the advantage and the latest technology from outside the company, or developing the manufacturing machines' throughput in the workshop. Furthermore, the machinery workshop was not capable of managing the debt issue, which remained unsolved during the entire lifetime of the firm.

From the technology perspective, the board machines manufactured in the firm slowed down substantially due to internal reasons, such as non-market-orientated management, which ignored the competitors' technological development in terms of both the machines' capacity and portfolio.[836] Their board grade's customers did not require as aggressive width and speed development compared to the customers of the printing and writing grades. Consequently, Tampella's machinery workshop stagnated in its concept development and focused more

833 Chandler 1994, p. 560, Kuisma 2011, p. 265, Ariely 2015, p. 3, 6.
834 Lilja et al. 1992, p. 151, Lamberg et al. 2004, p. 343, Aaltonen and Kujala 2010, pp. 391–392, Kuisma 2011, p. 266, Bøhren 2019, pp. 2085–2117.
835 Orlikowski and Gash 1994, p. 17.
836 Zahra et al. 1999b, p. 201, Wiersema and Bowen 2008, pp. 115–132, Braguinsky and Hounshell 2016, p. 62.

and more on the development of consumer board grades with barrier properties. For instance, Tampella's competitor Valmet successfully utilised information from such end users as *Playboy*, *Time*, *Life* and *National Geographic* for its machinery workshop's concept development, which meant improved paper printing quality and reader satisfaction.[837] Furthermore, the machinery workshop's managerial operations contributed for its part in the top management's investment decisions and substantial technological path-dependent burden, the stagnation of its paper and board business units, as long as the firm's paper and board technological know-how was concentrated in-house in the machinery workshop.

This is evident based on four facts: the machinery workshop focused on kraft and board machines, it had only modest focus on printing and writing paper machines and on the coated paper grades, it prolonged newspaper production in Anjalankoski, and it prolonged deliveries of the paper and board machines from the internal machinery workshop to the firm's production plants. In addition, new machine sales opportunities to external customers were reduced by lacking alternative machine concepts for different paper and board grades and by the machines' lower capacities compared to global competitors.[838] In line with the top management's strategy, Inkeroinen did not make significant investments in time for its narrow board machines. It can be stated that technological path dependence dominated the management's investment decisions, which prevented full utilisation of their machinery workshop's board-making know-how for in-house plants. According to academics, the aforementioned items generally indicate that the firm's paper and board machines' technology and knowledge are not at the level of the competitors, which slows the development of the end products.[839]

In summary, between 1958 and 1995, the Finnish state's political interference with cluster collaborations, the national banks' power struggles, and significant élite political and business spheres significantly influenced Tampella's critical decision-making. Considering the disadvantages of the above, the life cycle of the firm can be explained as a *'downward spiral'* phenomenon. This is based on the fact that the top management fell into a state of vacillation, where leaders did not make or were not allowed to make significant decisions about the firm's strategy or critical problems, such as the firm's debt and cluster-based collaborations.[840] The firm's top management should have focused on critical constraints as early as the 1970s, rather than repeating the same secondary decisions.[841] It was not until the firm's financial situation was serious and institutional financing changes were made in Finland that the firm's executives and top man-

837 Nykänen 2018, p. 47.
838 Tushman and Anderson 1986, p. 463.
839 Lorenzoni and Lipparini 1999, p. 334.
840 Hambrick and Daveni 1988, pp. 19–20.
841 Kelly 2017, p. 12.

agement abandoned diversification, as did several other Finnish forest companies, such as Enso-Gutzeit and Kymi.[842] The firm's executives should have decided to abandon diversification based on the continued indebtedness and weak profits.

Another core reason for the firm's stagnation was that the top management did not utilise the available internal and external information to learn from past decisions. The consequences were harmful cluster activities, lack of control of the debt, a very late shift from newsprint and kraft board to higher value-added grades, and the machinery workshop's stagnated technological development.[843] This indicates a certain degree of self-reinforcing behaviour by the top management, which can generate significant financial losses, as Eurocan Kitimat's investment proved.[844] The top management did not take managerial competencies into account in its strategic decision-making process. This is evident, as the firm's investment and operational performance activities were primarily based on managerial competence and, secondly, on the top management's capability.[845] For instance, the critical reason for the technology change of Anjalankoski's plant was based on managerial habit changes in the 1980s.[846] The use of market information had no sufficient influence on the decision-making of investments. This indicates a lack of company culture to support the top management's decision-making through information from the exogenous competitive environment and endogenous organization. As a consequence, the managerial understanding and sensing of the realism of the businesses was reduced by the lack of the organization's dynamic capability based on the weak interaction between middle and senior management in the company's various business units in domestic and foreign sister companies and the firm's head office. It means that the information needed for technology, in particular, was not sufficiently or efficiently upward in the organization in the context of the market, technology and organizational dynamics.

This dissertation demonstrates how a production plant's decision-making is different from that of a company as a whole. The results of the analysis primarily prove that the long-term success of a company is not possible without well-functioning sub-organizations. The firm's strategies and fundamental decisions are irrelevant if the organization does not act and develop its internal functions.

In addition, executives and the top management must respond as quickly as possible to the changing business environment with the seriousness required.

842 Lamberg and Ojala 2001, p. 168, Sajasalo 2006, p. 210.
843 Barney 1986a, pp. 7–8, Zahra et al. 1999b, p. 201.
844 Eurocan Pulp and Paper Co. Ltd. internal memo 23.10.1974: Summary of projected operations in 1972, 1973 and 1974. Arthur 1994, pp. 111–158, Lamberg and Ojala 2001, pp. 157–158.
845 Wang et al. 2015, pp. 929–962.
846 Laurila 1997, p. 235.

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ANNEX

Calibration model

The analysis presents the technological change in the time context of both investment decisions and operational performance activity due to the production unit's long-term and robust path dependencies. The calibration model values of the investment activities, [-5 to +5], are based on event analysis. They define the *positive or negative* status of the factor (for instance, market demand) in question, and investment activities that are relevant to performances. For example, in Figure 16, data for Anjalakoski's investment activities and newsprint market demand, are based on the archival source of Tampella's annual reports from 1958 to 1995. It means the market demand statements by Tampella's exececutives and top management, which are also presented in the appendix: Market data for the optimal capital investment. Correspondingly, the Anjalankoski's investment activities are based on the Tampella's top management statements, which are also presented in the appendix: Tampella forest unit's technology investment annual costs from 1856 to 1995, and Market data for the optimal capital investment.

The higher the positive or negative values, the more significant the meaning is for the company. It defines the goodness and the importance of the investments made in Tampella. Some of its significant investments were significantly positive and important for operations. Respectively, at its weakest, a single investment was significantly *negative* and vital for operations.

Positive investments	
5	Significant positive and important further meaning
4	Significant positive and further meaning
3	Positive and further meaning
2	Significant positive
1	Positive
0	Not significant and no further meaning, neither positive nor negative
-1	Negative
-2	Significant negative
-3	Negative and further meaning
-4	Significant negative and further meaning
-5	Significant negative and important further meaning
Negative investments	

Tampella forest unit's technology investment annual costs from 1856 to 1995

		Annual cost (FMK million def. 1995)
1856	Combining blast furnace and foundry in machinery workshop	
1887	Inkeroinen board machine 1 and ground wood plant	
1889	Inkeroinen board machine 2	
1927	Inkeroinen board machine 3	
1938	Anjalankoski newsprint machine 1	
1939	Anjalankoski newsprint machine 2, FMK 50.13 million	
1952	Anjalankoski Semi-pulp mill	
1953	Machinery workshop drilling machines	
1958	Land purchased for Heinola Fluting plant	
1959	Anjalankoski newsprint machine 1 & 2 steam and condensate improvement	50.31
1960	Inkeroinen gradual improvements	634.57
1960	Machinery workshop machine tools	
1961	Heinola Fluting board machine 1, old FMK 6300 million	
1961	Expansion of plate workshop and Messukylä's foundry	
1962	Machinery workshop's thermal-and painting facilities, engineering office	
1965	Inkeroinen board machine 4	340.47
1966	Anjalankoski PM 1 wet end short-circulation and precalender	111.58
1966	Expansions of core machinery workshops and Messukylä's foundry	
1966	Heinola Fluting kraft plant	
1967	Heinola Fluting board machine 1 capacity modification	
1967	Espanol board machine 1	47.76
1968	Inkeroinen Power plant, FMK 40 million	
1968	Heinola Fluting board machine 1 semipulp mill modernization	
1968	Eurocan Kitimat cellulose, kraft paper, testliner machine, FMK 134 million	
1968	Pineville board machine 3, USD 38 million	
1969	Anjalankoski expansion of power plant, FMK 33.1 million	
1969	Anjalankoski newsprint machine 2 efficiency modernisation	
1969	Inkeroinen board machine 2 improvements	114.68
1970	Inkeroinen groundwood plant	105.76
1970	Inkeroinen Pilot machine 1	
1970	Slurry- and reject treatment plant	
1971	Anjalankoski broke treatment	
1971	Anjalankoski PM 2 process computer	
1971	Inkeroinen board machine 1 converting and packaging	
1971	Eurocan Kitimat board machine 1 and 2 modification	
1971	Machinery workshop's apartments for employees	
1971	Anjalankoski efficiency improvements, Process computer FMK 8.342 million	
1971	Anjalankoski newsprint 2 process computer and broke treatment	307.88
1972	Inkeroinen gradual improvements, FMK 5.2 million	165.77
1972	Inkeroinen board machine 4 after dryer section, converting, wrapping line	
1972	Espanola board machine 1 gradual improvements	
1972	Heinola Fluting board machine 1 pick up and dryer section modification, FMK 6.322 million	
1972	Eurocan Kitimat modernization in pulp mill (and saw mill) FMK 53.1 million	1972.00
1973	Anjalankoski newsprint machine 1 rebuild of press, calender, electric drives	
1973	Inkeroinen board machine 1 Winder	126.48
1974	Anjalankoski reject refining FMK 1.953 million, R&D FMK 16.5 million	184.76
1975	Inkeroinen thermomechanical pulp 0.972 and water treatment FMK 8.493 million	274.42
1976	Anjalankoski thermomechanical pulp 26, automatic wrapping line FMK 4.9 million	237.82
1976	Espanola board machine 1 efficiency improvements	
1976	Heinola Fluting board machine 1 process computer	
1977	Anjalankoski maintenance related, FMK 7 million	
1977	Espanola BM 1 forming section	49.43
1978	Anjalankoski newsprint machine 1 dryer section, heat recovery system, drives FMK 10.2 million	116.90
1978	Inkeroinen BM 4 process computer	
1979	Anjalankoski PM 2 dryer section, heat recovery system, drives, reel, FMK 20.8 million	
1979	Inkeroinen board machine 3 process computer system, FMK 3.7 million	
1979	Inkeroinen board machine 4 Converting and brush calender, FMK 32.2 million	
1979	Machinery workshop's machine tools and hydraulic drilling machines	
1979	Heinola Fluting board machine 1 automatic roll wrapping line 4.3, recovery boiler, FMK 12.8 million	197.80
1980	Inkeroinen board machine 3 maintenance improvements	210.03
1981	Inkeroinen board machine 4 Headbox+former 13.9, process computer 3.7, gloss brush, FMK 14.2 million	
1981	Modification of wood handling, PGW, barking plant	
1981	Machinery workshop's machine tools, thermal- and hard chrome plants	368.88
1982	Inkeroinen pressure groundwood, wood handling, chipping, barking. FMK 164 million	1056.92
1982	Workshop's machine tools' diversification and switch facilities for Tamrock & power	
1982	Heinola Fluting board machine 1 CTMP deflaker, process computer and drying capacity	
1983	Anjalankoski newsprint machine 3, FMK 1185, USD 280 million	
1983	Inkeroinen power plant of natural gas	
1983	Inkeroinen pilot machine 2, 100% groundwood utilization, FMK 25 million	795.82
1984	Heinola Fluting board machine 1 dust burn and fluidized bed boiler, drying capacity and IT-system, FMK 299 million	200.16
1985	Machinery workshop streamline manufacturing facilities	157.81
1986	Inkeroinen water treatment, Tamrock automatic sparepart logistic center	121.25
1987	Anjalankoski gradual small improvements in TMP	
1987	Machinery workshop's expansion in Tamrock Trackdrill	
1987	Espanola board machine 1 gas turbine, waste heat boiler, sheet cutter, grade change	195.55
1988	Machinery workshop's pilot paper machine in Inkeroinen, FMK 106 million	974.51
1988	Anjalankoski newsprint machine 2 major rebuild for MFC, FMK 600, (=USD 150 million)	
1988	Machinery workshop's Myllypuro machines and tools	
1989	Heinola Fluting board machine 1 rebuild, semi-cellulose expansion, recovery boiler, water treatment, FMK 299 million	
1989	Machinery workshop's power plant for pilot machine, FMK 75 million	1245.92
1990	Expansion of machinery workshop's pilot paper machine in Inkeroinen, FMK 25.4 million	878.77
1990	Completion of Tampella Carcanos development project, FMK 50 million	
1990	Anjalankoski newsprint machine 3 Headbox and calender	
1990	Inkeroinen board machine 4 modification, FMK 392.5 million	
1990	Lapua metals manufacturing facilities, FMK 20 million	
1990	Machinery workshop's facilities for Tamrock in Myllypuro, FMK 84 million	
1991	Espanola board machine 1 modification, FMK 249 million	492.92
1992	Deinvestment of entire paper and board business	99.06
1992	Heinola Fluting softwood fibre line	

Sources: Tampella Annual Reports from 1958 to 1995, *Paper and Timber Journal* between 1957 and 1996. Costs unit is FMK million (def. 1995).

Technology data

Tampella production unit	Tampella's paper and board machines' design speeds (m/min)											
	1950	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Anjalankoski PM 1	**450**	450	450	450	450	450	450	450	450	450	450	450
Anjalankoski PM 2	**450**	450	450	450	450	450	450	450	450	450	450	450
Anjalankoski PM 3												
Inkeroinen BM 1[1]	**30**	30	30	30	**56**	**60**	60	60	60	60	60	60
Inkeroinen BM 2[1]	**20**	20	20	20	**56**	**60**	60	60	60	60	60	60
Inkeroinen BM 3[1]	**30**	30	30	30	**56**	**60**	60	60	60	60	60	60
Inkeroinen BM 4										**450**	450	450
Workshop´s customer machines	**200**	**300**	300	300	300	**610**	610	610	610	610	610	**700**
Espanola										**430**	430	430
Heinola Fluting						**610**	610	610	610	610	610	610
Eurocan pulp and Paper Kitimat BM 1												**750**
Eurocan pulp and Paper Kitimat BM 2												**762**
Pineville Kraft Corporation												**700**
Note1: In 1958 and 1960, Inkeroinen´s board machines´ speeds calculated from production												
	1969	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Anjalankoski PM 1	450	450	450	**800**	800	800	800	800	800	800	800	800
Anjalankoski PM 2	450	450	450	450	450	450	450	450	450	450	450	450
Anjalankoski PM 3										**1200**	1200	1200
Inkeroinen BM 1[1]	60	60	60	60	60	60						
Inkeroinen BM 2[1]	60	60	60	60	60	60	60					
Inkeroinen BM 3[1]	60	60	60	60	60	60	60	60	60	60	60	60
Inkeroinen BM 4	450	450	450	450	450	450	450	**450**	450	450	450	450
Workshop´s customer machines	**915**	915	915	915	915	**1065**	**1100**	1100	1100	1100	1100	1100
Espanola	430	430	430	430	430	430	430	430	430	430	430	430
Heinola Fluting	610	610	610	610	610	610	610	610	610	610	610	610
Eurocan pulp and Paper Kitimat BM 1	750	750	750	750	750	750	750	750	750	750	750	750
Eurocan pulp and Paper Kitimat BM 2	762	762	762	762	762	762	762	762	762	762	762	762
Pineville Kraft Corporation	700	700	700	700	700	700	700	700	700	700	700	700
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Anjalankoski PM 1	800	800	800	800	800	800	800	800	800			
Anjalankoski PM 2	450	450	**1500**	1500	1500	1500	1500	1500	1500			
Anjalankoski PM 3	1200	1200	1200	1200	1200	1200	1200	1200	1200			
Inkeroinen BM 1[1]												
Inkeroinen BM 2[1]												
Inkeroinen BM 3[1]	60	60	60	60								
Inkeroinen BM 4	450	450	450	**500**	500	500	500	500	500			
Workshop´s customer machines	1100	1100	1100	1100	**1200**	1200	1200	1200	1200			
Espanola	430	430	430	430	**430**	430	430	430	430			
Heinola Fluting	610	610	**900**	900	900	900	900	900	900			
Eurocan pulp and Paper Kitimat BM 1	750	750	750	750	750	750	750	750	750			
Eurocan pulp and Paper Kitimat BM 2	762	762	762	762	762	762	762	762	762			
Pineville Kraft Corporation	700	700	700	700	700	700	700	700	700			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Paper grade and market area	The paper and board machines' speed development in the market area (m/min)										
Newsprint	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic	600	1200	1300	1300	1300	1300	1300	1400	1400	1400	1400	1400
Nordic	450	800	800	800	1000	1000	1200	1400	1400	1400	1400	1400
North and Latin America	640	925	1070	1070	1070	1070	1070	1070	1250	1250	1250	1250
Asia	186	450	610	610	750	1000	1000	1000	1000	1000	1000	1000
Cartonboard												
Europe excl. Nordic	180	250	250	250	500	500	500	500	500	500	500	500
Nordic	30	160	460	460	460	460	610	610	610	610	610	750
North and Latin America	400	610	610	610	610	610	610	610	610	650	650	650
Asia	180	180	450	450	450	500	500	500	500	610	610	610
Kraft-and testliner												
Europe excl. Nordic	150	430	430	430	430	430	430	500	550	600	600	600
Nordic	150	360	460	460	460	610	700	700	700	700	700	700
North and Latin America	388	701	701	701	701	701	701	701	722	722	950	950
Asia	50	152	160	160	160	160	160	170	310	450	450	450
Newsprint	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
Nordic	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1500	1500
North and Latin America	1250	1250	1250	1250	1250	1250	1250	1250	1388	1388	1388	1388
Asia	1000	1000	1000	1100	1100	1100	1100	1100	1100	1200	1200	1200
Cartonboard												
Europe excl. Nordic	500	600	600	600	600	600	600	600	600	600	600	600
Nordic	750	750	750	750	750	750	750	750	750	750	750	750
North and Latin America	650	650	650	650	650	650	650	650	650	650	650	650
Asia	610	610	610	610	610	610	610	610	610	610	610	610
Kraft-and testliner												
Europe excl. Nordic	600	600	600	600	600	600	600	600	600	600	600	600
Nordic	700	700	750	800	1000	1000	1000	1000	1000	1000	1000	1000
North and Latin America	950	950	988	988	988	988	988	988	988	988	988	988
Asia	450	650	650	650	660	660	660	680	680	680	680	680
Newsprint	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	1500	1500	1700	1700	1700	1700	1700	1700	1700			
Nordic	1500	1600	1600	1600	1600	1600	1600	1600	1811			
North and Latin America	1400	1400	1525	1525	1525	1525	1525	1525	1525			
Asia	1400	1400	1400	1600	1600	1600	1600	1600	1700			
Cartonboard												
Europe excl. Nordic	600	600	600	600	600	600	690	690	690			
Nordic	750	750	750	750	750	750	773	773	900			
North and Latin America	650	650	650	780	780	780	780	780	780			
Asia	610	610	610	610	610	610	610	610	800			
Kraft-and testliner												
Europe excl. Nordic	600	600	600	600	600	850	900	900	1200			
Nordic	1000	1000	1000	1000	1000	1000	1000	1000	1000			
North and Latin America	988	988	988	988	988	988	988	988	988			
Asia	900	900	900	900	900	900	900	900	900			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Paper grade, market area, production unit	Speed difference between Tampella production units and other machines in market area (%)											
Newsprint and Anjalankoski PM 1	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic	-25	-63	-65	-65	-65	-65	-65	-68	-68	-68	-68	-68
Nordic	0	-44	-44	-44	-55	-55	-63	-68	-68	-68	-68	-68
North and Latin America	-30	-51	-58	-58	-58	-58	-58	-58	-64	-64	-64	-64
Asia	142	0	-26	-26	-40	-55	-55	-55	-55	-55	-55	-55
Average all	22	-39	-48	-48	-55	-58	-60	-62	-64	-64	-64	-64
Newsprint and Anjalankoski PM 2												
Europe excl. Nordic	-25	-63	-65	-65	-65	-65	-65	-68	-68	-68	-68	-68
Nordic	0	-44	-44	-44	-55	-55	-63	-68	-68	-68	-68	-68
North and Latin America	-30	-51	-58	-58	-58	-58	-58	-58	-64	-64	-64	-64
Asia	142	0	-26	-26	-40	-55	-55	-55	-55	-55	-55	-55
Average all	22	-39	-48	-48	-55	-58	-60	-62	-64	-64	-64	-64
Newsprint and Anjalankoski PM 3												
Europe excl. Nordic												
Nordic												
North and Latin America												
Asia												
Average all												
Newsprint and Anjalankoski PM 1	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	-68	-68	-68	-43	-43	-43	-43	-43	-43	-43	-43	-43
Nordic	-68	-68	-68	-43	-43	-43	-43	-43	-43	-43	-47	-47
North and Latin America	-64	-64	-64	-36	-36	-36	-36	-36	-42	-42	-42	-42
Asia	-55	-55	-55	-27	-27	-27	-27	-27	-27	-33	-33	-33
Average all	-64	-64	-64	-37	-37	-37	-37	-37	-39	-40	-41	-41
Newsprint and Anjalankoski PM 2												
Europe excl. Nordic	-68	-68	-68	-68	-68	-68	-68	-68	-68	-68	-68	-68
Nordic	-68	-68	-68	-68	-68	-68	-68	-68	-68	-68	-70	-70
North and Latin America	-64	-64	-64	-64	-64	-64	-64	-64	-68	-68	-68	-68
Asia	-55	-55	-55	-59	-59	-59	-59	-59	-59	-63	-63	-63
Average all	-64	-64	-64	-65	-65	-65	-65	-65	-66	-66	-67	-67
Newsprint and Anjalankoski PM 3												
Europe excl. Nordic										-14	-14	-14
Nordic										-14	-20	-20
North and Latin America										-14	-14	-14
Asia										0	0	0
Average all										-11	-12	-12
Newsprint and Anjalankoski PM 1	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	-47	-47	-53	-53	-53	-53	-53	-53	-53			
Nordic	-47	-50	-50	-50	-50	-50	-50	-50	-56			
North and Latin America	-43	-43	-48	-48	-48	-48	-48	-48	-48			
Asia	-43	-43	-43	-50	-50	-50	-50	-50	-53			
Average all	-45	-46	-48	-50	-50	-50	-50	-50	-52			
Newsprint and Anjalankoski PM 2												
Europe excl. Nordic	-70	-70	-12	-12	-12	-12	-12	-12	-12			
Nordic	-70	-72	-6	-6	-6	-6	-6	-6	-17			
North and Latin America	-68	-68	-2	-2	-2	-2	-2	-2	-2			
Asia	-68	-68	7	-6	-6	-6	-6	-6	-12			
Average all	-69	-69	-3	-6	-6	-6	-6	-6	-11			
Newsprint and Anjalankoski PM 3												
Europe excl. Nordic	-20	-20	-29	-29	-29	-29	-29	-29	-29			
Nordic	-20	-25	-25	-25	-25	-25	-25	-25	-34			
North and Latin America	-14	-14	-21	-21	-21	-21	-21	-21	-21			
Asia	-14	-14	-14	-25	-25	-25	-25	-25	-29			
Average all	-17	-18	-23	-25	-25	-25	-25	-25	-28			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Cartonboard and Inkeroinen BM 1	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic	-83	-88	-88	-88	-89	-88	-88	-88	-88	-88	-88	-88
Nordic	0	-81	-93	-93	-88	-87	-90	-90	-90	-90	-90	-92
North and Latin America	-93	-95	-95	-95	-91	-90	-90	-90	-90	-91	-91	-91
Asia	-83	-83	-93	-93	-88	-88	-88	-88	-88	-90	-90	-90
Average all	-65	-87	-92	-92	-89	-88	-89	-89	-89	-90	-90	-90
Cartonboard and Inkeroinen BM 2												
Europe excl. Nordic	-89	-92	-92	-92	-89	-88	-88	-88	-88	-88	-88	-88
Nordic	-33	-88	-96	-96	-88	-87	-90	-90	-90	-90	-90	-92
North and Latin America	-95	-97	-97	-97	-91	-90	-90	-90	-90	-91	-91	-91
Asia	-89	-89	-96	-96	-88	-88	-88	-88	-88	-90	-90	-90
Average all	-77	-91	-95	-95	-89	-88	-89	-89	-89	-90	-90	-90
Cartonboard and Inkeroinen BM 3												
Europe excl. Nordic	-83	-88	-88	-88	-89	-88	-88	-88	-88	-88	-88	-88
Nordic	0	-81	-93	-93	-88	-87	-90	-90	-90	-90	-90	-92
North and Latin America	-93	-95	-95	-95	-91	-90	-90	-90	-90	-91	-91	-91
Asia	-83	-83	-93	-93	-88	-88	-88	-88	-88	-90	-90	-90
Average all	-65	-87	-92	-92	-89	-88	-89	-89	-89	-90	-90	-90
Cartonboard and Inkeroinen BM 4												
Europe excl. Nordic										-10	-10	-10
Nordic										-26	-26	-40
North and Latin America										-31	-31	-31
Asia										-26	-26	-26
Average all										-23	-23	-27

