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FRAMEWORK FOR THE IMPLEMENTATION AND INTEGRATION OF ERP-MES SYSTEM: A CASE STUDY OF AN INDUSTRIAL PRODCUTION PROCESS.

ABSTRACT

This master thesis research study presents the case of an industrial production process that is embarking on enterprise system implementation and integration of ERP & MES system. A decision based on the need to meet internal & external demands for organizational change. This research study presented IT as a tool for enterprise system implementations and conceptual backgrounds from the business process and business architectural dimension, which set a roadmap towards the constructed framework for the implementation & integration project, specifically the implementation & Integration of ERP-MES system building on the framework presented in TOGAF. This research explored the functionalities and similarities of these systems to be implemented. A parallel case study was presented for prediction of the possible outcome of this research study. The theoretical and practical concepts considered relevant to this research objective were empirically tested and validated using the guidelines provided. The final framework for the implementation & integration of ERP & MES as presented in this research is the outcome of the rigor from previous effort with the effort from this research study, which is subject to further development and optimization for research purposes in organization's general and case specific needs.

Keywords: ERP, MES, BPM, BPR, Architecture, TOGAF, Artifacts, implementation, integration, strategic

LIST OF ABBREVIATIONS

ACCT-   Accounting
APS -   Advanced Planning Scheduling
BA-   Business Architecture
DSRM-   Design-Science Research Methodology
EA-   Enterprise Architecture
ENGR-   Engineering
ERP –   Enterprise Resource Planning
BPM-   Business Process Management
KB -   Kimberly-Clark
MES-   Manufacturing Execution System
MRP-   Material Requirement Planning
PURCH-   Purchasing
SAP-   System Application & Product
SCM -   Supply Chain Management
S&OP-   Sales & Operations planning
TOGAF-   The Open Group Architecture Framework

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1   INTRODUCTION

Recently, the level of failures recorded in the implementation of enterprise system in organizations generally is quite alarming, although, there are an equally great amount of successes recorded too, coupled with several other enterprise system implementations related challenges organizations are facing globally. Irrespective of these challenges, most organizations are still willing to invest in enterprise systems, in order to enhance their competitiveness, meet internal and external demands, in the bid to gain organizational relevance, compliance, legacy systems integration, enhance capabilities and operational performance, business process automation, and aligning business process with information systems management. Unfortunately, in spite of the fact that there are a vast amount of research on enterprise system implementation especially ERP system implementation, which has long been the backbone of core organizational success, there is still a scarcity of research on critical success factors of initial and ongoing implementation. This setback is obvious in widely cited literature up to date, with just a few of them that have been able to theorize the initial and ongoing implementation success, even though there are enormous benefits embedded in the enterprise systems but still failures are recorded, then these failures could be attributed to numerous reasons, majorly and specifically among these reasons is the inability in the area of research to provide a holistic framework that can fully capture all of the critical factors that will enhance overall success and return on investments (Fui-Hoon Nah, Lee-Shang & Kuang, 2001).

Globally, it is obvious how organizations are getting connected now a days, how they are steadily and quietly connecting and networking one business function with another, one business unit with another and one business process with another. These organizations are doing all of these by putting information systems in the place where it can yield more and better informations, and managers are assigned to monitor this system and they are able to gather realtime information, (Davenport, 2000). The growth and enhancement of organizational performance through the end-to-end connection provided by IT innovations, which has attempted to integrate all departments, functions, and unit in an organization to a single computer system. In addition, the growth in manufacturing companies globally and the willingness to invest in information systems to achieve productivity gains and competitive advantages in the market.

fortunately, the emergence of new classes of packaged application software over the past years has enabled the implementation of enterprise systems especially ERP system gained a major status in the market in response to these needs (Somers & Nelson, 2001).

This innovative move that has enhanced organizational performance through providing end-to-end connectivity (Ehie & Madsen, 2005), requires strategic and operational approaches that will enable interrelation and alignment of certain elements both from the business process and the enterprise system for productivity. Besides, there are different strategic approaches to ERP software integration, one of the two main technical options are the implementation of a standard package with minimum deviation from the standard settings, and the other is the customization of a system to suit local requirements. Notwithstanding, from the management perspective, the nature of the ERP integration problem may include strategy, organization, and technical dimensions (Holland & Light, 1999). Although, many organizations and SMEs today are still adopting ERP to manage their operations, but for most of this period, the information system specialists have still not paid attention to the operation floor that is the core business process (Holst, 2001), which also from this end has long affected the successful implementation of ERP and other support systems and the holistic result that should be derived from them. On the other hand, despite all strategies and work that has been done regarding the implementation of information systems such as ERP system in organizations of different size and structure, with case study of successful and unsuccessful implementations, the emphasize on evaluating customized cases of ERP support integration systems are still lacking (Ehie & Madsen, 2005).

1.1   Organization background

Kimberly-Clark happens to be an American based corporation founded in the year 1880 and has undergone several transformation stages from name changes to acquisitions. Kimberly-Clark is one of the leading global manufacturers of household personal care and paper based consumer products, Kimberly-Clark has manufacturing facilities in 37 countries and products lining on shelves in about 175 countries, the organization boasts such top-selling brands as Kleenex, Cottonelle, Scott, Huggies, Pull-ups, Kotex and Depend. Kimberly-Clark products hold number 1 or number 2-share position in more than 80 countries worldwide. In 2013, the company reported sales of about $ 21.2 billion and employed 42,500 workers. In 2014, the organization has contributed more than 35.8 million in cash and product to charitable causes. (http://www.kimberly-clark.com/ourcompany.aspx).