Cartonboard and Inkeroinen BM 1	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	-88	-90	-90	-90	-90	-90						
Nordic	-92	-92	-92	-92	-92	-92						
North and Latin America	-91	-91	-91	-91	-91	-91						
Asia	-90	-90	-90	-90	-90	-90						
Average all	-90	-91	-91	-91	-91	-91						
Cartonboard and Inkeroinen BM 2												
Europe excl. Nordic	-88	-90	-90	-90	-90	-90	-90					
Nordic	-92	-92	-92	-92	-92	-92	-92					
North and Latin America	-91	-91	-91	-91	-91	-91	-91					
Asia	-90	-90	-90	-90	-90	-90	-90					
Average all	-90	-91	-91	-91	-91	-91	-91					
Cartonboard and Inkeroinen BM 3												
Europe excl. Nordic	-88	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90
Nordic	-92	-92	-92	-92	-92	-92	-92	-92	-92	-92	-92	-92
North and Latin America	-91	-91	-91	-91	-91	-91	-91	-91	-91	-91	-91	-91
Asia	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90
Average all	-90	-91	-91	-91	-91	-91	-91	-91	-91	-91	-91	-91
Cartonboard and Inkeroinen BM 4												
Europe excl. Nordic	-10	-25	-25	-25	-25	-25	-25	-25	-25	-25	-25	-25
Nordic	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
North and Latin America	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31
Asia	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26
Average all	-27	-30	-30	-30	-30	-30	-30	-30	-30	-30	-30	-30

Cartonboard and Inkeroinen BM 1	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic												
Nordic												
North and Latin America												
Asia												
Average all												
Cartonboard and Inkeroinen BM 2												
Europe excl. Nordic												
Nordic												
North and Latin America												
Asia												
Average all												
Cartonboard and Inkeroinen BM 3												
Europe excl. Nordic	-90	-90	-90	-90								
Nordic	-92	-92	-92	-92								
North and Latin America	-91	-91	-91	-92								
Asia	-90	-90	-90	-90								
Average all	-91	-91	-91	-91								
Cartonboard and Inkeroinen BM 4												
Europe excl. Nordic	-25	-25	-25	-17	-17	-17	-28	-28	-28			
Nordic	-40	-40	-40	-33	-33	-33	-35	-35	-44			
North and Latin America	-31	-31	-31	-36	-36	-36	-36	-36	-36			
Asia	-26	-26	-26	-18	-18	-18	-18	-18	-38			
Average all	-30	-30	-30	-26	-26	-26	-29	-29	-36			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Workshop and												
Newsprint	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic	-67	-75	-77	-77	-77	-53	-53	-56	-56	-56	-56	-50
Nordic	-56	-63	-63	-63	-70	-39	-49	-56	-56	-56	-56	-50
North and Latin America	-69	-68	-72	-72	-72	-43	-43	-43	-51	-51	-51	-44
Asia	8	-33	-51	-51	-60	-39	-39	-39	-39	-39	-39	-30
Average all	-46	-60	-66	-66	-70	-44	-46	-49	-51	-51	-51	-44
Cartonboard												
Europe excl. Nordic	11	20	20	20	-40	22	22	22	22	22	22	40
Nordic	567	88	-35	-35	-35	33	0	0	0	0	0	-7
North and Latin America	-50	-51	-51	-51	-51	0	0	0	0	-6	-6	8
Asia	11	67	-33	-33	-33	22	22	22	22	0	0	15
Average all	135	31	-25	-25	-40	19	11	11	11	4	4	14
Kraft-and testliner												
Europe excl. Nordic	33	-30	-30	-30	-30	42	42	22	11	2	2	17
Nordic	33	-17	-35	-35	-35	0	-13	-13	-13	-13	-13	0
North and Latin America	-48	-57	-57	-57	-57	-13	-13	-13	-16	-16	-36	-26
Asia	300	97	88	88	88	281	281	259	97	36	36	56
Average all	80	-2	-9	-9	-9	78	74	64	20	2	-3	11
Workshop and												
Newsprint	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	-35	-35	-35	-35	-35	-24	-21	-21	-21	-21	-21	-21
Nordic	-35	-35	-35	-35	-35	-24	-21	-21	-21	-21	-27	-27
North and Latin America	-27	-27	-27	-27	-27	-15	-12	-12	-21	-21	-21	-21
Asia	-9	-9	-9	-17	-17	-3	0	0	0	-8	-8	-8
Average all	-26	-26	-26	-28	-28	-16	-14	-14	-16	-18	-19	-19
Cartonboard												
Europe excl. Nordic	83	53	53	53	53	78	83	83	83	83	83	83
Nordic	22	22	22	22	22	42	47	47	47	47	47	47
North and Latin America	41	41	41	41	41	64	69	69	69	69	69	69
Asia	50	50	50	50	50	75	80	80	80	80	80	80
Average all	49	41	41	41	41	64	70	70	70	70	70	70
Kraft-and testliner												
Europe excl. Nordic	53	53	53	53	53	78	83	83	83	83	83	83
Nordic	31	31	22	14	-9	7	10	10	10	10	10	10
North and Latin America	-4	-4	-7	-7	-7	8	11	11	11	11	11	11
Asia	103	41	41	41	39	61	67	62	62	62	62	62
Average all	46	30	27	25	19	38	43	42	42	42	42	42
Workshop and												
Newsprint	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	-27	-27	-35	-35	-29	-29	-29	-29	-29			
Nordic	-27	-31	-31	-31	-25	-25	-25	-25	-34			
North and Latin America	-21	-21	-28	-28	-21	-21	-21	-21	-21			
Asia	-21	-21	-21	-31	-25	-25	-25	-25	-29			
Average all	-24	-25	-29	-31	-25	-25	-25	-25	-28			
Cartonboard												
Europe excl. Nordic	83	83	83	83	100	100	74	74	74			
Nordic	47	47	47	47	60	60	55	55	33			
North and Latin America	69	69	69	41	54	54	54	54	54			
Asia	80	80	80	80	97	97	97	97	50			
Average all	70	70	70	63	78	78	70	70	53			
Kraft-and testliner												
Europe excl. Nordic	83	83	83	83	100	41	33	33	0			
Nordic	10	10	10	10	20	20	20	20	20			
North and Latin America	11	11	11	11	21	21	21	21	21			
Asia	22	22	22	22	33	33	33	33	33			
Average all	32	32	32	32	44	29	27	27	19			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Espanola BM 1 and Kraft-and testliner	1950	1955	1956	1957	1958	1960	1961	1962	1964	1965	1967	1968
Europe excl. Nordic										-28	-28	-28
Nordic										-39	-39	-39
North and Latin America										-40	-55	-55
Asia										-4	-4	-4
Average all										-28	-32	-32
Heinola Fluting BM 1 and Kraft-and testliner												
Europe excl. Nordic						42	42	22	11	2	2	2
Nordic						0	-13	-13	-13	-13	-13	-13
North and Latin America						-13	-13	-13	-16	-16	-36	-36
Asia						281	281	259	97	36	36	36
Average all						78	74	64	20	2	-3	-3
Eurocan Kitimat BM 1 and Kraft-and testliner												
Europe excl. Nordic												25
Nordic												7
North and Latin America												-21
Asia												67
Average all												19
Eurocan Kitimat BM 2 and Kraft-and testliner												
Europe excl. Nordic												27
Nordic												9
North and Latin America												-20
Asia												69
Average all												21
Pineville BM 1 and Kraft-and testliner												
Europe excl. Nordic												17
Nordic												0
North and Latin America												-26
Asia												56
Average all												11

Espanola BM 1 and Kraft-and testliner	1968	1969	1970	1971	1973	1975	1978	1979	1980	1981	1983	1985
Europe excl. Nordic	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28
Nordic	-39	-39	-39	-43	-46	-57	-57	-57	-57	-57	-57	-57
North and Latin America	-55	-55	-55	-56	-56	-56	-56	-56	-56	-56	-56	-56
Asia	-4	-4	-34	-34	-34	-35	-35	-35	-37	-37	-37	-37
Average all	-32	-32	-39	-40	-41	-44	-44	-44	-45	-45	-45	-45
Heinola Fluting BM 1 and Kraft-and testliner												
Europe excl. Nordic	2	2	2	2	2	2	2	2	2	2	2	2
Nordic	-13	-13	-13	-19	-24	-39	-39	-39	-39	-39	-39	-39
North and Latin America	-36	-36	-36	-38	-38	-38	-38	-38	-38	-38	-38	-38
Asia	36	36	-6	-6	-6	-8	-8	-8	-10	-10	-10	-10
Average all	-3	-3	-13	-15	-17	-21	-21	-21	-21	-21	-21	-21
Eurocan Kitimat BM 1 and Kraft-and testliner												
Europe excl. Nordic	25	25	25	25	25	25	25	25	25	25	25	25
Nordic	7	7	7	0	-6	-25	-25	-25	-25	-25	-25	-25
North and Latin America	-21	-21	-21	-24	-24	-24	-24	-24	-24	-24	-24	-24
Asia	67	67	15	15	15	14	14	14	10	10	10	10
Average all	19	19	7	4	3	-3	-3	-3	-3	-3	-3	-3
Eurocan Kitimat BM 2 and Kraft-and testliner												
Europe excl. Nordic	27	27	27	27	27	27	27	27	27	27	27	27
Nordic	9	9	9	2	-5	-24	-24	-24	-24	-24	-24	-24
North and Latin America	-20	-20	-20	-23	-23	-23	-23	-23	-23	-23	-23	-23
Asia	69	69	17	17	17	15	15	15	12	12	12	12
Average all	21	21	8	6	4	-1	-1	-1	-2	-2	-2	-2
Pineville BM 1 and Kraft-and testliner												
Europe excl. Nordic	17	17	17	17	17	17	17	17	17	17	17	17
Nordic	0	0	0	-7	-13	-30	-30	-30	-30	-30	-30	-30
North and Latin America	-26	-26	-26	-29	-29	-29	-29	-29	-29	-29	-29	-29
Asia	56	56	8	8	8	6	6	6	3	3	3	3
Average all	11	11	0	-3	-4	-9	-9	-9	-10	-10	-10	-10

Espanola BM 1 and Kraft-and testliner	1986	1987	1988	1989	1990	1991	1992	1994	1995	1996		
Europe excl. Nordic	-28	-28	-28	-28	-28	-28	-49	-52	-52	-64		
Nordic	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57		
North and Latin America	-56	-56	-56	-56	-56	-56	-56	-56	-56	-56		
Asia	-37	-52	-52	-52	-52	-52	-52	-52	-52	-52		
Average all	-45	-49	-49	-49	-49	-49	-54	-54	-54	-57		
Heinola Fluting BM 1 and Kraft-and testliner												
Europe excl. Nordic	2	2	2	50	50	50	6	0	0	-25		
Nordic	-39	-39	-39	-10	-10	-10	-10	-10	-10	-10		
North and Latin America	-38	-38	-38	-9	-9	-9	-9	-9	-9	-9		
Asia	-10	-32	-32	0	0	0	0	0	0	0		
Average all	-21	-27	-27	8	8	8	-3	-5	-5	-11		
Eurocan Kitimat BM 1 and Kraft-and testliner												
Europe excl. Nordic	25	25	25	25	25	25	-12	-17	-17	-38		
Nordic	-25	-25	-25	-25	-25	-25	-25	-25	-25	-25		
North and Latin America	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24		
Asia	10	-17	-17	-17	-17	-17	-17	-17	-17	-17		
Average all	-3	-10	-10	-10	-10	-10	-19	-21	-21	-26		
Eurocan Kitimat BM 2 and Kraft-and testliner												
Europe excl. Nordic	27	27	27	27	27	27	-10	-15	-15	-37		
Nordic	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24		
North and Latin America	-23	-23	-23	-23	-23	-23	-23	-23	-23	-23		
Asia	12	-15	-15	-15	-15	-15	-15	-15	-15	-15		
Average all	-2	-9	-9	-9	-9	-9	-18	-19	-19	-25		
Pineville BM 1 and Kraft-and testliner												
Europe excl. Nordic	17	17	17	17	17	17	-18	-22	-22	-42		
Nordic	-30	-30	-30	-30	-30	-30	-30	-30	-30	-30		
North and Latin America	-29	-29	-29	-29	-29	-29	-29	-29	-29	-29		
Asia	3	-22	-22	-22	-22	-22	-22	-22	-22	-22		
Average all	-10	-16	-16	-16	-16	-16	-25	-26	-26	-31		