Kimberly-Clark South Africa is the administration center for the Nigeria production plant. Kimberly-Clark Nigeria is one of the fastest growing manufacturing plants in the world, due to the population increase in Nigeria and the demand for products produced by Kimberly-Clark, this subsidiary production plant part of the organization is embarking on enterprise systems integration project. This production plant's structure is made up of different department and

subunits such as the administrating team, production team and support team. The production team is further divided into sub-teams with each team having a leader. The production process itself is made up of series of processes, and sub processes that are involved in the transformation raw materials from raw states to the packaging state and these series of transformation involve the use certain data in the area of material utilization, labor costing, production tracking, scheduling, controlling and planning. Currently, ERP system is in use with other integrated support systems such as accounting, purchasing, customer relations, and human resources, unfortunately the production department is not, no information systems in place for monitoring and controlling its daily activities, which has led to wastages, lack of visibility, traceability, redundancy and manual processes, in addition to the existing challenges of lack of previous documentation of implementation and sustainability plans, which would have been reused in the current situation. These challenges motivated the move to integrate a system as a solution for production process control and monitoring (MES), and a provision for an implementation and integration guideline for sustainable benefits, which now becomes a task for this research study to provide the required solution.

1.2   Objectives

The objective of this master thesis is aimed at presenting a research effort geared towards the completion of a master level studies, and this research effort will have the potential for knowledge elicitations and further research efforts, by theoretically and practically reviewing previous research efforts within this research domain, which will provide a solution path to this research problem and this will be empirically validated through the data analysis processes. To set the direction for this entire effort the research study presents the research problem thus:

- How can MES be integrated into the existing organizational structure using information systems to improve productivity, saving time and cost?
- What are the steps or framework to follow for improving productivity, transiting from manual to automated system using information system management?
- How best can MES-ERP be integrated for effectiveness and efficiency on the production floor?

Based on these research problems, this research objective will solely therefore be directed towards the provision of a framework that will assist in the implementing and integrating of ERP-MES systems into the existing case organization business process, to improve production process, save time and cost.

1.3 Thesis outline

In the introduction, a general overview of enterprise system implementation was presented and the background information of the research case organization, in order to establish the conceptual idea behind this research study the objective of this research was presented which was based on the research problem and finally on this chapter the outline of this master thesis.

Chapter two of this master thesis will present the theoretical background of enterprise systems implementation as the main domain where this research will be developed from, information technology will be presented in this same chapter as the tool that will enable enterprise information systems implementation. This chapter will also present the business process and the business architecture perspective of EA and the definition of these components and how these components relate to the research problem and how they will present a road-map towards the final framework construct of this report according to the objective of this master thesis. In addition to the backgrounds in chapter two, chapter three will on the other hand present the background overview of the ERP system and the definition, and a brief transitional history of ERP systems, then the description of the MES section of this research, also the explanation behind the integration of both systems. Finally, in this chapter will be the presentation of a practical case study of a production process with similar implementation process as the research case study.

Then chapter four will present the research methods with a theoretical background as a guide for the research study, the research approach, the description of the case study organization current and targeted state, data gathering process, data analysis process and the interpretation of the data collected for the empirical study lastly in this chapter will be the presentation of limitations.

Chapter five will be dedicated to the presentation of findings and discussion of the research study drawn from the entire research effort and presenting the final research outcome based on the objective this research is meant to fulfill. This will lead to the concluding chapter, chapter six which will be presenting the conclusion drawn wholesomely from the research and present further research opportunities.

2 ENTERPRISE INFORMATION SYSTEMS IMPLEMENTATION

This chapter will be presenting the background overview of enterprise information systems implementation as the main domain from where other components such as the BPM and BA of EA will be discussed, but before considering the business process and EA perspective in this chapter, information technology will be discussed in this chapter as the enabler or tool for other components to thrive, furthermore, this chapter will be presenting the definition of these components and how they relate to this research and how it will set a roadmap towards the final framework construct at the end of this research study.

2.1 Background overview of information systems implementation

To specifically identify the element of information systems that can address a research phenomenon such as the one presented in this master thesis could really be challenging, when been compared with numerous challenges organizations face globally nowadays. However, based on insight gathered from previous effort, it has been made easy going by an observation forward-   ed from previous effort that in recent time when organizations are trying to achieve productivity gains, competitive advantages in the market and responding to business needs, they opt for the option of adopting the integration of packaged software, which in this case is the integration of MES to existing ERP systems, this is all in the intention to be efficient and effective. As a matter of fact, until recently, as we enter the 1990s, that it was noticed that, one of the tools that have greatly transformed organizations is information technology, to an extend that the use of information technology can be personalized to suit individual and organizational needs (Davenport & Short, 1990).

Guarino (1998) refers to information systems as consisting of a component of three different types: application programs, information resources like databases and knowledge bases and user interfaces, these components when properly integrated will assist any organization to accomplish a concrete business purpose, with this in the mind, these components of information systems need to be

well implemented in one way or the other within an organization, so as to gain the desired benefit. In the light of this, an approach towards reviewing further the implementation of information systems holistically, Von, March, Park & Ram (2004), explained that, "Information systems implementation within an organization is for the purpose of improving the effectiveness and efficiency of that organization, and that the extent to which this purpose is achieved is dependent on the capabilities of the information system and characteristics of the organization, its work systems, its people, its development and the method of implementation". Cooper & Zmud, (1990) in like manner explains that the pressure most organizations are facing to make their operational, tactical, and strategic processes more efficient and effective. That hugely the attractive means of improving these processes is greatly dependent on a wide variety of information technologies.