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Tampella production unit	Tampella's paper and board machines' design widths (cm)											
	1950	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Anjalankoski PM 1	**546**	546	546	546	546	546	546	546	546	546	546	546
Anjalankoski PM 2	**546**	546	546	546	546	546	546	546	546	546	546	546
Anjalankoski PM 3												
Inkeroinen BM 1	**150**	150	150	150	**150**	**150**	150	150	150	150	150	150
Inkeroinen BM 2	**215**	215	215	215	**215**	**215**	215	215	215	215	215	215
Inkeroinen BM 3	**215**	215	215	215	**215**	**215**	215	215	215	215	215	215
Inkeroinen BM 4										**455**	455	455
Workshop´s customer machines	**360**	**360**	360	360	370	**690**	690	690	690	690	695	**716**
Espanola										**390**	390	390
Heinola Fluting						**690**	690	690	690	690	690	690
Eurocan pulp and Paper Kitimat BM 1												**711**
Eurocan pulp and Paper Kitimat BM 2												**711**
Pineville Kraft Corporation												**716**
	1969	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Anjalankoski PM 1	546	546	546	**546**	546	546	546	546	546	546	546	546
Anjalankoski PM 2	546	546	546	546	546	546	546	546	546	546	546	546
Anjalankoski PM 3										**915**	915	915
Inkeroinen BM 1	150	150	150	150	150	150						
Inkeroinen BM 2	215	215	215	215	215	215	215					
Inkeroinen BM 3	215	215	215	215	215	215	215	215	215	215	215	215
Inkeroinen BM 4	455	455	455	455	455	455	455	**455**	455	455	455	455
Workshop´s customer machines	**833**	850	850	850	850	**950**	**950**	950	950	950	950	950
Espanola	390	390	390	390	390	390	390	390	390	390	390	390
Heinola Fluting	690	690	690	690	690	690	690	690	690	690	690	690
Eurocan pulp and Paper Kitimat BM 1	711	711	711	711	711	711	711	711	711	711	711	711
Eurocan pulp and Paper Kitimat BM 2	711	711	711	711	711	711	711	711	711	711	711	711
Pineville Kraft Corporation	716	716	716	716	716	716	716	716	716	716	716	716
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Anjalankoski PM 1	546	546	546	546	546	546	546	546	546			
Anjalankoski PM 2	546	546	**548**	548	548	548	548	548	548			
Anjalankoski PM 3	915	915	915	915	915	915	915	915	915			
Inkeroinen BM 1												
Inkeroinen BM 2												
Inkeroinen BM 3	215	215	215	215								
Inkeroinen BM 4	455	455	455	**510**	510	510	510	510	510			
Workshop´s customer machines	950	950	950	950	**950**	950	950	950	950			
Espanola	390	390	390	390	**430**	430	430	430	430			
Heinola Fluting	690	690	**690**	690	690	690	690	690	690			
Eurocan pulp and Paper Kitimat BM 1	711	711	711	711	711	711	711	711	711			
Eurocan pulp and Paper Kitimat BM 2	711	711	711	711	711	711	711	711	711			
Pineville Kraft Corporation	716	716	716	716	716	716	716	716	716			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Paper grade and market area	The paper and board machines' width development in the market area (cm)											
Newsprint	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic	464	742	742	742	760	760	760	762	762	762	762	762
Nordic	548	742	742	742	745	745	847	847	847	847	905	905
North and Latin America	574	737	737	737	874	874	874	874	874	879	879	986
Asia	334	438	575	575	575	710	710	710	710	710	710	710
Cartonboard												
Europe excl. Nordic	345	409	409	409	409	410	410	500	500	500	500	500
Nordic	320	320	613	613	613	613	690	690	690	690	690	775
North and Latin America	550	571	599	599	767	767	767	767	767	767	767	767
Asia	279	279	575	575	575	575	575	575	575	580	580	580
Kraft-and testliner												
Europe excl. Nordic	345	409	409	409	409	410	410	500	500	500	500	500
Nordic	320	320	613	613	613	613	690	690	690	690	690	775
North and Latin America	550	571	599	599	767	767	767	767	767	767	767	767
Asia	279	279	575	575	575	575	575	575	575	580	580	580
Newsprint	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	762	780	780	780	780	780	780	915	915	915	930	930
Nordic	905	915	915	915	915	915	915	922	922	930	930	930
North and Latin America	986	986	986	986	986	986	986	986	986	986	986	986
Asia	710	885	885	887	887	887	887	895	895	895	895	895
Cartonboard												
Europe excl. Nordic	500	696	696	696	696	696	696	696	696	696	696	696
Nordic	775	775	775	775	775	775	775	775	775	775	775	775
North and Latin America	767	767	767	767	767	767	767	778	778	778	778	778
Asia	580	580	580	580	580	580	580	580	580	580	580	580
Kraft-and testliner												
Europe excl. Nordic	500	696	696	696	696	696	696	696	696	696	696	696
Nordic	775	775	775	775	775	775	775	775	775	775	775	775
North and Latin America	767	767	767	767	767	767	767	778	778	778	778	778
Asia	580	580	580	580	580	580	580	580	580	580	580	580
Newsprint	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	930	930	935	980	980	980	1000	1000	1000			
Nordic	930	945	945	945	945	945	945	945	965			
North and Latin America	986	986	986	986	986	986	986	986	986			
Asia	895	895	895	900	900	900	900	900	900			
Cartonboard												
Europe excl. Nordic	696	696	696	696	696	696	696	696	696			
Nordic	775	775	775	775	775	775	775	775	900			
North and Latin America	778	778	778	810	810	810	810	810	810			
Asia	580	580	580	580	580	580	580	580	580			
Kraft-and testliner												
Europe excl. Nordic	696	696	696	696	696	696	696	696	696			
Nordic	775	775	775	775	775	775	775	775	900			
North and Latin America	778	778	778	810	810	810	810	810	810			
Asia	580	580	580	580	580	580	580	580	580			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Paper grade, market area, production unit	Width difference between Tampella production units and other machines in market area (%)											
Newsprint and Anjalankoski PM 1	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic	18	-26	-26	-26	-28	-28	-28	-28	-28	-28	-28	-28
Nordic	0	-26	-26	-26	-27	-27	-36	-36	-36	-36	-40	-40
North and Latin America	-5	-26	-26	-26	-38	-38	-38	-38	-38	-38	-38	-45
Asia	63	25	-5	-5	-5	-23	-23	-23	-23	-23	-23	-23
Average all	19	-14	-21	-21	-24	-29	-31	-31	-31	-31	-32	-34
Newsprint and Anjalankoski PM 2												
Europe excl. Nordic	18	-26	-26	-26	-28	-28	-28	-28	-28	-28	-28	-28
Nordic	0	-26	-26	-26	-27	-27	-36	-36	-36	-36	-40	-40
North and Latin America	-5	-26	-26	-26	-38	-38	-38	-38	-38	-38	-38	-45
Asia	63	25	-5	-5	-5	-23	-23	-23	-23	-23	-23	-23
Average all	19	-14	-21	-21	-24	-29	-31	-31	-31	-31	-32	-34
Newsprint and Anjalankoski PM 3												
Europe excl. Nordic												
Nordic												
North and Latin America												
Asia												
Average all												
Newsprint and Anjalankoski PM 1	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	-28	-30	-30	-30	-30	-30	-30	-40	-40	-40	-41	-41
Nordic	-40	-40	-40	-40	-40	-40	-40	-41	-41	-41	-41	-41
North and Latin America	-45	-45	-45	-45	-45	-45	-45	-45	-45	-45	-45	-45
Asia	-23	-38	-38	-38	-38	-38	-38	-39	-39	-39	-39	-39
Average all	-34	-38	-38	-38	-38	-38	-38	-41	-41	-41	-42	-42
Newsprint and Anjalankoski PM 2												
Europe excl. Nordic	-28	-30	-30	-30	-30	-30	-30	-40	-40	-40	-41	-41
Nordic	-40	-40	-40	-40	-40	-40	-40	-41	-41	-41	-41	-41
North and Latin America	-45	-45	-45	-45	-45	-45	-45	-45	-45	-45	-45	-45
Asia	-23	-38	-38	-38	-38	-38	-38	-39	-39	-39	-39	-39
Average all	-34	-38	-38	-38	-38	-38	-38	-41	-41	-41	-42	-42
Newsprint and Anjalankoski PM 3												
Europe excl. Nordic										0	-2	-2
Nordic										-2	-2	-2
North and Latin America										-7	-7	-7
Asia										2	2	2
Average all										-2	-2	-2
Newsprint and Anjalankoski PM 1	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	-41	-41	-42	-44	-44	-44	-45	-45	-45			
Nordic	-41	-42	-42	-42	-42	-42	-42	-42	-43			
North and Latin America	-45	-45	-45	-45	-45	-45	-45	-45	-45			
Asia	-39	-39	-39	-39	-39	-39	-39	-39	-39			
Average all	-42	-42	-42	-43	-43	-43	-43	-43	-43			
Newsprint and Anjalankoski PM 2												
Europe excl. Nordic	-41	-41	-41	-44	-44	-44	-45	-45	-45			
Nordic	-41	-42	-42	-42	-42	-42	-42	-42	-43			
North and Latin America	-45	-45	-44	-44	-44	-44	-44	-44	-44			
Asia	-39	-39	-39	-39	-39	-39	-39	-39	-39			
Average all	-42	-42	-42	-42	-42	-42	-43	-43	-43			
Newsprint and Anjalankoski PM 3												
Europe excl. Nordic	-2	-2	-2	-7	-7	-7	-9	-9	-9			
Nordic	-2	-3	-3	-3	-3	-3	-3	-3	-5			
North and Latin America	-7	-7	-7	-7	-7	-7	-7	-7	-7			
Asia	2	2	2	2	2	2	2	2	2			
Average all	-2	-2	-3	-4	-4	-4	-4	-4	-5			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Cartonboard and Inkeroinen BM 1	1950	1955	1956	1957	1958	1960	1961	1962	1964	1965	1967	1968
Europe excl. Nordic	-57	-63	-63	-63	-63	-63	-63	-70	-70	-70	-70	-70
Nordic	-53	-53	-76	-76	-76	-76	-78	-78	-78	-78	-78	-81
North and Latin America	-73	-74	-75	-75	-80	-80	-80	-80	-80	-80	-80	-80
Asia	-46	-46	-74	-74	-74	-74	-74	-74	-74	-74	-74	-74
Average all	-57	-59	-72	-72	-73	-73	-74	-76	-76	-76	-76	-76
Cartonboard and Inkeroinen BM 2												
Europe excl. Nordic	-38	-47	-47	-47	-47	-48	-48	-57	-57	-57	-57	-57
Nordic	-33	-33	-65	-65	-65	-65	-69	-69	-69	-69	-69	-72
North and Latin America	-61	-62	-64	-64	-72	-72	-72	-72	-72	-72	-72	-72
Asia	-23	-23	-63	-63	-63	-63	-63	-63	-63	-63	-63	-63
Average all	-39	-41	-60	-60	-62	-62	-63	-65	-65	-65	-65	-66
Cartonboard and Inkeroinen BM 3												
Europe excl. Nordic	-38	-47	-47	-47	-47	-48	-48	-57	-57	-57	-57	-57
Nordic	-33	-33	-65	-65	-65	-65	-69	-69	-69	-69	-69	-72
North and Latin America	-61	-62	-64	-64	-72	-72	-72	-72	-72	-72	-72	-72
Asia	-23	-23	-63	-63	-63	-63	-63	-63	-63	-63	-63	-63
Average all	-39	-41	-60	-60	-62	-62	-63	-65	-65	-65	-65	-66
Cartonboard and Inkeroinen BM 4												
Europe excl. Nordic										-9	-9	-9
Nordic										-34	-34	-41
North and Latin America										-41	-41	-41
Asia										-22	-22	-22
Average all										-26	-26	-28
Cartonboard and Inkeroinen BM 1	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	-70	-78	-78	-78	-78	-78						
Nordic	-81	-81	-81	-81	-81	-81						
North and Latin America	-80	-80	-80	-80	-80	-80						
Asia	-74	-74	-74	-74	-74	-74						
Average all	-76	-78	-78	-78	-78	-78						
Cartonboard and Inkeroinen BM 2												
Europe excl. Nordic	-57	-69	-69	-69	-69	-69	-69					
Nordic	-72	-72	-72	-72	-72	-72	-72					
North and Latin America	-72	-72	-72	-72	-72	-72	-72					
Asia	-63	-63	-63	-63	-63	-63	-63					
Average all	-66	-69	-69	-69	-69	-69	-69					
Cartonboard and Inkeroinen BM 3												
Europe excl. Nordic	-57	-69	-69	-69	-69	-69	-69	-69	-69	-69	-69	-69
Nordic	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
North and Latin America	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Asia	-63	-63	-63	-63	-63	-63	-63	-63	-63	-63	-63	-63
Average all	-66	-69	-69	-69	-69	-69	-69	-69	-69	-69	-69	-69
Cartonboard and Inkeroinen BM 4												
Europe excl. Nordic	-9	-35	-35	-35	-35	-35	-35	-35	-35	-35	-35	-35
Nordic	-41	-41	-41	-41	-41	-41	-41	-41	-41	-41	-41	-41
North and Latin America	-41	-41	-41	-41	-41	-41	-41	-42	-42	-42	-42	-42
Asia	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22
Average all	-28	-35	-35	-35	-35	-35	-35	-35	-35	-35	-35	-35
Cartonboard and Inkeroinen BM 1	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic												
Nordic												
North and Latin America												
Asia												
Average all												
Cartonboard and Inkeroinen BM 2												
Europe excl. Nordic												
Nordic												
North and Latin America												
Asia												
Average all												
Cartonboard and Inkeroinen BM 3												
Europe excl. Nordic	-69	-69	-69	-69								
Nordic	-72	-72	-72	-72								
North and Latin America	-72	-72	-72	-73								
Asia	-63	-63	-63	-63								
Average all	-69	-69	-69	-69								
Cartonboard and Inkeroinen BM 4												
Europe excl. Nordic	-35	-35	-35	-27	-27	-27	-27	-27	-27			
Nordic	-41	-41	-41	-34	-34	-34	-34	-34	-43			
North and Latin America	-42	-42	-42	-37	-37	-37	-37	-37	-37			
Asia	-22	-22	-22	-12	-12	-12	-12	-12	-12			
Average all	-35	-35	-35	-28	-28	-28	-28	-28	-30			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Workshop and Newsprint	1950	1955	1956	1957	1958	1960	1961	1962	1964	1965	1967	1968
Europe excl. Nordic	-22	-51	-51	-51	-51	-9	-9	-9	-9	-9	-9	-6
Nordic	-34	-51	-51	-51	-50	-7	-19	-19	-19	-19	-23	-21
North and Latin America	-37	-51	-51	-51	-58	-21	-21	-21	-21	-22	-21	-27
Asia	8	-18	-37	-37	-36	-3	-3	-3	-3	-3	-2	1
Average all	-22	-43	-48	-48	-49	-10	-13	-13	-13	-13	-14	-13
Cartonboard												
Europe excl. Nordic	4	-12	-12	-12	-10	68	68	38	38	38	39	43
Nordic	13	13	-41	-41	-40	13	0	0	0	0	1	-8
North and Latin America	-35	-37	-40	-40	-52	-10	-10	-10	-10	-10	-9	-7
Asia	29	29	-37	-37	-36	20	20	20	20	19	20	23
Average all	3	-2	-33	-33	-34	23	20	12	12	12	13	13
Kraft-and testliner												
Europe excl. Nordic	4	-12	-12	-12	-10	68	68	38	38	38	39	43
Nordic	13	13	-41	-41	-40	13	0	0	0	0	1	-8
North and Latin America	-35	-37	-40	-40	-52	-10	-10	-10	-10	-10	-9	-7
Asia	29	29	-37	-37	-36	20	20	20	20	19	20	23
Average all	3	-2	-33	-33	-34	23	20	12	12	12	13	13
Workshop and Newsprint	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	9	9	9	9	9	22	22	4	4	4	2	2
Nordic	-8	-7	-7	-7	-7	4	4	3	3	2	2	2
North and Latin America	-16	-14	-14	-14	-14	-4	-4	-4	-4	-4	-4	-4
Asia	17	-4	-4	-4	-4	7	7	6	6	6	6	6
Average all	1	-4	-4	-4	-4	7	7	2	2	2	2	2
Cartonboard												
Europe excl. Nordic	67	22	22	22	22	36	36	36	36	36	36	36
Nordic	7	10	10	10	10	23	23	23	23	23	23	23
North and Latin America	9	11	11	11	11	24	24	22	22	22	22	22
Asia	44	47	47	47	47	64	64	64	64	64	64	64
Average all	32	22	22	22	22	37	37	36	36	36	36	36
Kraft-and testliner												
Europe excl. Nordic	67	22	22	22	22	36	36	36	36	36	36	36
Nordic	7	10	10	10	10	23	23	23	23	23	23	23
North and Latin America	9	11	11	11	11	24	24	22	22	22	22	22
Asia	44	47	47	47	47	64	64	64	64	64	64	64
Average all	32	22	22	22	22	37	37	36	36	36	36	36
Workshop and Newsprint	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	2	2	2	-3	-3	-3	-5	-5	-5			
Nordic	2	1	1	1	1	1	1	1	-2			
North and Latin America	-4	-4	-4	-4	-4	-4	-4	-4	-4			
Asia	6	6	6	6	6	6	6	6	6			
Average all	2	1	1	0	0	0	-1	-1	-1			
Cartonboard												
Europe excl. Nordic	36	36	36	36	36	36	36	36	36			
Nordic	23	23	23	23	23	23	23	23	6			
North and Latin America	22	22	22	17	17	17	17	17	17			
Asia	64	64	64	64	64	64	64	64	64			
Average all	36	36	36	35	35	35	35	35	31			
Kraft-and testliner												
Europe excl. Nordic	36	36	36	36	36	36	36	36	36			
Nordic	23	23	23	23	23	23	23	23	6			
North and Latin America	22	22	22	17	17	17	17	17	17			
Asia	64	64	64	64	64	64	64	64	64			
Average all	36	36	36	35	35	35	35	35	31			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Espanola BM 1 and Kraft-and testliner	**1950**	**1955**	**1956**	**1957**	**1958**	**1960**	**1961**	**1962**	**1964**	**1965**	**1967**	**1968**
Europe excl. Nordic										-22	-22	-22
Nordic										-43	-43	-50
North and Latin America										-49	-49	-49
Asia										-33	-33	-33
Average all										-37	-37	-38
Heinola Fluting BM 1 and Kraft-and testliner												
Europe excl. Nordic						68	68	38	38	38	38	38
Nordic						13	0	0	0	0	0	-11
North and Latin America						-10	-10	-10	-10	-10	-10	-10
Asia						20	20	20	20	19	19	19
Average all						23	20	12	12	12	12	9
Eurocan Kitimat BM 1 and Kraft-and testliner												
Europe excl. Nordic												42
Nordic												-8
North and Latin America												-7
Asia												23
Average all												12
Eurocan Kitimat BM 2 and Kraft-and testliner												
Europe excl. Nordic												42
Nordic												-8
North and Latin America												-7
Asia												23
Average all												12
Pineville BM 1 and Kraft-and testliner												
Europe excl. Nordic												43
Nordic												-8
North and Latin America												-7
Asia												23
Average all												13
Espanola BM 1 and Kraft-and testliner	**1969**	**1970**	**1971**	**1973**	**1975**	**1978**	**1979**	**1980**	**1981**	**1983**	**1985**	**1986**
Europe excl. Nordic	-22	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44
Nordic	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
North and Latin America	-49	-49	-49	-49	-49	-49	-49	-50	-50	-50	-50	-50
Asia	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33
Average all	-38	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44
Heinola Fluting BM 1 and Kraft-and testliner												
Europe excl. Nordic	38	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Nordic	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
North and Latin America	-10	-10	-10	-10	-10	-10	-10	-11	-11	-11	-11	-11
Asia	19	19	19	19	19	19	19	19	19	19	19	19
Average all	9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Eurocan Kitimat BM 1 and Kraft-and testliner												
Europe excl. Nordic	42	2	2	2	2	2	2	2	2	2	2	2
Nordic	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
North and Latin America	-7	-7	-7	-7	-7	-7	-7	-9	-9	-9	-9	-9
Asia	23	23	23	23	23	23	23	23	23	23	23	23
Average all	12	2	2	2	2	2	2	2	2	2	2	2
Eurocan Kitimat BM 2 and Kraft-and testliner												
Europe excl. Nordic	42	2	2	2	2	2	2	2	2	2	2	2
Nordic	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
North and Latin America	-7	-7	-7	-7	-7	-7	-7	-9	-9	-9	-9	-9
Asia	23	23	23	23	23	23	23	23	23	23	23	23
Average all	12	2	2	2	2	2	2	2	2	2	2	2
Pineville BM 1 and Kraft-and testliner												
Europe excl. Nordic	43	3	3	3	3	3	3	3	3	3	3	3
Nordic	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
North and Latin America	-7	-7	-7	-7	-7	-7	-7	-8	-8	-8	-8	-8
Asia	23	23	23	23	23	23	23	23	23	23	23	23
Average all	13	3	3	3	3	3	3	3	3	3	3	3
Espanola BM 1 and Kraft-and testliner	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1994**	**1995**	**1996**			
Europe excl. Nordic	-44	-44	-44	-44	-38	-38	-38	-38	-38			
Nordic	-50	-50	-50	-50	-45	-45	-45	-45	-52			
North and Latin America	-50	-50	-50	-52	-47	-47	-47	-47	-47			
Asia	-33	-33	-33	-33	-26	-26	-26	-26	-26			
Average all	-44	-44	-44	-45	-39	-39	-39	-39	-41			
Heinola Fluting BM 1 and Kraft-and testliner												
Europe excl. Nordic	-1	-1	-1	-1	-1	-1	-1	-1	-1			
Nordic	-11	-11	-11	-11	-11	-11	-11	-11	-23			
North and Latin America	-11	-11	-11	-15	-15	-15	-15	-15	-15			
Asia	19	19	19	19	19	19	19	19	19			
Average all	-1	-1	-1	-2	-2	-2	-2	-2	-5			
Eurocan Kitimat BM 1 and Kraft-and testliner												
Europe excl. Nordic	2	2	2	2	2	2	2	2	2			
Nordic	-8	-8	-8	-8	-8	-8	-8	-8	-21			
North and Latin America	-9	-9	-9	-12	-12	-12	-12	-12	-12			
Asia	23	23	23	23	23	23	23	23	23			
Average all	2	2	2	1	1	1	1	1	-2			
Eurocan Kitimat BM 2 and Kraft-and testliner												
Europe excl. Nordic	2	2	2	2	2	2	2	2	2			
Nordic	-8	-8	-8	-8	-8	-8	-8	-8	-21			
North and Latin America	-9	-9	-9	-12	-12	-12	-12	-12	-12			
Asia	23	23	23	23	23	23	23	23	23			
Average all	2	2	2	1	1	1	1	1	-2			
Pineville BM 1 and Kraft-and testliner												
Europe excl. Nordic	3	3	3	3	3	3	3	3	3			
Nordic	-8	-8	-8	-8	-8	-8	-8	-8	-20			
North and Latin America	-8	-8	-8	-12	-12	-12	-12	-12	-12			
Asia	23	23	23	23	23	23	23	23	23			
Average all	3	3	3	2	2	2	2	2	-1			

Sources: Pöyry Group 2018 from 1955 to 1996, *Paper and Timber Journal* between 1957 and 1996, Tampella Annual Reports from 1958 to 1995.