Davenport (1998), in an article, still on information system implementation, argues that the information system implementation in an organization is a function of how such an organization optimizes information system capabilities, the company's strategy and the organization culture. Hyötyläinen (2005), suggested a strategic approach to information system implementation, specifically ERP system, that, "the strategic approach to the implementation of ERP in an organization is based on the organization business activity and these activities will involve end user enterprise or a similar organization that is considered to be in phases. This cycle covers from the company's strategic planning to the continual development of the information system and its uses". In that same article, it was further explicated to include four different cycles: strategic planning to the information systems and systems selection, requirement definitions then the information system's implementation stage and finally the information systems development.

In summary of all that has previously been established, it will be right to said that to whatever extends any organization is willing to implement information system, it is dependent on some vital elements, which are enclosed in the capabilities of the information technologies (systems), that is the potential of the technology to address the organizational challenges, and not only that, but should also be in alignment with the objectives of the organization, the characteristics of the organization, which means the organization identity, and lastly the strategic approach of the organization. This is basically an approach that such an organization is expected to follow to achieve the desired changes in line with their objectives and identity. Relatively, according to all that has been said by authors and scholars aforementioned and their respective views on the desires of organizations striving towards efficiency and effectiveness, likewise their suggested approaches to the implementation of information systems. All these needs are not farfetched from that of the research organization, that is in quest to implementing a system that will enhance productivity gain and the strategy needed to get this need met.

2.2 Information technology as a tool for information system implementation

Lately, transformation noticeable in organizations can be attributed to capabilities offered by information technology to the degree of customization of needs, in computation, software applications and business process redesign. These transformations have greatly impacted organizations in improving organizational capabilities in organization transactions, geographical location, automation, analytics, information, sequences, knowledge management, tracking and disintermediation. Information technology and business process redesign are well known for playing vital roles in an industrial process, although both largely have separate tools for specific and limited environments, nevertheless, IT is greatly used in industrial process for analysis and modeling tools. IT in manufacturing encompasses process modeling, production scheduling and control, material management information systems, (Davenport & Short, 1990).

Information technology as an artifact whose underlying technologies base is comprised of computer or communications hardware and software in any organizational environment such as manufacturing firms.

(Cooper & Zmud, 1990)

With the intention that the definition has unveiled the idea that information technology is indeed a tool that can be used to enhance organizational changes or business process changes as the case may be, on the other hand, in a way to determine where to begin in spite of the foreknowledge that this entire effort will revolve round the premises of information systems. Harmon (2003) suggested that, in situation like this, trying to figure out where to start, that any attempt to in trying to place business process reengineering in isolation as an element could be really challenging in the world business process change, nevertheless, that the place to begin is the overview of the technologies and methodologies. Which will now lead to identifying and defining other key elements that are considered relevant as either technology or methodologies as a place to start, towards the desired outcome, the proposed framework construction that will enable the desired integration and implementation process. Correspondently, an approach into the exploration of the overview of technologies and methodologies to be used as suggested by Harmon (2003), it is equally important to discuss the premises and the foundation that will enable the utilization of these technologies and methodologies. Eason (2005) said that the integration of these separate technologies and methods provides the opportunity for a single information technology, therefore, beyond the realization of the starting point it is important to delve into the fundamentals of the technologies and methodologies to be explored.

Having established the definition of information technology, another component or element that is considered relevant is business process, in which Alter (2002), has defined:

As activities within each step that include combinations of information processing, communication, sense making, decision-making, thinking, and physical actions.

(Alter, 2002)

This definition was explained further in emphasize to the point that the actual operation of business processes often deviates from the idealized business processes that were originally designed or imagined. Moreover, there are different participants that were involved in the series of activities that are performing the same steps differently based on differences in skills, training, and incentives. In a nutshell, in a business process, there is the involvement of capabilities both human and IT related, incentives, training all of which are not part of initial process. However, these and many other activities play some part in any organization and its paradigms.

In an approach to deviate away a bit but, in any sense trying to relate business process to reality, that is from a practical point of view, the research case organization is made up of series of complex business processes, which involves different participants, departments, vendors, contractors, engineers, team leaders, managers and in their different units they are perhaps performing similar functions differently, needless to go into details on the complexity of the business processes. However, at some point, a decision has to be made in order to change from legacy systems to another, in order to improve efficiency, improve quality, and meet up demands, such decisions will have an impact on the entire business process, the organizational structure and its resource e.g. human and tools. Therefore, this change requires someone or something to manage the change and overhauling of the business process and in this case decision-making that will require a systemic approach to operating and managing these changes, which now leads to the emergence of business process management.

BPM is a way to operate and manage a business not just a way to improve individual processes.

(Smart, Maddern & Maull, 2009)

As a matter of fact, these series of activity or better still resources combined in the business process of any organization need to be organized, maintained, improved and changed when necessary in a way of responding to changes and improving performance. Harmon (2003), & Trkman (2010), respectively in their own view defined BPM as:

The automation of business processes; this is a growing activity tending towards a narrower process, a disentangling process from its re-engineering process, IT-centric and context.
(Harmon, 2003)

All efforts in an organization to analyze and continually improve fundamental activities such as manufacturing, marketing, communications, and other major elements of company's operations or processes.
(Trkman, 2010)

Notably, from these definitions, other elements of information system implementation are identified and the context within which they can be explored. However, having defined information technology, business process, and business process management, which are the fundamental building blocks or concepts on which this research will be built upon. Nevertheless, the two components identified as the main dimensions to this research are the BPM and EA that will be explained in more detail in subsequent sections.

In general Information technology has created an enabling environment for organizations small or large, to revolutionize their business process and thrive effortlessly in order to meet their internal and external demands, it is, however, important to know the definition of some basic elements that work together, in other words, those elements that interact with each other towards the implementation of information systems in any organization. It is also vital to clear out curiosity to as what is the relationship existing between these elements. Provided, it has been intentionally established that IT is the tool that will enhance the required or desired organizational changes to occur, with this in mind, it is undoubtedly right to say information technology will not find relevance if there was no need for the use of information technology. In the same way information technology has found relevance in business processes, so is business process management that involve series of activity both from human and the use of tools, this same business process requires people (managers) to operate and maintain it. Then, comes business process management. Importantly, information technology and the business process need to be aligned, and this process of alignment requires a structure, which leading to the EA dimension especially the business architectural perspective which will eventually lead towards the outcome of this entire effort.

2.3   Overview of BPM dimension of information system implementation

Rosemann & vom Brocke (2015) Introduces "BPM to has emerged as a comprehensive consolidation of disciplines sharing the belief that a process-centered approach leads to substantial improvements in both performance and compliance of a system. In addition to that is the fact that BPM has the power to innovate and continuously transform businesses and entire intra-organizational value chain". The concept from a generic point of view of BPM is considered to be a tradition that has been in existence for decades irrespective of terms given to it, it could be termed as work simplification, Six sigma, Business process re-engineering. Harmon (2015) Unfortunately explains that "BPM is a popular concept that has not yet been theoretically grounded properly, which has led to problems in identifying critical success factors of BPM programs both in general

and case-specific" (Trkman, 2010). However, any organization that needs improvement in all their business processes requires a revolutionary approach to business performance improvement, which must include how the business will be viewed, structured and how it ~~is~~ will be improved, not just in terms of the organization business functions, divisions or products, (Davenport, 2013). This revolutionary approach can only be conceptualized into framework which allows the categorization of various methods and a correspondent conformity to these methods can generate mutual understanding, which therefore implies that such a conceptual framework can lead to a relevant unified method, which will reveal a step further into understanding how these methods can be facilitated by the use of tools for automating the development process, which will be based on the categorization of methods and the corresponding conformity to these methods in general terms, but it is equally important to be able to categorize base on specific organizations, Which is now going to be the methods that will address certain or specific organizational needs, that does not involve all the generalized characteristics of other organization (Scheer, 2012).

 In regards to the method categorizations, the handbook written by Rosemann & vom Brocke(2015) outlined some key issues that may arise in any organization as to how much need to be integrated in any organization that would operate and manage a comprehensive BPM effort, these concerns were categorized at enterprise level concern, process level concerns and implementation level concerns. However, because this research outcome will in one way or the other be impacted by the enterprise, process, and the implementation level concerns, towards the construct of the final framework, these concerns will be explored briefly.

- **Enterprise level concerns**: EA, value chains and value networks, business frameworks, value chain diagrams, process measurement systems and managing culture change.
- **Process Level concerns:** Innovation, analyzing and modeling service processes, analyzing and modeling complex processes.
- **Implementation level concerns**: BPM systems, standards, and certification.

As earlier stated these concerns may have a wider scope of consideration irrespective of this research effort, but they were considered on the fact that they will enhance a holistic view into the probable issues that might impact any effort towards the construction of implementation steps for any organization and in this case the entire effort of this research towards the final construction of the framework, on the other hand, these concerns will enhance the support needed to visualize the category of concerns that will be encountered in data gathering process and the referenced case study, which will be discussed later in the empirical analysis sections. All of these are with the intention to put together the entire element that will contribute to this research outcome. Moving forward in this effort Rosemann & vom Brocke (2015) identified six core elements of business process management, to be strategic alignment, governance, methods, information tech-

nology, people and culture. These six element plays vital role in any business process, cutting across all facets of any organization and in whatever change such an organization are about to implement, relatively these elements are quite relevant to the case organization, because it is embarking on a change process, that will have impact on every part of these elements in the organization; the strategy, methods, technology, people, culture and governance.

These elements are the elements that this research has identified important from the BPM dimension that relates to those levels of concerns mentioned and to the framework construct. Surprisingly, Somers & Nelson (2001), in an earlier research has empirically analyzed and outlined critical factors that affects implementation and integration process in an organization from start to completion, where it was said that the process should consist of six phases: The initiation phase, adoption phase, adaptation phase, acceptance phase, routinization phase and infusion phase. However, for this aforementioned phases to be effective some key factors has to be identified and address as factors that will enhance the success of any organizational implementation and integration, they are; top management support and involvement, the need for a project champion, user training, technology competencies, process delineation, project planning, change management, and business process re-engineering before implementation, not isolating the effectiveness of communication, goal setting or expectation, usage of IS and business team and lastly the avoidance of customization. In a way of categorization, when these elements are categorized into the suggested six phases, one can really evaluate their impacts and relate them to this research challenges on how they can be integrated into the ongoing project, having said that, this has provided this research a partial path towards the actualization of the desired objectives, however, to make the effort an holistic one the EA aspect will be discussed in subsequent section, nevertheless, IT alignment is the integrating factor that is enabling the integration of these two (BPM & EA) dimension or perspective together towards a proper information system implementation into any organization for productivity gain and sustainability. Putting all of these elements together, it will enhance the capacity of the proposed framework to set a blueprint to what should be done prior, during and after the implementation project, vis-à-vis bearing in mind those concerns level that has been discussed earlier that could assist in recognizing what level each of these issues that can hamper a successful implementation and integration process.