Market data for the optimum capital investment activities and exploring the market-orientation behaviour

The data for both optimum capital investment activities and exploring the market-orientation behaviour. The market factors amount of the activities, distribution between different units and distribution within the individual unit (N=724).

Market factor	Unit	Year	Activity	Status
Demand	Anjalankoski 1	1958	Based on demand-pull	Basic investment in 1938 for line PM 1
Demand	Anjalankoski 1	1958	Based on demand-pull	Demand picking up again in Western Europe
Demand	Anjalankoski 1	1959	Based on demand-pull	newsprint had production restrictions due to overcapacity
Demand	Anjalankoski 1	1959	Cooperation	Meet customers quality challenges
Demand	Anjalankoski 1	1959	Based on technology push	Steam efficiency
Demand	Anjalankoski 1	1960	Based on technology push	Mills had peak production due to a high technical level
Demand	Anjalankoski 1	1961	Based on demand-pull	Production is maximised due to good sales
Demand	Anjalankoski 1	1962	Based on demand-pull	Overcapacity due to launched new machines during the year
Demand	Anjalankoski 1	1963	Product differentation	Production recors by delivering special grades of paper
Demand	Anjalankoski 1	1964	Based on demand-pull	Production restraints
Demand	Anjalankoski 1	1964	Product differentation	Specialty Hi-Fi and printing paper were produced
Demand	Anjalankoski 1	1966	Based on demand-pull	Products with good demand
Demand	Anjalankoski 1	1966	Based on demand-pull	Specialty products production increased
Demand	Anjalankoski 1	1966	Product differentation	Specialty products production increased
Demand	Anjalankoski 1	1966	Based on technology push	Precalander investments
Demand	Anjalankoski 1	1969	Based on demand-pull	The PM 1 and PM 2's order backlog was good
Demand	Anjalankoski 1	1970	Based on demand-pull	Full operation rate of paper machines
Demand	Anjalankoski 1	1971	Based on demand-pull	Good order backlog
Demand	Anjalankoski 1	1973	Based on demand-pull	Demand exceeded production capacity
Demand	Anjalankoski 1	1973	Based on technology push	PM1 press section, machine calender, electric drive
Demand	Anjalankoski 1	1975	Based on demand-pull	Economic downturn recession
Demand	Anjalankoski 1	1976	Based on demand-pull	Plan for new PM 3 of improved Hi-Fi newsprint
Demand	Anjalankoski 1	1976	Based on technology push	Thermo-mechanical pulp
Demand	Anjalankoski 1	1981	Based on demand-pull	A few production restrictions
Demand	Anjalankoski 1	1983	Based on demand-pull	Pm3 start-up declined 50per cent of PM 1 production
Demand	Anjalankoski 2	1958	Based on demand-pull	Basic investment in 1938 for line PM 2
Demand	Anjalankoski 2	1959	Based on technology push	Steam efficiency
Demand	Anjalankoski 2	1971	Based on technology push	DCS, broke handling
Demand	Anjalankoski 2	1975	Based on demand-pull	The financial crises
Demand	Anjalankoski 2	1976	Based on demand-pull	Low operation rate due to international financial crises
Demand	Anjalankoski 2	1976	Based on technology push	Thermo-mechanical pulp
Demand	Anjalankoski 2	1977	Based on demand-pull	Low operation rate due to international competition
Demand	Anjalankoski 2	1979	Based on demand-pull	Full operation rate of paper machines
Demand	Anjalankoski 2	1980	Based on demand-pull	Full operation rate of paper machines
Demand	Anjalankoski 2	1982	Based on demand-pull	Capacity of the paper mill was only 80per cent
Demand	Anjalankoski 2	1982	Based on demand-pull	The downturn continued and deepened further
Demand	Anjalankoski 3	1983	Based on demand-pull	Newsprint over capacity during PM 3 start-up
Demand	Anjalankoski 3	1984	Based on demand-pull	A production restriction
Demand	Anjalankoski 3	1985	Based on demand-pull	Production records by delivering special paper grades
Demand	Anjalankoski 3	1985	Based on technology push	Production records by delivering special paper grades

Market factor	Unit	Year	Activity	Status
Demand	Anjalankoski 3	1985	Product differentation	Production records by delivering special paper grades
Demand	Anjalankoski 3	1986	Based on demand-pull	Production records by delivering special paper grades
Demand	Anjalankoski 3	1986	Product differentation	Production records by delivering special paper grades
Demand	Anjalankoski 3	1986	Based on technology push	Production records by delivering special paper grades
Demand	Anjalankoski 2	1989	Product differentation	New coated grades of Tamedia product family
Demand	Anjalankoski 3	1990	Based on technology push	Start up of headbox and wet end
Demand	Anjalankoski 3	1992	Based on demand-pull	Sales records even though the order back log weakened
Demand	Anjalankoski 3	1992	Product differentation	Sales records even though the order back log weakened
Demand	Inkeroinen 1	1958	Based on demand-pull	First bm in 1897 in Inkeroinen
Demand	Inkeroinen 1	1959	Based on demand-pull	The lack of orders
Demand	Inkeroinen 1	1960	Based on demand-pull	High production by good order backlog
Demand	Inkeroinen 1	1961	Based on demand-pull	The maximum operation rate by market demand
Demand	Inkeroinen 1	1961	Based on technology push	The maximum operation rate by market demand
Demand	Inkeroinen 1	1962	Based on demand-pull	Lower demand than the increased production capacity
Demand	Inkeroinen 1	1962	Based on technology push	Lower demand than the increased production capacity
Demand	Inkeroinen 1	1963	Based on demand-pull	The maximum operation rate by market demand
Demand	Inkeroinen 1	1963	Based on technology push	The maximum operation rate by market demand
Demand	Inkeroinen 1	1965	Based on demand-pull	Good order back log
Demand	Inkeroinen 1	1965	Based on demand-pull	Start up of new board machine
Demand	Inkeroinen 1	1966	Based on demand-pull	Bm 1 shutdown by the lack of orders in July
Demand	Inkeroinen 1	1968	Based on demand-pull	Good order back log
Demand	Inkeroinen 1	1970	Based on technology push	New production record in Inkeroinen
Demand	Inkeroinen 1	1970	Based on demand-pull	Lack of orders in bm1 and bm 3
Demand	Inkeroinen 1	1971	Based on demand-pull	Markets have forced more detailed quality control
Demand	Inkeroinen 1	1975	Based on demand-pull	The financial crises
Demand	Inkeroinen 1	1976	Based on demand-pull	Low operation rate due to international financial crises
Demand	Inkeroinen 1	1977	Based on demand-pull	American took markets share due to lower cost structure
Demand	Inkeroinen 1	1978	Based on technology push	Divestment of board mill by the old technology
Demand	Inkeroinen 2	1958	Based on demand-pull	First bm 2 in 1899
Demand	Inkeroinen 2	1959	Based on technology push	Old wood grinding machine off
Demand	Inkeroinen 2	1971	Based on technology push	DCS, broke handling
Demand	Inkeroinen 2	1974	Based on demand-pull	New production record in Inkeroinen
Demand	Inkeroinen 2	1974	Based on technology push	New production record in Inkeroinen
Demand	Inkeroinen 2	1976	Based on technology push	Thermo-mechanical pulp
Demand	Inkeroinen 2	1979	Based on technology push	Divestment of BM 2 by the old technology
Demand	Inkeroinen 3	1958	Based on demand-pull	Purchasing of new bm in 1926-27
Demand	Inkeroinen 3	1959	Based on technology push	Old wood grinding machine off
Demand	Inkeroinen 3	1971	Product differentation	Centralise and increase sheeting- and packaging
Demand	Inkeroinen 3	1976	Based on technology push	New thermo-mechanical pulp
Demand	Inkeroinen 3	1979	Based on demand-pull	High production by good order backlog
Demand	Inkeroinen 3	1979	Based on technology push	High production by good order backlog
Demand	Inkeroinen 3	1980	Based on demand-pull	Good demand
Demand	Inkeroinen 3	1982	Based on technology push	Wood yard modification
Demand	Inkeroinen 3	1984	Based on demand-pull	Full production rate of board machines
Demand	Inkeroinen 3	1984	Based on technology push	Full production rate of board machines
Demand	Inkeroinen 3	1985	Based on demand-pull	New production record in Inkeroinen

Market factor	Unit	Year	Activity	Status
Demand	Inkeroinen 3	1985	Based on technology push	New production record in Inkeroinen
Demand	Inkeroinen 3	1987	Based on demand-pull	New production record in Inkeroinen
Demand	Inkeroinen 3	1987	Based on technology push	New production record in Inkeroinen
Demand	Inkeroinen 3	1988	Based on demand-pull	Markets are recovering from over capacity
Demand	Inkeroinen 3	1989	Based on demand-pull	Good board demand
Demand	Inkeroinen 3	1989	Based on demand-pull	Decision for development of Inkeroinen unit
Demand	Inkeroinen 4	1989	Product differentation	Focus on food -and medicin packaging
Demand	Inkeroinen 3	1991	Based on demand-pull	Divestment due to the market collapse in Soviet Union
Demand	Inkeroinen 3	1991	Based on technology push	Divestment due to the market collapse in Soviet Union
Demand	Inkeroinen 4	1971	Product differentation	Centralise and increase sheeting- and packaging
Demand	Inkeroinen 4	1976	Based on technology push	New thermo-mechanical pulp
Demand	Inkeroinen 4	1978	Based on demand-pull	Decision of new forming section and embossing unit
Demand	Inkeroinen 4	1978	Based on technology push	Decision of new forming section and embossing unit
Demand	Inkeroinen 4	1978	Based on technology push	Decision of new DCS
Demand	Inkeroinen 4	1981	Based on demand-pull	New production record in BM 4
Demand	Inkeroinen 4	1981	Based on technology push	New production record in BM 4
Demand	Inkeroinen 4	1981	Product differentation	Decision of grade change to folding box board
Demand	Inkeroinen 4	1983	Based on technology push	Start up of recycled fibre to groundwood
Demand	Inkeroinen 4	1991	Based on demand-pull	Start up of rebuild
Demand	Inkeroinen 4	1991	Based on demand-pull	80 per cent operation rate, 10d shutdown due to weak demand
Demand	Inkeroinen 4	1992	Based on technology push	Bleaching mechanical pulp (Year of new owner)
Demand	I Pilot 1	1970	Based on technology push	Start up of new pilot facilities
Demand	Pilot 2	1983	Based on technology push	New pilot 2 construction work started up
Demand	Pilot 2	1984	Based on technology push	Start up of pilot 2 plant
Demand	Pilot 2	1986	Based on technology push	Completed pilot 2 plant
Demand	Pilot 2	1988	Based on technology push	Expansion of Pilot facilities
Demand	Pilot 2	1990	Based on technology push	Expansion of pilot facilities completed
Demand	Workshop	1958	Based on demand-pull	In 1856 Wasastjerna bought Idmans foundry, saw mill and blast furnace
Demand	Workshop	1959	Based on demand-pull	The entire production capacity in use
Demand	Workshop	1959	Based on technology push	The entire production capacity in use
Demand	Workshop	1959	Product differentation	Products such as forest machinery, water turbines, steam boilers and diesel engines
Demand	Workshop	1960	Based on technology push	Workshop machinery modification
Demand	Workshop	1960	Based on demand-pull	The Soviet Union major customer, 50per cent products exported
Demand	Workshop	1961	Based on demand-pull	The new production record and export share was 55per cent
Demand	Workshop	1961	Based on technology push	The new production record and export share was 55per cent
Demand	Workshop	1961	Based on technology push	Messukylä plate workshop and foundry expansions completed
Demand	Workshop	1963	Based on demand-pull	The lack of orders, shortened working week
Demand	Workshop	1965	Based on demand-pull	The lack of orders, shortened working week
Demand	Workshop	1966	Based on demand-pull	Demand was satisfied in the increasing competition environment
Demand	Workshop	1966	Based on demand-pull	Workshop and Messukylä expansions
Demand	Workshop	1966	Based on technology push	Workshop foundry efficiency project by new ovens
Demand	Workshop	1968	Based on demand-pull	Good order back log
Demand	Workshop	1969	Based on demand-pull	The new orders record
Demand	Workshop	1972	Based on demand-pull	Weak order back log and production had 3d working week
Demand	Workshop	1974	Based on demand-pull	2 years order back log

Market factor	Unit	Year	Activity	Status
Demand	Workshop	1975	Based on demand-pull	Order backlog was up to 1977, full employment
Demand	Workshop	1976	Based on technology push	Full operation rate in production
Demand	Workshop	1976	Based on demand-pull	Full operation rate in production
Demand	Workshop	1976	Cooperation	Cooperation in Germany/France/Japan due to established JV/TVW PMG.
Demand	Workshop	1976	Based on technology push	Workshop expansion project completed
Demand	Workshop	1978	Based on demand-pull	The production capacity equals to the amount of orders
Demand	Workshop	1979	Based on demand-pull	The order backlog was up to 1981
Demand	Workshop	1979	Based on technology push	Machinery tools, hydraulic drills, expansion of PGW workshop
Demand	Workshop	1979	Based on demand-pull	Excellent order backlog, especially in boilers and Tamrock
Demand	Workshop	1979	Product differentation	Excellent order backlog, especially in boilers and Tamrock
Demand	Workshop	1981	Based on demand-pull	Good order backlog in boilers and Tamrock, very bad in machines
Demand	Workshop	1981	Product differentation	Good order backlog in boilers and Tamrock, very bad in machines
Demand	Workshop	1982	Based on demand-pull	Good order backlog in boilers and Tamrock, very bad in machines
Demand	Workshop	1982	Product differentation	Good order backlog in boilers and Tamrock, very bad in machines
Demand	Workshop	1983	Based on demand-pull	Demand increased in forest and mining, but low in rock drilling
Demand	Workshop	1983	Product differentation	Demand increased in forest and mining, but low in rock drilling
Demand	Workshop	1984	Cooperation	TVW renewed and expanded into marketing and product development
Demand	Workshop	1984	Based on demand-pull	Increased demand in all workshops businesses
Demand	Workshop	1984	Product differentation	Increased demand in all workshops businesses
Demand	Workshop	1987	Based on demand-pull	Better order backlog than the past two years
Demand	Workshop	1988	Based on demand-pull	Good markets and full capacity utilisation rate in all units
Demand	Workshop	1988	Based on technology push	Full capacity utilisation rate in all workshops units
Demand	Workshop	1988	Based on demand-pull	Expansion of Tamrock Trackdrills mill
Demand	Workshop	1989	Based on demand-pull	Good markets and full capacity utilisation rate in all units
Demand	Workshop	1989	Based on technology push	Full capacity utilisation rate in all workshops units
Demand	Workshop	1989	Cooperation	JV with KEMCO and Mitsui, mining JV with American Baker Hughes
Demand	Workshop	1988	Based on technology push	Decision of the new pilot paper machine to Inkeroinen
Demand	Workshop	1988	Cooperation	Decision of the new pilot paper machine to Inkeroinen
Demand	Workshop	1989	Based on technology push	Power plant research and development centre to Tampere
Demand	Workshop	1990	Based on technology push	Inkeroinen pilot and Power pilot started up
Demand	Workshop	1990	Cooperation	Inkeroinen pilot and Power pilot started up
Demand	Workshop	1990	Based on demand-pull	Weak marked demand due to global markets
Demand	Workshop	1992	Based on demand-pull	Further weak marked demand due to global financial crises
Demand	Workshop	1992	Based on technology push	Divestment of pilot facilities of Inkeroinen
Demand	Workshop	1993	Product differentation	Tamrock and tampella Power focused on after sales-services
Demand	Workshop	1995	Based on demand-pull	Tamrock and Power had good demand
Demand	Workshop	1995	Product differentation	Tamrock and Power had good demand
Demand	Espanola	1964	Based on demand-pull	Decision of JV with Hija de Capdevila Guarro in Spain
Demand	Espanola	1969	Based on demand-pull	Espanola full ownership by Tampella
Demand	Espanola	1970	Technology development	Achieved target production
Demand	Espanola	1972	Based on demand-pull	Over capacity in the markets
Demand	Espanola	1977	Product differentation	The portfolio expanded by former rebuild start-up
Demand	Espanola	1977	Based on technology push	Competitiveness improved by former rebuild start-up
Demand	Espanola	1979	Based on demand-pull	Board grades overcapacity in the Spain
Demand	Espanola	1982	Based on demand-pull	The record production

Market factor	Unit	Year	Activity	Status
Demand	Espanola	1982	Based on technology push	The record production
Demand	Espanola	1983	Based on demand-pull	The record production
Demand	Espanola	1983	Based on technology push	The record production
Demand	Espanola	1984	Based on demand-pull	High operation rate
Demand	Espanola	1985	Based on demand-pull	The record production
Demand	Espanola	1985	Based on technology push	The record production
Demand	Espanola	1987	Product differentation	Focus on folding box board based on RCF
Demand	Espanola	1989	Based on demand-pull	Decision of bm 1 major rebuild
Demand	Espanola	1991	Based on demand-pull	Start up of bm 1rebuild
Demand	Espanola	1992	Based on demand-pull	The demand collapsed due to overcapacity in local markets
Demand	Espanola	1993	Based on demand-pull	Focus on Asian and European markets by EG
Demand	Espanola	1993	Product differentation	New portfolio management strategy by EG
Demand	Espanola	1995	Product differentation	Raw material change to RCF
Demand	Espanola	1995	Based on demand-pull	New production record
Demand	Espanola	1995	Based on technology push	New production record
Demand	Heinola Fluting	1958	Based on demand-pull	Mill construction work on-going in Heinola
Demand	Heinola Fluting	1960	Based on demand-pull	Fluting board machine started up
Demand	Heinola Fluting	1962	Based on demand-pull	Good operation rate during year
Demand	Heinola Fluting	1962	Based on technology push	Good operation rate during year
Demand	Heinola Fluting	1963	Based on demand-pull	Good operation rate during year
Demand	Heinola Fluting	1963	Based on technology push	Good operation rate during year
Demand	Heinola Fluting	1964	Based on demand-pull	Good operation rate during year
Demand	Heinola Fluting	1964	Based on technology push	Good operation rate during year
Demand	Heinola Fluting	1965	Based on demand-pull	Good operation rate during year
Demand	Heinola Fluting	1965	Based on technology push	Good operation rate during year
Demand	Heinola Fluting	1966	Based on demand-pull	Good demand
Demand	Heinola Fluting	1967	Based on demand-pull	Expansion rebuild due to the strong demand
Demand	Heinola Fluting	1968	Based on technology push	Semi chemical pulp mill modernisation for fluting quality
Demand	Heinola Fluting	1969	Based on demand-pull	Good demand
Demand	Heinola Fluting	1969	Based on technology push	Good operation rate
Demand	Heinola Fluting	1970	Based on demand-pull	Good order back log
Demand	Heinola Fluting	1971	Based on demand-pull	Low demand forced focus to new market areas
Demand	Heinola Fluting	1971	Based on demand-pull	New production record
Demand	Heinola Fluting	1971	Based on technology push	New production record
Demand	Heinola Fluting	1972	Based on demand-pull	Implementation of board machine expansion
Demand	Heinola Fluting	1972	Based on demand-pull	Demand was higher than production capability
Demand	Heinola Fluting	1973	Based on demand-pull	Demand was higher than production capability
Demand	Heinola Fluting	1973	Based on demand-pull	The new production record
Demand	Heinola Fluting	1973	Based on technology push	The new production record
Demand	Heinola Fluting	1975	Based on demand-pull	Price collapse 75per cent from year before and operation rate 53per cent
Demand	Heinola Fluting	1976	Based on technology push	New DCS online-control for basis weight and moisture
Demand	Heinola Fluting	1976	Based on demand-pull	Operation rate 64per cent and 89 days production shutdown
Demand	Heinola Fluting	1977	Based on demand-pull	Employees lay offs 10 days due to lack of orders
Demand	Heinola Fluting	1978	Based on demand-pull	The demand got better, prices unchanged
Demand	Heinola Fluting	1979	Based on demand-pull	New production record