Before proceeding to the EA view of this research, it good to mention that in BPM from its business view, process view and IT view, it bridges the gap between all of these views, which means that, inherent in BPM is the potential to assist any organization in a collaborative way to predict and optimize process outcomes through process modeling and simulation, rapidly customizing processes with users using strategies, policies in place of codes, proactively identifying and responding to business issues in real time with automated response and human decision mechanisms, also swiftly deploying of new solutions from the reuse of building blocks that can be changed at once (Jensen, Cline & Owen, 2011).

2.4 Overview of Enterprise architectural dimension of information system implementation

Ganesan and Paturi (2009), Explains that EA can be used as a tool to capture the strategic context both internal and external in an organization, in a manner of emphasize, it can be said that for any organization to meet up their demands either in efficiency or performance, the tool that can enable such effort is EA. In another view Jensen, Cline & Owen (2011) explains that EA as a discipline that has provided the foundation for any organization to align their strategic objectives with opportunities for change, which is achieved through the transition planning and architectural governance. EA has the capacity to carry any organizations processes from the initial state until the final and ensuring compliance and sustainability through an iterative pattern, thus aligning the organizations business strategies and IT. In this manner, it is no doubt that information system has been supporting the business of numerous organizations, to an extent that information system support their decision making, coordination and control, also in many areas assisted managers and other workers to analyze problems, create visibility of complex components and the creation of new products and services. In the same way, EA has in a tremendous way assisted organizations in information system management going by the increase in size and complexity of the information systems implementation. Which has necessitated the use of some of the logical construct for defining how to control each interface and how to integrate all the component of the system (Pereira & Sousa, 2004).

Simon, Fischbach & Scholder (2014) in an article, wherein it was presented that inherent in EA are the constituents of strategic management, which are strategic analysis, strategy formulation, strategy execution and finally strategic governance, all of these strategically unveils the framework within which any organization can be strategically sustained, this has greatly made EA gain relevance and perhaps enhanced the conceptual base for any organization in quest of how to go about any information systems implementation projects, in the sense that it will help such organizations in channeling the path to follow to reach its target, not only that but to also sustain it. However, one would have suggestively decided to pick the layer of EA that is significant or has great importance to certain organizational issues, but holistically considered, EA has strategically planned in a simple manner how to integrate BA with business motives, which will further assist the organization in developing, communicating and managing business plans in an orderly manner.

In the opinion of this research effort, it can be positing that EA has filled in gaps or complimented BPM in some key areas especially in compliance and sustainability, although, independently each has benefits to offers. However, putting these two together will go a long way in yielding more result and ensuring sustainability, not just having short time benefits, but a continuous one and make room for improvement when necessary which will make the business process flexible and responsive. In support of this claims, Jensen, Cline & Owen (2011), explained that BPM and EA each have values on their own, however, they are

also, naturally synergistic, and best when done together for better business outcomes and strategic alignment of business and IT. Furthermore, when done together, BPM will provide the context of the business, understanding and measurements while EA provides the disciple for translating business vision and strategy into architectural change. In which both put together will be needed for continuous improvement and sustainability. In the light of this, it is necessary to define the term EA in regard of its relationship with information system implementation in an organization according to (Pereira & Sousa, 2004) refers to EA:

A framework or blueprint for how an organization achieves the current and future business objectives.
(Pereira & Sousa, 2004)

From the definition, it will be noticed that EA has included the objective of the organization to cover the business itself, information, application and the organization technology strategies and most importantly the impact that of all of these components will have on the business functions. However, the architecture has enabled the integration of all those elements discussed previously in the section in accordance with the objective of the research into a unified framework. To further establish these claims, a step towards unifying all of the objectives of an organization, aligning the organization strategy to the architecture of the organi- zation. Ross, Weill & Robertson (2006) refers to EA as:

The organizing logic for business processes and IT infrastructure, to reflect the integration and standardization requirements of the mode of operation of the organization,

(Ross, Weill & Robertson, 2006).

EA in any organization that is planning for change in its business process, needs to have a prepared platform for the required change and next will be how to collaborate and sustain the change. In the sense that, from an organizational perspective, EA can be fully beneficial when the organization consider to engineer the planning and implementation processes to take the advantage of the synergistic power of the rich architectural planning. Also taking into consideration, technically, the business process improvement, which will create a platform for visibility, traceability and integrity between result and process throughout all the roles and tools. The element of EA that directly impact and perfectly ties these two concept together with respect to this research effort to integrate both BPM and EA together is the BA, because this is the point where the business process and architecture finds common ground or intersections to work together towards the realization of the organization target, in the sense that business processes in itself are an integral part of the BA, therefore the process architecture inherently signifies the business process architectural. Which now leads to the consideration of the business architectural perspective as presented in TOGAF and other researchers. However, the table below shows key elements of BPM & EA as it has been previously explained from these two points of views.

Table 1: Elements of BPM & EA

	BPM	EA
	BPM	EA
1	Strategic alignment	Strategic analysis
2	Methods	Strategic formulation
3	Information technology	Strategic execution
4	Governance	Strategic governance
5	People	*
6	Culture	*

Rosemann & vom Brocke (2015) & Simon, Fischbach & Scholder (2014)

From the comparison between both dimensions it is clear that BPM included people and culture into its elements but these two are in EA but perhaps are integral elements in other element, however, table clearly shows that if these dimensions are well integrated together will definitely there will great outcome will cut across all the facets of any organization in operation and strategies.