Market factor	Unit	Year	Activity	Status
Demand	Heinola Fluting	1979	Based on technology push	New production record
Demand	Heinola Fluting	1980	Based on demand-pull	good demand
Demand	Heinola Fluting	1982	Based on demand-pull	Good demand and new production record
Demand	Heinola Fluting	1982	Based on technology push	Good demand and new production record
Demand	Heinola Fluting	1983	Based on demand-pull	New production record and all capacity in use
Demand	Heinola Fluting	1983	Based on technology push	New production record and all capacity in use
Demand	Heinola Fluting	1984	Based on technology push	Steam power plant expansion
Demand	Heinola Fluting	1984	Based on demand-pull	New production record and all capacity in use
Demand	Heinola Fluting	1984	Based on technology push	New production record and all capacity in use
Demand	Heinola Fluting	1985	Based on demand-pull	New production record
Demand	Heinola Fluting	1985	Based on technology push	New production record
Demand	Heinola Fluting	1986	Based on demand-pull	Plan to rebuild board -and pulp machine, recovery boiler, winder
Demand	Heinola Fluting	1987	Based on technology push	Implementation of pope reel and winder
Demand	Heinola Fluting	1987	Based on demand-pull	New production record
Demand	Heinola Fluting	1987	Based on technology push	New production record
Demand	Heinola Fluting	1988	Based on demand-pull	Decision of board machine rebuild
Demand	Heinola Fluting	1989	Based on demand-pull	Start up of headbox, forming,press, dryers,drives, DCS
Demand	Heinola Fluting	1991	Based on demand-pull	Good demand
Demand	Eurocan Kitimat	1965	Based on demand-pull	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Demand	Eurocan Kitimat	1966	Based on demand-pull	Signiture of Tree Farm Licence with local authority
Demand	Eurocan Kitimat	1968	Based on demand-pull	Start construction work
Demand	Eurocan Kitimat	1970	Based on demand-pull	Start up of board - and kraft machines
Demand	Eurocan Kitimat	1971	Based on technology push	Modifications of the machines
Demand	Eurocan Kitimat	1972	Based on technology push	Machines modifications completed
Demand	Eurocan Kitimat	1976	Based on demand-pull	Divestment by Tampella
Demand	Eurocan Kitimat	1993	Based on demand-pull	Divestment by Enso-Gutzeit
Demand	Pineville Kraft	1965	Based on demand-pull	Joint-venture with Enso-Gutzeit and Bodcaw Company
Demand	Pineville Kraft	1966	Based on demand-pull	Start up of construction work
Demand	Pineville Kraft	1968	Based on demand-pull	Start up of kraft liner machine
Demand	Pineville Kraft	1971	Based on technology push	Reparing of power turbine
Demand	Pineville Kraft	1973	Based on demand-pull	Divestment of joint venture
Price	Anjalankoski 1	1965	Pricing dynamics	The price of newsprint is lower than 10 years ago
Price	Anjalankoski 1	1967	Pricing dynamics	Export prices fell as the economic downturn weaken
Price	Anjalankoski 1	1966	cost efficiency	deculator- and precalander
Price	Anjalankoski 1	1969	cost efficiency	Steam power plant
Price	Anjalankoski 1	1972	cost efficiency	Production efficiency by computer controls
Price	Anjalankoski 1	1973	cost efficiency	PM 1 press section, hard calender and drives
Price	Anjalankoski 1	1975	Pricing dynamics	Decreased prices by the economic downturn recession
Price	Anjalankoski 1	1977	Pricing dynamics	Over capacity in European markets due to American import
Price	Anjalankoski 1	1978	Pricing dynamics	Over capacity in Europe
Price	Anjalankoski 1	1978	cost efficiency	Dryer, heat recovery, drives
Price	Anjalankoski 1	1982	Pricing dynamics	The downturn continued and deepened further
Price	Anjalankoski 2	1971	cost efficiency	DCS, broke handling
Price	Anjalankoski 2	1972	cost efficiency	Wood grinding machines
Price	Anjalankoski 3	1989	Multi-product production	Newsprint and coated magazine paper prices stabilised by demand

Market factor	Unit	Year	Activity	Status
Price	Anjalankoski 3	1983	Pricing dynamics	Start up of new newsprint paper machine 3
Price	Anjalankoski 3	1983	cost efficiency	Start up of new newsprint paper machine 3
Price	Anjalankoski 3	1989	Consumers habbits changes	New coated grades Tamedia product family
Price	Anjalankoski 3	1989	Multi-product production	New coated grades Tamedia product family
Price	Anjalankoski 3	1992	Multi-product production	Annual sales records even though the order book got weaker
Price	Inkeroinen 1	1964	Pricing dynamics	Sales prices slightly increased
Price	Inkeroinen 1	1966	Pricing dynamics	Small board grades price increases.
Price	Inkeroinen 1	1967	Pricing dynamics	Export prices fell as the economic downturn weaken
Price	Inkeroinen 1	1968	cost efficiency	Steam power plant expansion
Price	Inkeroinen 1	1970	cost efficiency	New groundwood equipment
Price	Inkeroinen 1	1972	cost efficiency	Production efficiency by computer controls
Price	Inkeroinen 1	1975	Pricing dynamics	The financial crises
Price	Inkeroinen 1	1977	Pricing dynamics	Over capacity in European markets due to American import
Price	Inkeroinen 1	1978	Pricing dynamics	Over capacity in European markets still
Price	Inkeroinen 1	1978	cost efficiency	Divestment of board machine
Price	Inkeroinen 2	1969	cost efficiency	Board machine modification
Price	Inkeroinen 2	1970	cost efficiency	New groundwood equipment
Price	Inkeroinen 2	1972	cost efficiency	Production efficiency by computer controls
Price	Inkeroinen 2	1979	cost efficiency	Divestment of board machine
Price	Inkeroinen 3	1982	cost efficiency	Modification of DCS and increased drying capacity
Price	Inkeroinen 3	1983	Pricing dynamics	From Recycled fibre to groundwood
Price	Inkeroinen 3	1983	cost efficiency	Natural gas power plant
Price	Inkeroinen 3	1991	cost efficiency	Divestment of board machine
Price	Inkeroinen 4	1968	cost efficiency	Steam power plant expansion
Price	Inkeroinen 4	1970	cost efficiency	New groundwood equipment
Price	Inkeroinen 4	1972	Multi-product production	Establishment of Tam-Duplex grades
Price	Inkeroinen 4	1972	cost efficiency	Converting plant
Price	Inkeroinen 4	1983	Multi-product production	Transform to groundwood based folding boxboard
Price	Workshop	1961	cost efficiency	Messukylä plate workshop and foundry expansions
Price	Workshop	1962	cost efficiency	Modifications of thermo- and surface treatment, drawing office
Price	Workshop	1966	cost efficiency	Workshop and Messukylä expansions, foundry efficiency project by new ovens
Price	Workshop	1982	cost efficiency	Tampere unit modification for Tamrock and power unit needs
Price	Espanola	1964	cost efficiency	Decision of joint venture for board mill
Price	Espanola	1967	Pricing dynamics	Board mill start-up
Price	Espanola	1967	cost efficiency	Board mill start-up
Price	Espanola	1967	Pricing dynamics	Export prices fell as the economic downturn got worse
Price	Espanola	1972	Pricing dynamics	price regulation in Spain
Price	Espanola	1976	Pricing dynamics	Fluting prices decreased
Price	Espanola	1977	Pricing dynamics	30-40per cent lower board prices by economic crises
Price	Espanola	1992	cost efficiency	The low price level due to the long-standing quality problems
Price	Espanola	1992	cost efficiency	The low price level due to the internal cost structure
Price	Espanola	1995	cost efficiency	Raw material changed to RCF
Price	Heinola Fluting	1965	Pricing dynamics	Fluting prices lightly increased
Price	Heinola Fluting	1966	Pricing dynamics	Prices stable due to good demand
Price	Heinola Fluting	1966	cost efficiency	Start up of the kraft plant to reduce fibre loses

Market factor	Unit	Year	Activity	Status
Price	Heinola Fluting	1967	cost efficiency	Expansion rebuild due to the strong demand
Price	Heinola Fluting	1967	Pricing dynamics	Expansion rebuild due to the strong demand
Price	Heinola Fluting	1967	Pricing dynamics	Export prices decreased due to economic downturn
Price	Heinola Fluting	1968	cost efficiency	Semi chemical pulp mill modernisation for fluting quality
Price	Heinola Fluting	1975	Pricing dynamics	Price collapse 75per cent from year before
Price	Heinola Fluting	1978	Pricing dynamics	The demand got better, prices unchanged
Price	Heinola Fluting	1982	cost efficiency	Modification of DCS and increased drying capacity
Price	Heinola Fluting	1984	cost efficiency	Steam power plant, IT-systems for financials and human resources
Price	Heinola Fluting	1985	cost efficiency	Defibrillation of semi-chemical pulp
Price	Eurocan Kitimat	1965	Pricing dynamics	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Price	Eurocan Kitimat	1965	cost efficiency	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Price	Eurocan Kitimat	1970	cost efficiency	Start up of board - and kraft machines
Price	Eurocan Kitimat	1971	cost efficiency	Modifications of the machines
Price	Eurocan Kitimat	1972	cost efficiency	Machines modifications completed
Price	Eurocan Kitimat	1976	cost efficiency	Divestment by Tampella
Price	Pineville Kraft	1965	Pricing dynamics	Joint-venture with Enso-Gutzeit and Bodcaw Company
Price	Pineville Kraft	1965	cost efficiency	Joint-venture with Enso-Gutzeit and Bodcaw Company
Price	Pineville Kraft	1968	cost efficiency	Start up of kraft liner machine
Price	Pineville Kraft	1971	cost efficiency	Reparing of power turbine
Price	Pineville Kraft	1973	cost efficiency	Divestment of joint venture
Financial crises	Anjalankoski 1	1958	Timing	Basic investment in 1938
Financial crises	Anjalankoski 1	1959	Timing	Steam efficiency
Financial crises	Anjalankoski 1	1960	Strong market position	High production compared to last year due to good economics
Financial crises	Anjalankoski 1	1966	Strong market position	The price of newsprint is lower than 10 years ago
Financial crises	Anjalankoski 1	1967	Understanding	Export prices fell as the economic downturn got worse
Financial crises	Anjalankoski 1	1969	Timing	Steam power plant
Financial crises	Anjalankoski 1	1974	Timing	reject-refining
Financial crises	Anjalankoski 1	1977	Timing	Maintenance
Financial crises	Anjalankoski 1	1978	Timing	dryer, heat recovery, drives
Financial crises	Anjalankoski 1	1980	Timing	pope reel roll
Financial crises	Anjalankoski 1	1982	Diversification	The downturn continued and got worse
Financial crises	Anjalankoski 1	1983	Understanding	PM3 start-up declined 50per cent of PM 1 production
Financial crises	Anjalankoski 2	1958	Timing	Basic investment in 1938
Financial crises	Anjalankoski 2	1959	Timing	Steam efficiency
Financial crises	Anjalankoski 2	1969	Strong market position	Capacity rebuild
Financial crises	Anjalankoski 2	1971	Timing	DCS, broke handling
Financial crises	Anjalankoski 2	1977	Timing	Maintenance
Financial crises	Anjalankoski 3	1980	Understanding	Decision for new PM 3
Financial crises	Anjalankoski 3	1980	Strong market position	Decision for new PM 3
Financial crises	Anjalankoski 3	1983	Strong market position	Start up of new PM 3
Financial crises	Anjalankoski 3	1983	Timing	Start up of new PM 3
Financial crises	Anjalankoski 3	1990	Strong market position	start-up of headbox and wet end
Financial crises	Anjalankoski 3	1990	Strong market position	start-up of headbox and wet end
Financial crises	Inkeroinen 1	1958	Timing	First bm in 1897
Financial crises	Inkeroinen 1	1959	Timing	divestment of old wood grinding machine
Financial crises	Inkeroinen 1	1960	Timing	Equipment modifications

Market factor	Unit	Year	Activity	Status
Financial crises	Inkeroinen 1	1970	Timing	New groundwood equipment
Financial crises	Inkeroinen 1	1971	Understanding	Centralise and increase sheeting- and packaging
Financial crises	Inkeroinen 1	1975	Understanding	Weak operation rate due to financial crises
Financial crises	Inkeroinen 1	1975	Diversification	Weak operation rate due to financial crises
Financial crises	Inkeroinen 1	1975	Timing	Divestment of semi-chemical pulp mill
Financial crises	Inkeroinen 1	1978	Strong market position	Divestment of board mill / closure
Financial crises	Inkeroinen 2	1958	Timing	First bm in 1899
Financial crises	Inkeroinen 2	1959	Timing	Old wood grinding machine off
Financial crises	Inkeroinen 2	1960	Timing	equipment modifications
Financial crises	Inkeroinen 2	1969	Timing	Board machine modification
Financial crises	Inkeroinen 2	1970	Timing	New groundwood equipment
Financial crises	Inkeroinen 2	1971	Understanding	Centralise and increase sheeting- and packaging
Financial crises	Inkeroinen 2	1975	Timing	Divestment of semi-chemical pulp mill
Financial crises	Inkeroinen 3	1958	Timing	purchasing of new bm in 1926–27
Financial crises	Inkeroinen 3	1959	Timing	Old wood grinding machine off
Financial crises	Inkeroinen 3	1960	Timing	equipment modifications
Financial crises	Inkeroinen 3	1970	Timing	New groundwood equipment
Financial crises	Inkeroinen 3	1971	Understanding	Centralise and increase sheeting- and packaging
Financial crises	Inkeroinen 3	1975	Timing	Divestment of semi-chemical pulp mill
Financial crises	Inkeroinen 3	1980	Timing	rationalisation and maintenance shutdown
Financial crises	Inkeroinen 3	1982	Timing	Wood yard modification
Financial crises	Inkeroinen 3	1983	Strong market position	Change of recycled fibre to groundwood
Financial crises	Inkeroinen 3	1983	Timing	Natural gas power plant
Financial crises	Inkeroinen 3	1991	Timing	Divestment of BM 3 / closure
Financial crises	Inkeroinen 4	1960	Timing	New board machine 4 construction
Financial crises	Inkeroinen 4	1970	Timing	New groundwood equipment
Financial crises	Inkeroinen 4	1971	Understanding	Centralise and increase sheeting- and packaging
Financial crises	Inkeroinen 4	1975	Timing	Divestment of semi-chemical pulp mill
Financial crises	Inkeroinen 4	1978	Timing	Decision of new forming section, DCS and embossing unit
Financial crises	Inkeroinen 4	1980	Timing	New forming section, DCS and embossing unit start-up
Financial crises	Inkeroinen 4	1981	Understanding	Decision from Recycled fibre to groundwood
Financial crises	Inkeroinen 4	1983	Strong market position	Change of recycled fibre to groundwood
Financial crises	Inkeroinen 4	1983	Timing	Natural gas power plant
Financial crises	Inkeroinen 4	1990	Timing	Rebuild of wet end,press, dryers, drives and DCS
Financial crises	Inkeroinen 4	1991	Timing	Start up of rebuild
Financial crises	Inkeroinen 4	1992	Timing	Bleaching mechanical pulp
Financial crises	I Pilot 1	1970	Timing	Pilot plant start-up 1
Financial crises	I Pilot 2	1983	Timing	Pilot plant 2 implementation
Financial crises	I Pilot 2	1986	Timing	Pilot plant 2 start-up
Financial crises	I Pilot 2	1990	Timing	Pilot plant 2 expansion start-up
Financial crises	Workshop	1958	Timing	purchasing of foundry in 1856
Financial crises	Workshop	1959	Strong market position	The entire production capacity in use
Financial crises	Workshop	1960	Timing	machinery modification
Financial crises	Workshop	1971	Timing	Investments to the housing facilities
Financial crises	Workshop	1981	Timing	Myllypuro expansion, thermo-threatment -and hard chrome plat-ing

Market factor	Unit	Year	Activity	Status
Financial crises	Workshop	1982	Timing	Tampere unit modification for Tamrock and power unit needs
Financial crises	Workshop	1990	Timing	Centralised operations to Tamrock Myllypuro and new office facilities
Financial crises	W R&D centre, Pilot	1990	Timing	Power R&D centre start-up, Inkeroinen pilot PM completed
Financial crises	Espanola	1964	Diversification	Decided to set up a joint venture in Spain
Financial crises	Espanola	1977	Understanding	30-40per cent decreased board prices
Financial crises	Espanola	1977	Timing	Former rebuild start-up
Financial crises	Espanola	1991	Timing	Start up of board machine and stock preparation rebuild
Financial crises	Heinola Fluting	1958	Timing	Construction work ongoing
Financial crises	Heinola Fluting	1960	Timing	Fluting board machine start-up
Financial crises	Heinola Fluting	1967	Strong market position	Capacity expansion of board machine
Financial crises	Heinola Fluting	1970	Timing	Slurry treatment plant start-up
Financial crises	Heinola Fluting	1971	Strong market position	Design of capacity expansion
Financial crises	Heinola Fluting	1975	Understanding	Price collapse 75per cent from year before and operation rate was 53per cent
Financial crises	Heinola Fluting	1976	Understanding	Operation rate 64per cent and production shutdown 89 days
Financial crises	Heinola Fluting	1978	Timing	Decision of automatic reel handling system
Financial crises	Heinola Fluting	1982	Timing	Modification of board machine DCS
Financial crises	Heinola Fluting	1982	Strong market position	increased drying capacity
Financial crises	Heinola Fluting	1986	Strong market position	Plan to rebuild board -and pulp machine, recovery boiler, winder
Financial crises	Heinola Fluting	1992	Timing	new long fibre line
Financial crises	Eurocan Kitimat	1965	Understanding	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Financial crises	Eurocan Kitimat	1965	Strong market position	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Financial crises	Eurocan Kitimat	1965	Diversification	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Financial crises	Eurocan Kitimat	1965	Timing	JV with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Financial crises	Eurocan Kitimat	1970	Understanding	Start up of board - and kraft machines
Financial crises	Eurocan Kitimat	1970	Strong market position	Start up of board - and kraft machines
Financial crises	Eurocan Kitimat	1971	Understanding	Modifications of the machines
Financial crises	Eurocan Kitimat	1972	Timing	Machines modifications completed
Financial crises	Eurocan Kitimat	1976	Timing	Divestment by Tampella
Financial crises	Pineville Kraft	1965	Understanding	Joint-venture with Enso-Gutzeit and Bodcaw Company
Financial crises	Pineville Kraft	1965	Strong market position	Joint-venture with Enso-Gutzeit and Bodcaw Company
Financial crises	Pineville Kraft	1965	Diversification	Joint-venture with Enso-Gutzeit and Bodcaw Company
Financial crises	Pineville Kraft	1965	Timing	Joint-venture with Enso-Gutzeit and Bodcaw Company
Financial crises	Pineville Kraft	1968	Understanding	Start up of kraft liner machine
Financial crises	Pineville Kraft	1968	Strong market position	Start up of kraft liner machine
Financial crises	Pineville Kraft	1971	Timing	Reparing of power turbine
Financial crises	Pineville Kraft	1973	Timing	Divestment of joint venture
Production quantity	Anjalankoski 1	1958	Scale and scope	Capacity expansion by the basic investment in 1938
Production quantity	Anjalankoski 1	1959	Scale and scope	Newsprint had production restrictions
Production quantity	Anjalankoski 1	1959	Manufacturing flexibility	Newsprint had production restrictions
Production quantity	Anjalankoski 1	1959	Technology development	Steam efficiency
Production quantity	Anjalankoski 1	1960	Technology development	The paper mills peak production due to a high technical level
Production quantity	Anjalankoski 1	1961	Cost structure	Production is maximised due to good sales

Market factor	Unit	Year	Activity	Status
Production quantity	Anjalankoski 1	1962	Scale and scope	Overcapacity due to launched new machines during the year.
Production quantity	Anjalankoski 1	1963	Manufacturing flexibility	Production records by delivering special paper grades
Production quantity	Anjalankoski 1	1964	Scale and scope	Production restraints
Production quantity	Anjalankoski 1	1964	Manufacturing flexibility	Production restraints
Production quantity	Anjalankoski 1	1965	Manufacturing flexibility	Specialty products production increased
Production quantity	Anjalankoski 1	1969	Technology development	Steam power plant expansion
Production quantity	Anjalankoski 1	1972	Technology development	Production efficiency
Production quantity	Anjalankoski 1	1973	Technology development	Press section, hard calender, drives
Production quantity	Anjalankoski 1	1974	Scale and scope	New production record
Production quantity	Anjalankoski 1	1974	Technology development	New production record
Production quantity	Anjalankoski 1	1976	Technology development	thermo-mechanical pulp
Production quantity	Anjalankoski 1	1977	Cost structure	Americans increased their market share in Europe
Production quantity	Anjalankoski 1	1978	Technology development	Rebuild of dryer section, heat recovery and drives
Production quantity	Anjalankoski 1	1981	Scale and scope	Mild production restrictions
Production quantity	Anjalankoski 1	1981	Manufacturing flexibility	Mild production restrictions
Production quantity	Anjalankoski 1	1983	Scale and scope	PM3 start-up declined 50per cent of PM 1 production
Production quantity	Anjalankoski 1	1983	Scale and scope	Operating rate was only 90per cent due to new PM 3
Production quantity	Anjalankoski 1	1984	Scale and scope	A production restriction
Production quantity	Anjalankoski 1	1984	Manufacturing flexibility	A production restriction
Production quantity	Anjalankoski 1	1985	Scale and scope	Production records by delivering special paper grades
Production quantity	Anjalankoski 1	1986	Scale and scope	Production records by delivering special paper grades
Production quantity	Anjalankoski 2	1958	Scale and scope	Basic investment in 1938
Production quantity	Anjalankoski 2	1959	Technology development	Steam efficiency
Production quantity	Anjalankoski 2	1969	Technology development	One month rebuild shutdown for 15per cent capacity improvement
Production quantity	Anjalankoski 2	1972	Technology development	wood grinding machines
Production quantity	Anjalankoski 2	1977	Technology development	Maintenance
Production quantity	Anjalankoski 2	1979	Technology development	dryer, heat recovery, drives, pope
Production quantity	Anjalankoski 2	1988	Scale and scope	Grade change to coated decision
Production quantity	Anjalankoski 2	1988	Manufacturing flexibility	Grade change to coated decision
Production quantity	Anjalankoski 2	1989	Technology development	Start up of new coated grades of Tamedia product family
Production quantity	Anjalankoski 3	1983	Scale and scope	Start up of new paper machine 3
Production quantity	Anjalankoski 3	1983	Cost structure	Start up of new paper machine 3
Production quantity	Anjalankoski 3	1987	Scale and scope	New Headbox, hard calender for capacity and quality

Market factor	Unit	Year	Activity	Status
Production quantity	Anjalankoski 3	1990	Technology development	Start up of Headbox, hard calender
Production quantity	Inkeroinen 1	1958	Scale and scope	Capacity expansion by the basic investment in 1897 and 1899
Production quantity	Inkeroinen 1	1960	Technology development	Equipment modifications
Production quantity	Inkeroinen 1	1962	Scale and scope	Higher production capacity than demand
Production quantity	Inkeroinen 1	1968	Technology development	Steam power plant expansion
Production quantity	Inkeroinen 1	1970	Technology development	New groundwood equipment
Production quantity	Inkeroinen 1	1970	Cost structure	New groundwood equipment
Production quantity	Inkeroinen 1	1971	Manufacturing flexibility	Centralise and increase sheeting- and packaging
Production quantity	Inkeroinen 1	1972	Technology development	Production efficiency by computer controls
Production quantity	Inkeroinen 1	1975	Scale and scope	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 1	1975	Technology development	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 1	1975	Cost structure	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 1	1976	Scale and scope	New thermo-mechanical pulp
Production quantity	Inkeroinen 1	1976	Technology development	New thermo-mechanical pulp
Production quantity	Inkeroinen 1	1976	Cost structure	New thermo-mechanical pulp
Production quantity	Inkeroinen 1	1977	Cost structure	Americans increased their market share in Europe
Production quantity	Inkeroinen 1	1978	Scale and scope	Divestment of board mill / closure
Production quantity	Inkeroinen 1	1958	Scale and scope	First bm in 1899
Production quantity	Inkeroinen 2	1960	Technology development	equipment modifications
Production quantity	Inkeroinen 2	1968	Technology development	Steam power plant expansion
Production quantity	Inkeroinen 2	1969	Technology development	Board machine modification
Production quantity	Inkeroinen 2	1970	Scale and scope	New groundwood equipment
Production quantity	Inkeroinen 2	1970	Technology development	New groundwood equipment
Production quantity	Inkeroinen 2	1970	Cost structure	New groundwood equipment
Production quantity	Inkeroinen 2	1971	Manufacturing flexibility	Centralise and increase sheeting- and packaging
Production quantity	Inkeroinen 2	1972	Technology development	Production efficiency by computer controls
Production quantity	Inkeroinen 2	1975	Scale and scope	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 2	1975	Technology development	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 2	1975	Cost structure	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 2	1976	Scale and scope	New thermo-mechanical pulp
Production quantity	Inkeroinen 2	1976	Technology development	New thermo-mechanical pulp
Production quantity	Inkeroinen 2	1976	Cost structure	New thermo-mechanical pulp
Production quantity	Inkeroinen 2	1979	Scale and scope	Divestment of board mill / closure

Market factor	Unit	Year	Activity	Status
Production quantity	Inkeroinen 2	1958	Scale and scope	purchasing of new bm in 1926-27
Production quantity	Inkeroinen 3	1960	Technology development	equipment modifications
Production quantity	Inkeroinen 3	1968	Technology development	Steam power plant expansion
Production quantity	Inkeroinen 3	1970	Scale and scope	New groundwood equipment
Production quantity	Inkeroinen 3	1970	Technology development	New groundwood equipment
Production quantity	Inkeroinen 3	1970	Cost structure	New groundwood equipment
Production quantity	Inkeroinen 3	1971	Manufacturing flexibility	Centralise and increase sheeting- and packaging
Production quantity	Inkeroinen 3	1972	Technology development	Production efficiency by computer controls
Production quantity	Inkeroinen 3	1975	Scale and scope	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 3	1975	Technology development	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 3	1975	Cost structure	Divestment of semi-chemical pulp mill
Production quantity	Inkeroinen 3	1976	Scale and scope	New thermo-mechanical pulp
Production quantity	Inkeroinen 3	1976	Technology development	New thermo-mechanical pulp
Production quantity	Inkeroinen 3	1976	Cost structure	New thermo-mechanical pulp
Production quantity	Inkeroinen 3	1979	Scale and scope	Expansion desing work continue
Production quantity	Inkeroinen 3	1980	Cost structure	Rationalisation shutdown
Production quantity	Inkeroinen 3	1980	Technology development	Maintenance shutdown
Production quantity	Inkeroinen 3	1982	Technology development	Wood yard modification
Production quantity	Inkeroinen 3	1983	Cost structure	From Recycled fibre to groundwood
Production quantity	Inkeroinen 3	1983	Technology development	Natural gas power plant
Production quantity	Inkeroinen 3	1991	Scale and scope	Divestment of BM 3 / closure
Production quantity	Inkeroinen 3	1965	Scale and scope	Start up of new board machine 4
Production quantity	Inkeroinen 3	1968	Technology development	Steam power plant expansion
Production quantity	Inkeroinen 4	1970	Scale and scope	New groundwood equipment
Production quantity	Inkeroinen 4	1970	Technology development	New groundwood equipment
Production quantity	Inkeroinen 4	1970	Cost structure	New groundwood equipment
Production quantity	Inkeroinen 4	1971	Manufacturing flexibility	Centralise and increase sheeting- and packaging
Production quantity	Inkeroinen 4	1972	Technology development	Drying capacity
Production quantity	Inkeroinen 4	1976	Scale and scope	New thermo-mechanical pulp
Production quantity	Inkeroinen 4	1976	Technology development	New thermo-mechanical pulp
Production quantity	Inkeroinen 4	1976	Cost structure	New thermo-mechanical pulp
Production quantity	Inkeroinen 4	1978	Technology development	Decision of new forming section, DCS and embossing unit
Production quantity	Inkeroinen 4	1980	Technology development	New forming section, DCS and embossing unit start-up

Market factor	Unit	Year	Activity	Status
Production quantity	Inkeroinen 4	1983	Cost structure	From Recycled fibre to groundwood
Production quantity	Inkeroinen 4	1983	Technology development	Natural gas power plant
Production quantity	Inkeroinen 4	1989	Scale and scope	Decision of bm 4 modification for grade change
Production quantity	Inkeroinen 4	1991	Scale and scope	Start up of wet end, press, dryers, drives and DCS rebuild
Production quantity	Inkeroinen 4	1991	Technology development	Start up of wet end, press, dryers, drives and DCS rebuild
Production quantity	Inkeroinen 4	1991	Cost structure	Start up of wet end, press, dryers, drives and DCS rebuild
Production quantity	Inkeroinen 4	1992	Manufacturing flexibility	Bleaching mechanical pulp, New owner of board mill
Production quantity	Inkeroinen 4	1992	Scale and scope	Bleaching mechanical pulp, New owner of board mill
Production quantity	Workshop	1958	Scale and scope	purchasing of foundry in 1856
Production quantity	Workshop	1960	Technology development	machinery modification
Production quantity	Workshop	1961	Scale and scope	Messukylä plate workshop and foundry expansions
Production quantity	Workshop	1962	Technology development	Modifications of thermo- and surface treatment, drawing office
Production quantity	Workshop	1966	Technology development	Workshop and Messukylä expansions, foundry efficiency project by new ovens
Production quantity	Workshop	1966	Cost structure	Workshop and Messukylä expansions, foundry efficiency project by new ovens
Production quantity	Workshop	1976	Scale and scope	Workshop expansion project completed
Production quantity	Workshop	1979	Scale and scope	New machinery tools and hydraulic drills, expansion of PGW workshop
Production quantity	Workshop	1981	Scale and scope	Myllypuro mill expansion, thermo-threatment -and hard chrome plating
Production quantity	Workshop	1982	Technology development	Tampere unit modification for Tamrock and power unit needs
Production quantity	Workshop	1985	Scale and scope	New spare parts centre for Tamrock
Production quantity	Workshop	1987	Scale and scope	Expansion of Tamrock Trackdrills mill
Production quantity	Workshop	1988	Scale and scope	Tamrock centralise operations to the Myllypuro
Production quantity	Workshop	1989	Scale and scope	Power plant research and development centre
Production quantity	Workshop	1990	Scale and scope	Centralisation to Tamrock Myllypuro,new office facilities
Production quantity	Workshop	1995	Scale and scope	Divestment of Tampella Power
Production quantity	W R&D centre, Pilot	1988	Technology development	New pilot paper machine to Inkeroinen
Production quantity	W R&D centre, Pilot	1989	Technology development	Power plant research and development centre to Tampere
Production quantity	W R&D centre, Pilot	1990	Technology development	Power R&D centre start-up, Inkeroinen pilot pm completed
Production quantity	Espanola	1964	Scale and scope	Establishment of JV with Capdevila-Tambar (later on Espanola) in Spain
Production quantity	Espanola	1964	Manufacturing flexibility	Establishment of JV with Capdevila-Tambar (later on Espanola) in Spain
Production quantity	Espanola	1967	Technology development	Start up of Capdevila-Tambar (later on Espanola)
Production quantity	Espanola	1970	Technology development	Achieved investment budgets production amount
Production quantity	Espanola	1976	Technology development	Decision to increase capacity and expand portfolio by former re-build
Production quantity	Espanola	1977	Technology development	Former rebuild start-up

Market factor	Unit	Year	Activity	Status
Production quantity	Espanola	1982	Scale and scope	The record production
Production quantity	Espanola	1982	Technology development	The record production
Production quantity	Espanola	1983	Scale and scope	The record production
Production quantity	Espanola	1983	Technology development	The record production
Production quantity	Espanola	1984	Scale and scope	High operation rate
Production quantity	Espanola	1984	Technology development	High operation rate
Production quantity	Espanola	1985	Scale and scope	The record production
Production quantity	Espanola	1985	Technology development	The record production
Production quantity	Espanola	1986	Scale and scope	Plan for board machine and stock preparation rebuild
Production quantity	Espanola	1987	Technology development	New gas turbine, waste power plant and sheet cutter
Production quantity	Espanola	1988	Scale and scope	Decision of board machine and stock preparation rebuild
Production quantity	Espanola	1989	Technology development	Rebuild completed
Production quantity	Espanola	1993	Scale and scope	New portfolio management strategy by EG
Production quantity	Espanola	1995	Cost structure	Raw material change to RCF
Production quantity	Espanola	1995	Cost structure	Gas combi power plant
Production quantity	Espanola	1995	Scale and scope	New production record
Production quantity	Espanola	1995	Technology development	New production record
Production quantity	Heinola Fluting	1958	Scale and scope	Mill construction work on-going in Heinola
Production quantity	Heinola Fluting	1960	Technology development	Fluting board machine start-up
Production quantity	Heinola Fluting	1966	Cost structure	Start up of the kraft plants equipment to reduce fibre loses
Production quantity	Heinola Fluting	1967	Scale and scope	Capacity expansion of board machine due to strong demand
Production quantity	Heinola Fluting	1968	Technology development	Semi chemical pulp mill modernisation for fluting quality
Production quantity	Heinola Fluting	1970	Technology development	Slurry treatment plant start-up
Production quantity	Heinola Fluting	1971	Scale and scope	Design of capacity expansion
Production quantity	Heinola Fluting	1971	Scale and scope	New production record
Production quantity	Heinola Fluting	1971	Technology development	New production record
Production quantity	Heinola Fluting	1972	Scale and scope	Implementation of board machine expansion
Production quantity	Heinola Fluting	1972	Scale and scope	Demand was higher than production capability
Production quantity	Heinola Fluting	1973	Scale and scope	The new production record
Production quantity	Heinola Fluting	1973	Technology development	The new production record
Production quantity	Heinola Fluting	1973	Scale and scope	Demand was higher than production capability
Production quantity	Heinola Fluting	1975	Scale and scope	Operation rate was 53per cent
Production quantity	Heinola Fluting	1975	Manufacturing flexibility	Operation rate was 53per cent

Market factor	Unit	Year	Activity	Status
Production quantity	Heinola Fluting	1976	Scale and scope	Operation rate 64per cent and production shutdown 89 days
Production quantity	Heinola Fluting	1976	Manufacturing flexibility	Operation rate 64per cent and production shutdown 89 days
Production quantity	Heinola Fluting	1977	Scale and scope	Employees lay offs 10 days due to lack of orders
Production quantity	Heinola Fluting	1979	Scale and scope	New production record
Production quantity	Heinola Fluting	1979	Technology development	New production record
Production quantity	Heinola Fluting	1979	Technology development	Automatic reel handling system, maintenance of recovery boiler
Production quantity	Heinola Fluting	1982	Scale and scope	Good demand and new production record
Production quantity	Heinola Fluting	1982	Technology development	Good demand and new production record
Production quantity	Heinola Fluting	1982	Technology development	Modification of board machine DCS and increased drying capacity
Production quantity	Heinola Fluting	1983	Scale and scope	New production record and all capacity in use
Production quantity	Heinola Fluting	1983	Technology development	New production record and all capacity in use
Production quantity	Heinola Fluting	1984	Technology development	Steam power plant, IT-systems for financials and human resources
Production quantity	Heinola Fluting	1984	Scale and scope	New production record and all capacity in use
Production quantity	Heinola Fluting	1984	Technology development	New production record and all capacity in use
Production quantity	Heinola Fluting	1985	Scale and scope	New production record
Production quantity	Heinola Fluting	1985	Technology development	New production record
Production quantity	Heinola Fluting	1986	Scale and scope	Plan to rebuild board -and pulp machine, recovery boiler, winder
Production quantity	Heinola Fluting	1987	Technology development	Implementation of pope reel and winder
Production quantity	Heinola Fluting	1987	Scale and scope	New production record
Production quantity	Heinola Fluting	1987	Technology development	New production record
Production quantity	Heinola Fluting	1988	Scale and scope	Decision of board - and pulp machine, recovery boiler, winder re-build
Production quantity	Heinola Fluting	1989	Technology development	Start up of headbox, forming, press, dryers, drives, DCS
Production quantity	Heinola Fluting	1992	Technology development	new long fibre line
Production quantity	Eurocan Kitimat	1965	Scale and scope	Joint venture with Enso-Gutzeitin, Myllykoski Paper and Kymi Oy
Production quantity	Eurocan Kitimat	1968	Scale and scope	Start construction work
Production quantity	Eurocan Kitimat	1970	Technology development	Start up of board - and kraft machines
Production quantity	Eurocan Kitimat	1971	Technology development	Modifications of the machines
Production quantity	Eurocan Kitimat	1972	Technology development	Machines modifications completed
Production quantity	Eurocan Kitimat	1976	Scale and scope	Divestment by Tampella
Production quantity	Pineville Kraft	1965	Scale and scope	Joint-venture with Enso-Gutzeit and Bodcaw Company
Production quantity	Pineville Kraft	1966	Scale and scope	Start up of construction work
Production quantity	Pineville Kraft	1968	Technology development	Start up of kraft liner machine
Production quantity	Pineville Kraft	1971	Technology development	Reparing of power turbine

Market factor	Unit	Year	Activity	Status
Production quantity	Pineville Kraft	1973	Scale and scope	Divestment of joint venture
Production quality	Anjalankoski 1	1959	Continuous improvements	Meet customer quality challenges
Production quality	Anjalankoski 1	1964	Continuous improvements	Specialty Hi-Fi and printing paper were produced
Production quality	Anjalankoski 1	1965	Continuous improvements	Specialty products production increased
Production quality	Anjalankoski 1	1966	Continuous improvements	Deculator- and precalander investments
Production quality	Anjalankoski 1	1972	Continuous improvements	Production efficiency by computer controls
Production quality	Anjalankoski 1	1973	Continuous improvements	press, hard calender, drives
Production quality	Anjalankoski 1	1974	Continuous improvements	reject-refining
Production quality	Anjalankoski 1	1976	Continuous improvements	thermo-mechanical pulp
Production quality	Anjalankoski 1	1980	Continuous improvements	Rebuild for pope reel roll
Production quality	Anjalankoski 1	1994	Continuous improvements	Sise press
Production quality	Anjalankoski 2	1971	Continuous improvements	DCS, broke handling
Production quality	Anjalankoski 2	1974	Continuous improvements	reject refining
Production quality	Anjalankoski 2	1976	Continuous improvements	thermo-mechanical pulp
Production quality	Anjalankoski 2	1989	Continuous improvements	New coated grades Tamedia-product family
Production quality	Anjalankoski 2	1992	Continuous improvements	Ph-neutral process
Production quality	Anjalankoski 3	1987	Continuous improvements	New Headbox, hard calender for capacity and quality
Production quality	Anjalankoski 3	1987	Continuous improvements	New Headbox, hard calender for capacity and quality
Production quality	Anjalankoski 3	1990	Continuous improvements	Start up of headbox and wet end
Production quality	Inkeroinen 1	1959	Continuous improvements	divestment of old wood grinding machine
Production quality	Inkeroinen 1	1960	Continuous improvements	equipment modifications
Production quality	Inkeroinen 1	1970	Continuous improvements	New groundwood equipment
Production quality	Inkeroinen 1	1971	Continuous improvements	Challenges in demand have forced more detailed quality control
Production quality	Inkeroinen 1	1972	Continuous improvements	New Winder
Production quality	Inkeroinen 1	1976	Continuous improvements	New thermo-mechanical pulp
Production quality	Inkeroinen 2	1959	Continuous improvements	Old wood grinding machine off
Production quality	Inkeroinen 2	1960	Continuous improvements	equipment modifications for better quality
Production quality	Inkeroinen 2	1970	Continuous improvements	New groundwood equipment
Production quality	Inkeroinen 2	1975	Continuous improvements	Divestment of semi-chemical pulp mill
Production quality	Inkeroinen 2	1976	Continuous improvements	New thermo-mechanical pulp
Production quality	Inkeroinen 3	1959	Continuous improvements	Old wood grinding machine off
Production quality	Inkeroinen 3	1960	Continuous improvements	equipment modifications for better quality
Production quality	Inkeroinen 3	1970	Continuous improvements	New groundwood equipment