2.4.1 Business architectural perspective

Based on insights from previous authors that have argued that the business architectural dimension of EA has often been overlooked. Simon, Fischbach & Scholder (2013), also supports these claims by saying that business strategy and particularly the model themselves often are underrepresented in EA literatures. However, until recently, apart from the generic discussion on EA from a general focus on IT issues, that interest has now been indicated towards the business elements at the operational level rather than just at the strategic level alone. Simon, Fischbach & Scholder (2014), in another recent article, explained that greatly among concerns shown in business elements is the absence of formalized means of a graphical representation that allows the structured and comparable visualization of the business elements in EA, also the unavailability of business model representation that will indicate the relationship existing between business entities involved. Keller (2009) and Brits, Botha, & Herselman (2007), both shared views on issues surrounding business elements, that capabilities can be used to facilitate decision making, moreover, that different types of capabilities and methods can be used in EA to offer a business-centric approaches, all of which was based on the provisions made in TOGAF architectural framework, which has greatly assisted in the visualization and representation of the BA and how it fits into the entire organizational architectural framework.

Simon, Fischbach & Scholder (2014), in justification for the inclusion of BA dimension of EA to this research effort, is the fact that the BA has specifically made provision for this research study with a structured description of components that are involved in organizational BA and how these components are re-

lated. These components are the business motivation, which captures the business strategy, the influencing factors and the reason for whatever way the business chooses to operate, another component captured is the business model, which is basically about value creation, customer segments and value propositions, and the third component is the business execution, which is that area that focuses more on the organization execution layer, this covers the organization in the area of the organization business processes, the organizational structure, business capability, people, resources and culture. In reference to elements outlined in Table 1, it is, however, clearer at this point where elements of business execution (BA) have finally found a point intersections or integration with elements in BPM in the overall EA framework. This is layer out of the whole EA that contains or captures the architectural models of the business operation (business process), looking specifically at factors that motivate the enterprise, how the enterprise is organizationally structured and, what functional capabilities the enterprises has.

The BA encompasses elements that serve as business process drivers and how to measure them, it also includes the actors and their role (people, organization, functions, units) and the quality of business activities, products, control measures, processes, all in all it has in some way filled the missing parts as presented in Table 1 above, at the EA side of the table which has finally justified the conceptual building block to the outcome of this research solution of an implemenation and integration framework for ERP&MES systems. Henceforth, for a holistic result to be achieved, the entire EA framework will be optimised. however, to also make the solution case specific the solution that will be suggested from the empirical data gathering process will be used in extending the framework to suit this research objective, although TOGAF in the framework has made provision for a general case, it also made provisions for an extension to suit the specific context. (http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap34.html#tag_34).

Table 2: Overview of the EA Framework

1	**Architecture Principle, Vision, and Requirements**	This is explained as artifacts that are intended to capture the surrounding context of formal architecture models, including general architecture principles, strategic, the context that forms input for architecture modeling, and requirements generated from the architecture. The architecture context is typically collected in the preliminary and architecture vision phases.
2	**Business Architecture**	These are artifacts that captures the architectural models of the business operation, looking specifically at factors that motivate the enterprise, how the enterprise is organizationally structured and, what functional capabilities the enterprises has.

3	**Information Systems Architecture**	These are artifacts that captures the architectural models of IT systems, looking at applications and data in line with the framework phases.
4	**Technology Architecture**	These are artifacts that captures procured technology assets that are used to implement and realize information systems solutions.
5	**Architecture Realization**	These are artifacts that captures change roadmaps showing the transition between architecture states and binding statements that are used to steer and govern an implementation of the architecture.

(http://pubs.opengroup.org/architecture/togaf9- doc/arch/chap34.html#tag_34).

Based on the premises of this research objective to provide a framework that will assist in the implementing and integrating of ERP-MES systems into the existing case organization business process, to improve production process, save time and cost, not to integrate BPM to EA, notwithstanding, it is an effort towards further conceptualizing the approach towards this research outcome. However, moving forward based on provision made in the comprehensive EA framework presented above, this framework has presented opportunity areas where this research can explore, like the architectural realization layer which has set up an opportunity for this research study to fit the research problem into this layer, because this layer captures change road map indicating how to migrate or transit from one state, stage and system to another in this context and it is also used to steer and govern the implementation of the architecture, another opportunity layer as earlier said is the BA layer that has integrated the business process dimension to the EA which means this research effort can from that point proceed further to practically validate those components and elements, extension can be made where necessary for organizations generally and case specific such as this research case. However, to fully understand the entire research premises the next chapter will be presenting the systems to be integrated and their background overview and a practical way to the implementation process.

3 ERP AND MES

This chapter will present the background overview of ERP system and the definition, a brief transitional history of ERP systems, then the description of the MES section of this research, also the explanation behind the integration of both systems. Finally, in this chapter will be the presentation of the case of a steel production process with a similar implementation process.

Ehie & Madsen (2005) Defined ERP as a packaged software solution that seeks to integrate the complete range of a business process and functions in order to present a holistic view of the business from single information and IT architecture. From this definition, ERP can be described to be an information systems tool with the ability to integrate different aspect of business functions and processes together within an organization putting all these functions and structure into a centralized location. Which therefore present a premise where all those elements discussed earlier from the business process perspective and the architectural perspective can intersect together as enterprise information system integration.