Market factor	Unit	Year	Activity	Status
Production quality	Inkeroinen 3	1976	Continuous improvements	New thermo-mechanical pulp
Production quality	Inkeroinen 4	1970	Continuous improvements	New groundwood equipment
Production quality	Inkeroinen 4	1972	Continuous improvements	Establishment of Tam-Duplex grades
Production quality	Inkeroinen 4	1976	Continuous improvements	New thermo-mechanical pulp
Production quality	Inkeroinen 4	1978	Continuous improvements	Decision of new forming section, DCS and embossing unit
Production quality	Inkeroinen 4	1980	Continuous improvements	New forming section, DCS and embossing unit start-up
Production quality	Inkeroinen 4	1981	Continuous improvements	Decision from Recycled fibre to groundwood
Production quality	Inkeroinen 4	1983	Continuous improvements	Change of recycled fibre to groundwood
Production quality	Inkeroinen 4	1989	Continuous improvements	Decision of bm 4 modification for grade change
Production quality	Inkeroinen 4	1990	Continuous improvements	Start up of wet end, press, dryers, drives and DCS rebuild
Production quality	Inkeroinen 4	1991	Continuous improvements	Start up of rebuild
Production quality	I Pilot 1	1970	Continuous improvements	Pilot plant start-up 1
Production quality	I Pilot 2	1983	Continuous improvements	Pilot plant 2 implementation
Production quality	I Pilot 2	1984	Continuous improvements	New pressure groundwood grinding and water treatment process
Production quality	I Pilot 2	1986	Continuous improvements	Pilot plant 2 start-up
Production quality	I Pilot 2	1988	Continuous improvements	Decision of pilot plant 2 expansion by new paper machine
Production quality	I Pilot 2	1990	Continuous improvements	Pilot plant 2 expansion start-up
Production quality	W R&D, Pilot	1988	Continuous improvements	New pilot paper machine to Inkeroinen
Production quality	W R&D, Pilot	1989	Continuous improvements	Power plant research and development centre to Tampere
Production quality	W R&D, Pilot	1990	Continuous improvements	Power R&D centre start-up, Inkeroinen pilot pm completed
Production quality	Espanola	1972	Continuous improvements	Focus on quality improvement activities
Production quality	Espanola	1976	Continuous improvements	Decision to increase capacity and expand portfolio by former re-build
Production quality	Espanola	1977	Continuous improvements	Former rebuild start-up
Production quality	Espanola	1987	Continuous improvements	Focus on folding box board based on RCF
Production quality	Espanola	1991	Continuous improvements	Start up of board machine and stock preparation rebuild
Production quality	Espanola	1992	Continuous improvements	The long-standing quality problems reduced end product price level
Production quality	Espanola	1995	Continuous improvements	Raw material changed to RCF
Production quality	Heinola Fluting	1960	Continuous improvements	Fluting board machine start-up
Production quality	Heinola Fluting	1966	Continuous improvements	Kraft raw material
Production quality	Heinola Fluting	1968	Continuous improvements	Semi chemical pulp mill modernisation for fluting quality
Production quality	Heinola Fluting	1976	Continuous improvements	New DCS online-control for basis weight and moisture
Production quality	Heinola Fluting	1982	Continuous improvements	Modification of board machine DCS and increased drying capacity
Production quality	Heinola Fluting	1985	Continuous improvements	defibrillation of semi-chemical pulp

Market factor	Unit	Year	Activity	Status
Production quality	Heinola Fluting	1987	Continuous improvements	Implementation of pope reel and winder
Production quality	Heinola Fluting	1989	Continuous improvements	Start up of headbox, forming, press, dryers, drives, DCS
Production quality	Heinola Fluting	1992	Continuous improvements	new long fibre line
Production quality	Eurocan Kitimat	1970	Continuous improvements	Start up of board - and kraft machines
Production quality	Eurocan Kitimat	1971	Continuous improvements	Modifications of the machines
Production quality	Eurocan Kitimat	1972	Continuous improvements	Machines modifications completed
Production quality	Pineville Kraft	1968	Continuous improvements	Start up of kraft liner machine

Sources: Tampella Annual Report from 1958 to 1995, The Central Archives for Finnish Business Records/ Suomen Elinkeinoelämän Keskusarkisto Elka Mikkeli Tampella's archives: Minutes of the board of directors, 1958–1979, Minutes of the board of executives, 1939–1979, Correspondence of top management, 1958–1995, CEO NG. Grotenfelt's memos, 1954–1970, and Eurocan Pulp and Paper Co. Ltd. internal memos, 1972–1974.

Organization data for the essential capability

The organization capability factors, related activities and operation's status (N=339).

Dynamic Capability	Unit	Year	Activity	Status
TMC	HQT	1958	Evaluation of org. capabilities and competencies	The slowdown in the international markets in 1956. The devaluation in 1957
MANAGERIAL COMPETENCE	Workshop	1958	Manage the needs of the technology	Delivered to VR for 934 locomotives by 1957
TMC	HQT	1958	Evaluation of org. capabilities and competencies	The Finnish General strike in 1956
TMC	HQT	1958	Evaluation of org. capabilities and competencies	The tense economics in Finland in 1956. Growth was 7,6 % between 1959-61
TMC	Workshop	1959	To commit employees to company	Full workshop employment helped employees to pay their loans
TMC	Heinola Fluting	1959	Commit employees to the company	Company built new apartments for new mill employees
TMC	HQT	1959	The long-term commitment and company culture	CEO Arno Solin was rational, skillful, flexible leader between 1929-1959
TMC	HQT	1959	The long-term commitment and company culture	Board member G.M. Nordenswan was intellect leader
MANAGERIAL COMPETENCE	mills	1959	Understanding and sense business opportunities	A successful response for customer quality requirements
MANAGERIAL COMPETENCE	Workshop	1959	Understanding and sense business opportunities	Full capacity in use in the workshop
MANAGERIAL COMPETENCE	Workshop	1959	Understanding and sense business opportunities	The increased sales of the forest equipments
HUMAN DEVELOPMENT	Workshop	1959	The lack of needed resources	The lack of the educated technical employees
MANAGERIAL COMPETENCE	Anjalankoski PM 1	1960	Manage the social ability to absorb technology	The good production by high technical skills
MANAGERIAL COMPETENCE	Workshop	1960	Manage the needs of the technology	The full capacity utilization, own machinery investments
MANAGERIAL COMPETENCE	Heinola Fluting	1960	Decisions and actions without delay	The new machine start up
TMC	HQT	1961	The failure to estimate agreements consequences	The competitiveness got weaker by EFTA agreement in 1961
HUMAN DEVELOPMENT	Workshop	1961	Secure needed resources in future	New technical school implementation
TMC	HQT	1963	Failure to commit employees to the company	Two weeks shutdown by strike
TMC	HQT	1963	The routines of the debt control problem	Lack of the own capitals by new social liabilities, high salaries, wood price
TMC	Heinola Fluting	1963	Failure to commit employees to the company	Two weeks shutdown by strike

Dynamic Capability	**Unit**	**Year**	**Activity**	**Status**
MANAGERIAL COMPETENCE	HQT	1963	Manage the needs of the technology	Delivered a board machine which use reed
TMC	HQT	1963	The routines of the debt control problem	Debt quantity increased by the investments and workshop customer´s loans
HUMAN DEVELOPMENT	Workshop	1964	The lack of needed resources	The lack of the experienced designers
TMC	HQT	1964	The routines of the debt control problem	Low capacity utilization reduced profits and available own capital.
TMC	HQT	1964	The routines of the debt control problem	The loans by the Finnish Central Bank and the Finnish Vientiluotto Oy
MANAGERIAL COMPETENCE	Workshop	1965	Understanding and sense business opportunities	The new board machine in Inkeroinen secured employment of workshop
MANAGERIAL COMPETENCE	Pineville Kraft	1965	Understanding and sense business opportunities	JV with Enso-Gutzeit and Bodcaw to secure fibre supply in North America.
TMC	Workshop	1965	The knowledge and culture to combine JV and sales activities	Plan to deliver board machine to Pineville Kraft
TMC	Workshop	1965	To commit employees to company	Built houses for the company's employees
TMC	Workshop	1965	To commit employees to company	Financial support for the construction of employees own houses
TMC	Workshop	1965	To commit employees to company	Helping families by the home nurses
TMC	Workshop	1965	The long-term commitment and company culture	Arranged housing for pensioners
TMC	Workshop	1965	To commit employees to company	Organized few healthcare chech-in places in Tampere
MANAGERIAL COMPETENCE	HQT	1965	Understanding and sense business opportunities	NG. Grotenfelt hosts Soviet journalists in Tampere
MANAGERIAL COMPETENCE	HQT	1966	Understanding and sense business opportunities	Outsourcing of the apartment activities
TMC	HQT	1966	To commit employees to company	The apartment loans to employees
TMC	HQT	1966	The routines of the debt control problem	Competitors gained advantage by workshop´s lack of the national lenders
MANAGERIAL COMPETENCE	Inkeroinen BM 4	1966	Decisions and actions without delay	The successful production
MANAGERIAL COMPETENCE	Espanola	1966	Decisions and actions without delay	The successful project implementation in Capdevila Tambar/Espanola
MANAGERIAL COMPETENCE	Pineville Kraft	1966	Decisions and actions without delay	The construction work started
TMC	Workshop	1966	The knowledge and culture to combine JV and sales	The delivery of the new board machine to Pineville Kraft signed
TMC	HQT	1967	Evaluation of org. capabilities and competencies	The devaluation of the Finnish mark
MANAGERIAL COMPETENCE	HQT	1967	Understanding and sense business opportunities	JV agreement with Ahlström,Kaukas,Kymi for centralized wood purchasing

Dynamic Capability	Unit	Year	Activity	Status
HUMAN DEVELOPMENT	Workshop	1967	Secure needed resources for future	Workshop received permission to set up its own school from government
MANAGERIAL COMPETENCE	Workshop	1967	Understanding and sense business opportunities	Machinery sold to Pineville Kraft Corp. by joint-venture activities
MANAGERIAL COMPETENCE	Eurocan Kitimat	1968	Decisions and actions without delay	The construction work started
TMC	workshop	1968	The knowledge and culture to combine JV and sales	The major machinery deliveries to Eurocan Kitimat signed
TMC	HQT	1968	The long-term commitment and company culture	Board member Ake Kihlman work 48 years in Tampella between 1920-68
MANAGERIAL COMPETENCE	HQT	1969	Decisions and actions without delay	external consultant hired. In consequence new organization, budget system
TMC	HQT	1969	Evaluation of org. capabilities and competencies	The agreement of the cyclical reserve fund to stabilice national economics
TMC	HQT	1969	Evaluation of org. capabilities and competencies	The new business tax law
MANAGERIAL COMPETENCE	HQT	1969	Reshape organization structures incl. resources	A new organization for the wood processing industry, headed by Klemetti
MANAGERIAL COMPETENCE	Workshop	1969	Reshape organization structures incl. resources	Workshops new organization , headed by Björklund
MANAGERIAL COMPETENCE	HQT	1969	Reshape organization structures incl. resources	A new organization for the wood processing industry, headed by Klemetti
MANAGERIAL COMPETENCE	HQT	1969	Reshape organization structures incl. resources	Workshops new organization , headed by Björklund
MANAGERIAL COMPETENCE	Workshop	1970	Manage threats	Agreement on the working conditions of the metal industry lasted 6 months
MANAGERIAL COMPETENCE	Workshop	1970	Understanding and sense business opportunities	Machinery sold to Eurocan Pulp and Paper Co.Ltd. by joint-venture activities
MANAGERIAL COMPETENCE	HQT	1970	Understanding and sense business opportunities	Grotenfelt optimistic about sales opportunities of MF- and MG-grades
MANAGERIAL COMPETENCE	HQT	1970	Understanding and sense business opportunities	Lack of big scale technology according to Grotenfelt
MANAGERIAL COMPETENCE	HQT	1970	Manage the needs of the technology	Big unit´s sack paper for smaller converters and specialities on small ones
MANAGERIAL COMPETENCE	HQT	1970	Understanding and sense business opportunities	Focus to expand sack paper market share and research work
MANAGERIAL COMPETENCE	HQT	1970	Manage the needs of the technology	Tampella have no coated paper, left behind in development
MANAGERIAL COMPETENCE	HQT	1970	Understanding and sense business opportunities	Previously sold capacity, new approach can be for a individual product
TMC	Workshop	1970	The failure to commit employees to company	Growing turbulence in the labor market
TMC	Workshop	1970	The failure to commit employees to company	Existing temporal strikes cause delivery delays.

Dynamic Capability	Unit	Year	Activity	Status
HUMAN DEVELOPMENT	Workshop	1970	The lack of needed resources	The lack of the professional employees
TMC	Workshop	1970	Evaluation of org. capabilities and competencies	The reduced profitability by the delivery terms of the customer loans.
MANAGERIAL COMPETENCE	Workshop	1970	Understanding and sense business opportunities	The reduced profitability of the prices of the raw materials and salaries
MANAGERIAL COMPETENCE	Mills	1970	Manage the needs of the technology	A lot of investment activities
TMC	Workshop	1971	The failure to commit employees to company	The seven weeks metal union strike
MANAGERIAL COMPETENCE	Eurocan Kitimat	1971	Manage threats	Eurocan Kitimat unsuccessful start up
MANAGERIAL COMPETENCE	Espanola	1971	Manage threats	Espanola start up delay
TMC	HQT	1971	Evaluation of org. capabilities and competencies	Reduced profit by the UKK-agreement and cyclical reserve fund payment
MANAGERIAL COMPETENCE	HQT	1971	Understanding and sense business opportunities	Reduced profit by the wood costs
MANAGERIAL COMPETENCE	HQT	1971	Understanding and sense business opportunities	The debt interests increased by the forest products warehouse quantities
TMC	HQT	1971	The routines of the debt control problem	debt interests increased by the international and workshop customer loans
MANAGERIAL COMPETENCE	Workshop	1971	Understanding and sense business opportunities	debt interests increased by the international and workshop customer loans
HUMAN DEVELOPMENT	HQT	1971	Focus on organization population	Focus on the development of the human resources
INFORMATION	HQT	1971	The development of the information system	Focus to increase internal information
TMC	HQT	1971	To commit employees to company	Increased health care,work safety,participation on housing,employees loans
MANAGERIAL COMPETENCE	Heinola Fluting	1971	Understanding and sense business opportunities	Market organization refocused on new markets
MANAGERIAL COMPETENCE	Pineville	1971	Manage the social ability to absorb technology	Turbine failure caused many weeks shutdown
MANAGERIAL COMPETENCE	HQT	1971	Understanding and sense business opportunities	Tampella deliver kraftliner boardmachine to Kemi Oy Kemi
MANAGERIAL COMPETENCE	Workshop	1971	Understanding and sense business opportunities	Tampella deliver kraftliner boardmachine to Kemi Oy Kemi
HUMAN DEVEL-OPMENT	HQT	1972	Secure needed resources for future	Human resources focused on employee policies, organization development
INFORMATION	HQT	1972	The development of the information system	Information sharing and communication increased
MANAGERIAL COMPETENCE	HQT	1972	Manage threats	Currency deviation caused significant loses

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	Workshop	1972	Reshape organization structures incl. resources	Reorganization
MANAGERIAL COMPETENCE	Workshop	1972	Manage the needs of the technology	Low capacity utilization rate
MANAGERIAL COMPETENCE	Eurocan Kitimat	1972	Manage threats	Succesful restart up
MANAGERIAL COMPETENCE	Heinola Fluting	1972	Understanding and sense business opportunities	Demand higher than production
MANAGERIAL COMPETENCE	Workshop	1972	Understanding and sense business opportunities	Workshop profitability may improve by the white-collar layoffs
MANAGERIAL COMPETENCE	Workshop	1972	Understanding and sense business opportunities	Workshop profitability may improve by white-collars of reorganization
MANAGERIAL COMPETENCE	Workshop	1972	Understanding and sense business opportunities	Workshop profitability better by the longer summer holidays
MANAGERIAL COMPETENCE	Workshop	1972	Understanding and sense business opportunities	Workshop profitability better by the decentralization of the white-collars
MANAGERIAL COMPETENCE	Workshop	1972	Understanding and sense business opportunities	Workshop profitability better by the white-collars disability pension
MANAGERIAL COMPETENCE	HQT	1972	Manage threats	Hi-Fi qualities need to be replaced by the new ones in the future
MANAGERIAL COMPETENCE	HQT	1972	Manage threats	Banks are concerned about debt burden and financial situation
TMC	HQT	1972	Evaluation of org. capabilities and competencies	the board should keep more frequent and regular meetings
MANAGERIAL COMPETENCE	HQT	1972	Decisions and actions without delay	termination, reduction or interruption of unprofitable production
MANAGERIAL COMPETENCE	HQT	1972	Decisions and actions without delay	Focus to reduce costs, eg staffing
MANAGERIAL COMPETENCE	HQT	1972	Reshape organization structures incl. resources	reorganization, reduction or closure of sub-departments
MANAGERIAL COMPETENCE	HQT	1972	Decisions and actions without delay	Small business income should be increased, such as housing
MANAGERIAL COMPETENCE	HQT	1972	Decisions and actions without delay	Detailed instructions and controls for the cost of travel and cars
MANAGERIAL COMPETENCE	HQT	1972	Understanding and sense business opportunities	Faster collection of available payments
MANAGERIAL COMPETENCE	HQT	1972	Understanding and sense business opportunities	Reduction of the warehouse assets
MANAGERIAL COMPETENCE	HQT	1972	Manage threats	Savings should be launched to the entire organization

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	HQT	1972	Manage threats	In large projects, the Legal Department should be involved
MANAGERIAL COMPETENCE	HQT	1972	Manage threats	Foreign and financial issues should be negotiated with the financial managers
TMC	HQT	1972	Evaluation of org. capabilities and competencies	Constant changes require flexible attitude and flexibility in production
HUMAN DEVELOPMENT	HQT	1972	Secure needed resources for future	Need to learn how to create new, more advanced and specialized products
MANAGERIAL COMPETENCE	HQT	1972	Manage the needs of the technology	Higher value products requires more flexiable production technology
HUMAN DEVELOPMENT	HQT	1972	Secure needed resources for future	High employee´s skills and knowledge are needed
MANAGERIAL COMPETENCE	HQT	1972	Manage the social ability to absorb technology	Employees' skills & knowledge need maintain and continuous development
HUMAN DEVELOPMENT	HQT	1972	Focus on organization population	Demand for co-operation, involvement and appreciation of the human contribution
HUMAN DEVELOPMENT	HQT	1972	Secure needed resources for future	Past generations have built us a present that is better than their starting point
HUMAN DEVELOPMENT	HQT	1972	Focus on organization population	Man is the most important factor in progress.
TMC	HQT	1972	Evaluation of org. capabilities and competencies	Government smart decisions also needed to create conditions
TMC	HQT	1973	Evaluation of org. capabilities and competencies	Production operations divided into two: Forest and Workshops, textile and plastics
TMC	HQT	1973	Evaluation of org. capabilities and competencies	Forest (Klemetin) and workshop (Forss) independent reporting to the CEO
TMC	HQT	1973	To commit employees to company	Kihlman was CFO since 1973 and reports to CEO Grotenfelt
TMC	HQT	1973	To commit employees to company	Vatanen served as manager since 1973 and reports to Kihlman.
MANAGERIAL COMPETENCE	HQT	1973	Manage threats	The financial situation requires immediate special actions from management
MANAGERIAL COMPETENCE	HQT	1973	Manage threats	Eurocan can not plan any improvement actions
MANAGERIAL COMPETENCE	HQT	1973	Manage threats	Financial situation demands the realization of Pineville's shares
TMC	HQT	1973	Evaluation of org. capabilities and competencies	Workshop needs to increase product-specific cooperation with other national competitors
TMC	HQT	1973	Evaluation of org. capabilities and competencies	Does it make sense to compete among domestic heavy metal players?
MANAGERIAL COMPETENCE	HQT	1973	Understanding and sense business opportunities	Possibility to develop higher value-added products