3.1 The evolution of ERP systems

Koh, Gunasekaran, & Goodman (2011) In an article presented "That in the 1970s, manufacturing processes were supported by MRP, this MRP enabled the production of a set of time-phased requirements for subassemblies, components, materials planning, and procurement. The Master Production Schedule (MPS) is being generated from the list of requirements, which is pivotal to the material planning and control process. Then later, in the 1980s, MRP expanded to Manufacturing Resource Planning (MRP II), which involves the planning and controlling of nearly all firm's resources, specifically production, marketing and finance (Jacobs, 2007). However, MRP II production used the same MRP planned order release logic to produce almost identical outputs. So, in the 1990s, technology enabled MRP II to incorporate all the resources of an enterprise, such as material planning, product design, HR, finance, logistics and capacity plan-

ning to name a few. This was as such referred to as ERP. There are many articles that deal with different approaches for ERP implementation" (Koh, Gunasekaran, & Goodman, 2011). It is important to mention another further advancement in technology that in recent time has brought about the development of ERPII, although, this is not the focus of this master thesis, but just to inform about the latest development of this system. This ERP II essentially involves four major perspectives; The Full SC-Suppliers, central SC enterprises (users) and customers and likewise vendors/consultant, this latest development is relatively new concept entirely (Koh, Gunasekaran, & Goodman, 2011).

3.1.1 Background overview of the implementation of ERP systems

According to Davenport (2000) "the evolution of the ERP system as a name modification from MRP (Manufacturing Resource Planning), in which its emerges is in the effort to address activities that customers do not really care about (back-office systems). But the use of this system has long transcended its initial name reasons, it now covers functions from accounting to manufacturing, from sales to service, and so on, it supports thousands of business activities. More recently the advent of Internet has merged the back-office and front-office systems together, such that aside from personal productivity system such as spreadsheets and word processors on PC's, and highly specialized production systems such as process control and internet based systems for personal knowledge access, these has made the system, the only system an organization requires".

Based on the previous statements, it is obvious why any organization will want to implement a system such as this to enhance their organizational productivity, in a way to integrate all their business activities (operational and managerial). In support of this claim, Somers & Nelson (2001), posit in an article "that the growing demand for ERP applications has several reasons such as competitive pressures, to become a low cost producers, revenue growth expectation and ability to compete globally, Y2k-related replacement and the need to re-engineer business process to meet market challenges". Having said that, it is important to say that it is not just about these needs that will make any organization want to implement ERP system, far beyond these needs is how this system will be implemented and so about benefits and return on investment, coupled with the fact that implementing such a system into any organization is an expensive adventure. However, Malhotra & Temponi (2010) argued based on studies about critical success factors of ERP implementation and integration, that factors affecting successful integration into any existing organization are dependent on either the organization is large or small. Although small and mid-sized companies are increasingly embracing ERP, research indicates that many fails to achieve their goals in terms of overall improvement and utilization of ERP due to poor implementation.

This poor implementation could be attributed to business operating in a highly competitive environment with limited resources (financial, technical personnel and technology), business problems resulting from lack of alignment of implementation practices with competitive strategy, cost and risk in undertaking the

technology and the systems. In addition to these factors on poor implementation is the geographical location of the business, which also may have a profound impact on the culture of the company, likewise recruiting new employees to fulfill key talents needs may pose a challenge as the resources to recruit nationally or globally may be lacking. In contrast, on the other hand in a large location, there are may be the provision of a plentiful supply of talent which will impact high cost of employee retention incentives and cost of living because of operational cost. In small businesses, employees are encouraged to perform multiple job functions (multitasking), and such approach enables small companies to respond to change in both their internal and external environment (Malhotra & Temponi, 2010).

However, in spite of all factors that may contribute or hamper the success of an enterprise information system such as ERP system in any organization, it is vital to say ERP has been an essential tool used by many organizations to effectively plan and manage all their resources, (Jacobs, 2007). It is a tool that aims to improve the internal efficiency of an organization by integrating different functions of that organization. Over the years, ERP has been viewed as the most imperative information technology (IT) infrastructure in modern organizations. ERP has grown so wide lately that it has enabled the addition of different modules to quite a number of real-life emerging business issues, such that the demand for integrated systems and increased competitiveness in supply chains has propelled vendors that are developing ERP to add more modules to ERP systems, such as Supply Chain Management, Customer Relational Management, Supplier Relationship Management and so on, this has further advanced the technology to an extend that it allows firms to collaborate internally and externally through mediums like the internet, intranet and certainly the computer. (Hendricks, Singhal & Stratman, 2007) and (Koh, Gunasekaran, & Goodman, 2011).

Unfortunately, with all that this enterprise wide information has to offer, it has some limitations, although, to consolidate for those limitations is the opportunity it has created for other modules to be integrated into the systems, however some of the functions ERP system has not been able to support holistically with respect to manufacturing and production organizations are; reduction in production errors that will result in waste and rework, swift location of root cause of production problems, reduction in manual entry time, reduction in cycle-time, equipment usage efficiency, improved planning and conditioned schedules, reduction in order-to-ship time, reduction in cost of regulatory compliance. As a result of these comes the MES systems which specifically cantered on addressing these business issues, moreover, it is a choice the case organization has decided to go for in order to tackle their production issues and integrate to the legacy systems in order to meet challenges internally and externally, however, the greatest need is how to successfully integrate this systems into the existing system. Next section will delving into more about MES systems and what it means.