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	HQT	1973	Understanding and sense business opportunities	Poor profitability dued to economic downturns and its impact on the workshop
TMC	HQT	1973	The long-term commitment and company culture	The company has some responsibility for employee health and housing
MANAGERIAL COMPETENCE	HQT	1973	Decisions and actions without delay	The financial situation requires a reduction in investments
MANAGERIAL COMPETENCE	HQT	1973	Decisions and actions without delay	The financial situation requires an improvement in result of operations
MANAGERIAL COMPETENCE	HQT	1973	Reshape organization structures incl. resources	Central organization implementation
TMC	HQT	1973	Evaluation of org. capabilities and competencies	Top management reorganization
TMC	HQT	1974	The routines of the debt control problem	Significant lack of capital, currency instability in the markets
TMC	HQT	1974	Evaluation of org. capabilities and competencies	The payment of the cyclical reserve fund
HUMAN DEVELOPMENT	Workshop	1974	The lack of needed resources	The lack of the professional employees
TMC	HQT	1974	To commit employees to company	The expanded Board of Directors
TMC	Workshop	1974	To commit employees to company	The social investments of the hygiene facilities and food canteens
MANAGERIAL COMPETENCE	Mills	1974	Manage the needs of the technology	Investments of the environment protection
MANAGERIAL COMPETENCE	HQT	1974	Understanding and sense business opportunities	Low operation rates (65-70%) of forest was due to increased oil prices
MANAGERIAL COMPETENCE	HQT	1974	Understanding and sense business opportunities	The low utilization rates in the forest industry continue
MANAGERIAL COMPETENCE	HQT	1974	Understanding and sense business opportunities	Despite the weak economic cycle, one year order backlog in workshop
TMC	Workshop	1974	Failure to commit employees to the company	Workshop director Arvo Karhola: Absences affect our well-being
MANAGERIAL COMPETENCE	HQT	1974	Understanding and sense business opportunities	A long term plan: Board decision to close Inkeroinen semichemical pulp mill
MANAGERIAL COMPETENCE	HQT	1974	Understanding and sense business opportunities	Board´s long term plan: Inkeroinen 4 modified to FBB incl furnish changes
MANAGERIAL COMPETENCE	HQT	1974	Understanding and sense business opportunities	Board´s a long term plan: Expansions of Heinola and Tampere units
TMC	HQT	1974	The long-term commitment and company culture	Boards a long term plan: New plan for apartment policies
MANAGERIAL COMPETENCE	Workshop	1974	Understanding and sense business opportunities	Inland Container corp. bought the first Fluting board machine and now another
INFORMATION	HQT	1974	The development of the information system	Increased information by NG. Grotenfelt

Dynamic Capability	Unit	Year	Activity	Status
TMC	Workshop	1974	To commit employees to company	Completed 3 apartment blocks for employees
TMC	Workshop	1974	The long-term commitment and company culture	Tampella arrange apartment for pensioners in Huikkaa
MANAGERIAL COMPETENCE	HQT	1975	Understanding and sense business opportunities	64% of Tampella's total production was exported abroad in 1974
MANAGERIAL COMPETENCE	HQT	1975	Decisions and actions without delay	The cost reduction project including lay offs
TMC	HQT	1975	To commit employees to company	Free health clinic services
MANAGERIAL COMPETENCE	Workshop	1975	Reshape organization structures incl. resources	Sales reorganization
MANAGERIAL COMPETENCE	HQT	1975	Decisions and actions without delay	Deinvested the ´T*ampella tänään´-magazine*
MANAGERIAL COMPETENCE	HQT	1975	Understanding and sense business opportunities	The packaging business established
MANAGERIAL COMPETENCE	HQT	1975	Understanding and sense business opportunities	LongTermPlan includes markets, products, competitors and own resources
MANAGERIAL COMPETENCE	HQT	1975	Understanding and sense business opportunities	Reduction of the gearing ratio is the main target
MANAGERIAL COMPETENCE	Workshop	1976	Understanding and sense business opportunities	Workshops problem is to maintain competitiveness and cashflow
MANAGERIAL COMPETENCE	HQT	1976	Reshape organization structures incl. resources	Forest reorganization
MANAGERIAL COMPETENCE	Mills	1976	Understanding and sense business opportunities	Profitability very weak in Tampella, specially in Forest industry
MANAGERIAL COMPETENCE	Mills	1976	Manage the needs of the technology	Low capacity utilization rate
TMC	HQT	1976	Evaluation of org. capabilities and competencies	The Finnish Central Bank and business banks continued tight finance policies
TMC	HQT	1976	Evaluation of org. capabilities and competencies	The new wealth and electricity taxes
TMC	HQT	1977	Evaluation of org. capabilities and competencies	Two times Finnish mark devaluation
MANAGERIAL COMPETENCE	Heinola Fluting	1977	Decisions and actions without delay	All employees 10 days lay off
TMC	HQT	1977	The routines of the debt control problem	The shares of the Oy Strömberg sold (90milj mk).
MANAGERIAL COMPETENCE	Espanola	1977	Manage the social ability to absorb technology	The successful investment
TMC	Espanola	1977	Evaluation of org. capabilities and competencies	The board prices reduced 30-40 % by the economic crises in Spain
TMC	HQT	1978	Evaluation of org. capabilities and competencies	Profitability improved by the value of Finnish mark

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	HQT	1978	Manage the needs of the technology	Profitability improved by the production utilization rate,cost reduction
MANAGERIAL COMPETENCE	Anjalankoski	1978	Manage the needs of the technology	Aarne Pelkonen: Very limited alternatives in Anjalankoski´s development
MANAGERIAL COMPETENCE	Anjalankoski	1978	Understanding and sense business opportunities	Aarne Pelkonen: 6 machines produce only 200kt/a in Anjalankoski and In-keroinen
MANAGERIAL COMPETENCE	Anjalankoski	1978	Manage threats	Aarne Pelkonen: Newsprint do not need to worry about electronic media
MANAGERIAL COMPETENCE	Anjalankoski	1978	Understanding and sense business opportunities	Pelkonen: It´s needed to reduce production costs by new pm in Anjalankoski
MANAGERIAL COMPETENCE	Anjalankoski	1978	Understanding and sense business opportunities	Aarne Pelkonen: Newsprint profitability is based on the production costs
MANAGERIAL COMPETENCE	Workshop	1979	Understanding and sense business opportunities	Weak profit due to workshop as its invoicing reduced by 27% and 37% in 1978-79
MANAGERIAL COMPETENCE	HQT	1979	Manage threats	Newsprint 20 % overcapacity continues in West-Europe
TMC	HQT	1979	Evaluation of org. capabilities and competencies	LongTermPlan: LWC accounted for 9 points from 13 as best alternative for new pm
TMC	HQT	1979	Evaluation of org. capabilities and competencies	LongTermPlan: Newsprint got 4 points from 13 as best alternative for new pm
TMC	HQT	1979	Evaluation of org. capabilities and competencies	LongTermPlan: SC got 7 from 13 points as second best alternative for new pm
MANAGERIAL COMPETENCE	HQT	1979	Understanding and sense business opportunities	LongTermPlan: LWC accounted for 9 points from 13 as best alternative for new pm
MANAGERIAL COMPETENCE	HQT	1979	Understanding and sense business opportunities	LongTermPlan: Newsprint got 4 points from 13 as best alternative for new pm
MANAGERIAL COMPETENCE	HQT	1979	Understanding and sense business opportunities	LongTermPlan: SC got 7 from 13 points as second best alternative for new pm
MANAGERIAL COMPETENCE	Anjalankoski	1979	Manage the social ability to absorb technology	Pöyry estimated too low costs of goods for PGW, slurry, water treatment, building
HUMAN DEVEL-OPMENT	Anjalankoski	1979	The lack of needed resources	Pöyry estimated too low costs of goods for PGW, slurry, water treatment, building
MANAGERIAL COMPETENCE	Anjalankoski	1979	Understanding and sense business opportunities	Lavonius: Mill unit with only one fluting machine is not good for cost point of view
MANAGERIAL COMPETENCE	Anjalankoski	1979	Manage threats	Lavonius: No improvement plans for cost structure of fluting
HUMAN DEVEL-OPMENT	Anjalankoski	1979	The lack of needed resources	Lavonius: No improvement plans for cost structure of fluting
MANAGERIAL COMPETENCE	Anjalankoski	1979	Understanding and sense business opportunities	Lavonius: Fluting´s export unstable and price not possible to control

Dynamic Capability	Unit	Year	Activity	Status
TMC	HQT	1979	Evaluation of org. capabilities and competencies	The political instability, variations in oil prices
MANAGERIAL COMPETENCE	Mills	1979	Reshape organization structures incl. resources	Transformation from uninterrupted 3-shift to 5-shift system
MANAGERIAL COMPETENCE	Workshop	1979	Understanding and sense business opportunities	Increased customer demand for machinery services and spare parts
TMC	Espanola	1979	Evaluation of org. capabilities and competencies	In Spain inflation increased by 16 % and RCF price by 70 %
TMC	HQT	1980	Evaluation of org. capabilities and competencies	Reorganization of business units from 10 to 3 units
TMC	HQT	1980	Evaluation of org. capabilities and competencies	labor market agreement rose salaries by10-15%,OPEC increased energy prices
TMC	HQT	1980	Evaluation of org. capabilities and competencies	Difficulties to get new loans, high interests rates for new loans
TMC	Workshop	1980	Failure to commit employees to the company	Outsourced activities in production and engineering due to temporal strikes
TMC	Workshop	1980	Evaluation of org. capabilities and competencies	Reorganization to three business units
TMC	HQT	1980	Evaluation of org. capabilities and competencies	Decision to produce newsprint in new pm 3 in by mill, Finnpap and head office
MANAGERIAL COMPETENCE	HQT	1980	Manage threats	New newsprint pm3 has lower risk due to ready customers
MANAGERIAL COMPETENCE	HQT	1980	Manage threats	New newsprint pm3 has lower risk due to old brand
TMC	HQT	1980	The long-term commitment and company culture	New newsprint pm3 has lower risk due to in-house culture to produce and market
HUMAN DEVELOPMENT	HQT	1980	Secure needed resources for future	New newsprint pm3 has lower risk due to in-house culture to produce and market
MANAGERIAL COMPETENCE	HQT	1980	Understanding and sense business opportunities	The growth of the newsprint market is small, but stable
MANAGERIAL COMPETENCE	Anjalankoski	1980	Manage the social ability to absorb technology	Pöyry estimated too low costs of goods for PGW, slurry, water treatment, building
HUMAN DEVELOPMENT	Anjalankoski	1980	The lack of needed resources	Pöyry estimated too low costs of goods for PGW, slurry, water treatment, building
MANAGERIAL COMPETENCE	Anjalankoski	1980	Understanding and sense business opportunities	Rastas: Other paper grades indicates higher growth than newsprint
MANAGERIAL COMPETENCE	Anjalankoski	1980	Understanding and sense business opportunities	Rastas: No existing raw material in-house for woodfree grades, so its rejected
MANAGERIAL COMPETENCE	HQT	1981	Manage threats	The treats of profitability by the increased costs of wood,energy and salaries
TMC	HQT	1981	Evaluation of org. capabilities and competencies	The financial challenges by the national creditors
MANAGERIAL COMPETENCE	Inkeroinen BM 4	1981	Manage the social ability to absorb technology	New production record based on past investments

Dynamic Capability	Unit	Year	Activity	Status
TMC	Workshop	1981	Failure to commit employees to the company	Over 63000 hours lost by the illegal strikes
MANAGERIAL COMPETENCE	Workshop	1981	Reshape organization structures incl. resources	Implementation of new sales unit as Tampella Engineering
TMC	HQT	1982	Evaluation of org. capabilities and competencies	Great devaluation of the Swedish crown, increased national protectionism
MANAGERIAL COMPETENCE	Espanola	1982	Manage the social ability to absorb technology	New production record
MANAGERIAL COMPETENCE	HQT	1983	Manage threats	export prices are too low in portion to wood-, energy- and employees costs
MANAGERIAL COMPETENCE	Inkeroinen	1983	Manage the needs of the technology	The successful transformation from RCF to ground wood fibre
MANAGERIAL COMPETENCE	Workshop	1983	Reshape organization structures incl. resources	Establishment of new marketing department
MANAGERIAL COMPETENCE	Inkeroinen	1983	Manage the needs of the technology	Construction of new pilot machine 2
MANAGERIAL COMPETENCE	Espanola	1983	Manage the social ability to absorb technology	New production record
MANAGERIAL COMPETENCE	Heinola Fluting	1983	Manage the social ability to absorb technology	New production record
MANAGERIAL COMPETENCE	Inkeroinen BM 3	1984	Understanding and sense business opportunities	The international reward in marketing competition
MANAGERIAL COMPETENCE	Mills	1984	Manage the social ability to absorb technology	The successful development of new paper - and board grades
MANAGERIAL COMPETENCE	Inkeroinen	1984	Manage the needs of the technology	The Pilot of the anaerobic waste water purification process
MANAGERIAL COMPETENCE	Workshop	1984	Understanding and sense business opportunities	Focus on automation
MANAGERIAL COMPETENCE	Workshop	1984	Understanding and sense business opportunities	Tampella,Valmet ja Wärtsilä resigned and expanded TVW-agreement
MANAGERIAL COMPETENCE	Workshop	1984	Manage threats	Focus on production flexibility,logistics,standardization,engineering programs
HUMAN DEVELOPMENT	HQT	1984	Focus on organization population	Education increased
MANAGERIAL COMPETENCE	Workshop	1984	Reshape organization structures incl. resources	two new units with Tamrock : Stock -and board machinery, and Power
TMC	HQT	1985	Evaluation of org. capabilities and competencies	Conclusion by top management - strategy has been succesful
MANAGERIAL COMPETENCE	Workshop	1985	Understanding and sense business opportunities	Focus on spare part business
TMC	Espanola	1985	Evaluation of org. capabilities and competencies	By EEC membership, changes in the custom taxes and tax policies in Spain

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	Heinola Fluting	1985	Manage the social ability to absorb technology	Success of the defibrillation of pulp and modern IT-system
MANAGERIAL COMPETENCE	Heinola Fluting	1985	Reshape organization structures incl. resources	Establishment of the packaging sales department
TMC	HQT	1986	Evaluation of org. capabilities and competencies	Transform business from power to the forest -and metal operations
TMC	HQT	1986	Evaluation of org. capabilities and competencies	Sold unuseful shares of the power companies and issued of shares
MANAGERIAL COMPETENCE	Inkeroinen	1986	Manage the social ability to absorb technology	The pilot machine 2 start up
TMC	Workshop	1986	Failure to commit employees to the company	The delay of the production resource reorganization by the industrial action
MANAGERIAL COMPETENCE	Workshop	1986	Reshape organization structures incl. resources	New organization to stock- and board machine business
MANAGERIAL COMPETENCE	Anjalankoski	1986	Manage the social ability to absorb technology	New production record
MANAGERIAL COMPETENCE	HQT	1987	Understanding and sense business opportunities	Improvements in profits & costs of the debt, Sold forest areas, companies
TMC	HQT	1987	To commit employees to the company	Two employee representatives nominated to the group of board of directors
HUMAN DEVELOPMENT	HQT	1987	Focus on organization population	Educate top management for international business strategy
MANAGERIAL COMPETENCE	HQT	1987	Reshape organization structures incl. resources	Establishment of the business development function
HUMAN DEVELOPMENT	HQT	1987	Focus on organization population	All employees educated to understand the meaning of the profitability
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	Focus to increase value of products, and customer orientation attitude
MANAGERIAL COMPETENCE	HQT	1988	Manage threats	The equity ratio from 13 % to 19 %, two issue of shares
TMC	HQT	1988	Evaluation of org. capabilities and competencies	The organizational efficiency improved by the changed daily routines
TMC	HQT	1988	To commit employees to the company	Highlight company norms and culture
HUMAN DEVELOPMENT	HQT	1988	Focus on organization population	Focus on education at the every organizational levels
INFORMATION	HQT	1988	The development of the information system	Increased information
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	In West Germany exists the most efficient magazine paper machine
TMC	HQT	1988	The long-term commitment and company culture	Metsävirta: Company have to invest in human resources
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	Metsävirta: Sweden has the most powerful newsprint machines

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	No immediate threats, but changes need to be made a lot in forest unit
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	Metsävirta: A standard newspaper should not be produce any more
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	Metsävirta: You need to know the customer's needs at an early stage
MANAGERIAL COMPETENCE	HQT	1988	Understanding and sense business opportunities	Paper quality must be at least as good as the best competitors
MANAGERIAL COMPETENCE	HQT	1989	Understanding and sense business opportunities	Tampella acquired a corrugated board factory owned by the Catelli family in Italy
MANAGERIAL COMPETENCE	HQT	1989	Manage the needs of the technology	The new technology adoption by international firm acquisitions
TMC	HQT	1989	To commit employees to the company	The employees had strong commitment for organizational changes
TMC	HQT	1989	Evaluation of org. capabilities and competencies	Competitiveness weak due to revaluation and interest rates rose
TMC	HQT	1989	Evaluation of org. capabilities and competencies	Signed pre agreement of joint-venture with The Ministry of Defense
MANAGERIAL COMPETENCE	HQT	1989	Decisions and actions without delay	All employees got reward due to last year profits
MANAGERIAL COMPETENCE	HQT	1990	Understanding and sense business opportunities	Focus on prod. expansion by rebuilds,improved news,higher board quality
MANAGERIAL COMPETENCE	HQT	1990	Manage threats	The board rationalization program
MANAGERIAL COMPETENCE	Anjalankoski	1990	Manage the social ability to absorb technology	The weak start up
MANAGERIAL COMPETENCE	Anjalankoski	1990	Understanding and sense business opportunities	Still newsprint grade
MANAGERIAL COMPETENCE	Workshop	1990	Manage the needs of the technology	The expansion of the pilot plant of the stock -and paper machinery industry
MANAGERIAL COMPETENCE	Workshop	1990	Reshape organization structures incl. resources	The centralized operations to Myllypuro facilities
MANAGERIAL COMPETENCE	Mills	1991	Decisions and actions without delay	Reduction of the employees was 15 % within two years in Forest unit
TMC	HQT	1991	Evaluation of org. capabilities and competencies	New owner as Solidium Oy bought all shares from SKOP
TMC	HQT	1991	Evaluation of org. capabilities and competencies	Devaluation of Finnish mark increased competiveness
MANAGERIAL COMPETENCE	HQT	1991	Understanding and sense business opportunities	The after taxes profit was -1638 Mmk
TMC	HQT	1991	Evaluation of org. capabilities and competencies	SKOP forgave 1,5 billion Fmk loans
MANAGERIAL COMPETENCE	HQT	1991	Manage threats	75ha forest area sold, reduction of employees and a plenty of lay offs

Dynamic Capability	Unit	Year	Activity	Status
MANAGERIAL COMPETENCE	Mills	1991	Manage the needs of the technology	Rebuilds of five machines completed between years of 1988-91
TMC	HQT	1991	Evaluation of org. capabilities and competencies	Devaluation
MANAGERIAL COMPETENCE	Mills	1991	Manage the social ability to absorb technology	Improved production and work efficiencies, increased flexibility
TMC	HQT	1991	Evaluation of org. capabilities and competencies	Veli Korpi: Tampella's weak profitability is mainly due to the economic downturn
MANAGERIAL COMPETENCE	HQT	1991	Manage the needs of the technology	Veli Korpi: Almost all production facilities are at a high level of technology
MANAGERIAL COMPETENCE	HQT	1991	Understanding and sense business opportunities	Veli Korpi: The products have a good image around the world
TMC	HQT	1991	The long-term commitment and company culture	Veli Korpi: Company has a long tradition of know-how
TMC	HQT	1991	The long-term commitment and company culture	Veli Korpi: A lot of expertise has been hired in recent years
TMC	HQT	1992	Evaluation of org. capabilities and competencies	SKOP CEO Matti Ali-Melkkilä: Tampella is not going to be split or SKOP does not sell
TMC	HQT	1992	Evaluation of org. capabilities and competencies	Massive investments by ex-CEO Pekka Salo and SKOP are completed
MANAGERIAL COMPETENCE	HQT	1992	Reshape organization structures incl. resources	simplified organizations in forest unit,water turbines and non-woven's deinvestments
MANAGERIAL COMPETENCE	Espanola	1992	Manage the social ability to absorb technology	unsolved quality claims,cost structure weak,problems in machinery deliveries
TMC	HQT	1992	Evaluation of org. capabilities and competencies	The shares of the Papertech sold to Valmet Oy
MANAGERIAL COMPETENCE	HQT	1992	Understanding and sense business opportunities	CEO Summa: Lack of demand and the third part of the production capacity is unused
TMC	HQT	1993	Evaluation of org. capabilities and competencies	The Tambox CCC (Italy) values were booked for 250 million down

Sources: Tampella Annual Report from 1958 to 1995, The Central Archives for Finnish Business Records/ Suomen Elinkeinoelämän Keskusarkisto Elka Mikkeli Tampella’s archives: Minutes of the board of directors, 1958–1979, Minutes of the board of executives, 1939–1979, Correspondence of top management, 1958–1995, CEO NG. Grotenfelt’s memos, 1954–1970, and Eurocan Pulp and Paper Co. Ltd. internal memos, 1972–1974.