3.2 The evolution of MES

First of all, in a way of establishing the conceptual idea behind MES, it is important to give a brief overview of the evolution of MES system, then its functionalities and how it is related to this research. The emergence of the MES during the nineties with the acronyms MES, Choi & Kim (2002) represented the development of a critical interface between MRP II systems and the shop floor and its control systems. Since then MES system has made important contribution in uniting core manufacturing processes into a value delivery focused thereby meeting customers' requirements and demand. Early implementation of MES system was achieved in the semiconductors industries, aerospace, defense and pharmaceutical (Rondeau, & Litteral, 2001).

When the ERP systems by nature become unsuitable for controlling day-to-day operation activities on the shop floor, MES system then became more and more relevant in the manufacturing processes, MES systems came with the aim of providing an interface between ERP system and the shop floor controllers in a way to support different execution activities ranging from scheduling, order release, quality control and data acquisition (MESA #6, 1997). Forger (1997) presented MES general functions as the management of machine resources availability, prioritization of production schedules, control of the flow of production units between machines, management of available labor, automated document control, and the provision of quality, process and maintenance management support.

The initial context within which the MES was developed and deployed was to provide a first-line supervision management with a visibility tool to enable the management of work orders and workstations executions, overtime MES expanded into an indispensable link in between the full range of enterprise stakeholder and the real time day to day activities happening on the production and logistics processes over an extended value chain, McClellan (2004). Globalization now forces manufacturing organizations to continuously improve their operational performance, in response to this manufacturing companies begin to adopt methods and tools that will focus on eliminating non-value added activities, this is where information system now became the supporting tool in providing a complementary way to improve visibility on manufacturing plant production performance, which has led to the integration and implementation of MES in manufacturing organizations (Modrák & Mandulák, 2009).

3.2.1 Background overview of MES

MES in an article by Saenz de Ugarte, Artiba & Pellerin, (2009), was defined thus:
As a common user interface and data management system that their primary function is turned towards manufacturing firms.
(Saenz de Ugarte, Artiba & Pellerin, 2009)

Based on the definition it can be explained that MES is just an interface system between the production floor and the centralized systems that oversee other

systems in a business organization, in addition to this explanation based on background information that has been established in the previous section, it can be further reiterated that the development of ERP support systems integration has greatly enhanced the integration of customized software applications such as MES. However, following Saenz de Ugarte, Artiba & Pellerin (2009) argument that this customized software has further led to the challenge of integrating multiple point systems that have enabled software providers the opportunity to pack multiple execution management components into single and integrated solutions such as ERP, SAP and MES. On the other hand, MES which is a system that has emerged out of the need to provide a common user interface and data management system, which was a concept desired to meet the demand on the floor of manufacturing enterprise so as to fulfill market requirements from a reactivity point of view, quality standards, cost saving and deadlines.

In the light of the idea behind the adoption of MES, and for the fact that the integration of this system is a predetermined one by the case organization, which limits this research effort from making comparison on which system fit better, nevertheless, MES also has the capacity required for the current organizational need, therefore, the focus at the point is to discuss the role MES will play in the integration process and how it will fit into the organizations legacy systems. According to Ben, Henry & Bouras (2011) that explains that the importance of MES systems solutions includes the production tracking, performance analysis and production control systems for batch/ continuous manufacturing. Hence, that the integration of ERP-MES architecture is a classic architecture that will be based on IEC 62264 standard for information exchange between enterprise system without necessary time delays in order to optimize the production and further provides potential for simplification of deployment of ERP-MES integration. However, it considered wise at this point to describe the research method and approach where the and a similar case organization that carried out similar implementation process in their production process will be discussed.

3.3   Description of a steel production process

The idea behind the presentation of this case study is purposely because it is also a production plant scenario, although, it is not in every way similar to the case organization in terms of product but similar in terms of production process and sector. This is aiming at practically describing a similar situation so that the entire implementation process can be understood and visualized both from the theoretical and practical point of view of a typical operation scenario. Also, in order to be able to predict from the outcome of this process the probably outcomes of this research study (Yin, 2003).

This case study is carried out in a steel plant. In this steel making plant the raw materials are converted into molten steel, then the molten steel is poured and solidified in a continuous caster. This product is the semi-finished product known as steel slabs. This semi-finished product is being transformed into finished product by rolling slabs into coils. The coils are typically rolled multiple

times at various temperatures, usually from high to low temperature. Then the coil can then be treated with protective coatings. This case was conducted in two business units of a steel plant: steel strip products and packaging steel products. The product variety at the packaging steel business unit is smaller than at the steel strip business unit. Products of the packaging steel business unit are usually thinner than at the steel strip business unit. At the time, the project was conducted, the steel plant had approximately 22000 employees and a yearly production of 6.7 million tons of crude steel. Because of its limited size, the company had concluded that its competitive position is improved by increasing operational performance: flexible and reliable delivery of goods to customers, and short lead times. The implementation of information systems for production planning and control was viewed one of the instruments needed to realize this strategy (Weirs, 2002).

3.3.1 Description of scenarios

In the light of approaching this implementation of information systems for the production planning and control, from the beginning of the integration process, it was already clear to the project team and organization that there are many alternatives that could be formulated in the allocation of resources to ERP and APS system. So, the first step was to identify the two extreme alternatives in terms of architecture scenarios and to include a middle way. This therefore led to three architecture scenarios described below.

- In the first scenario, most planning functions were allocated to the APS system, including master planning and demand management. There was no planning function present in the ERP system. Material explosion (MRP) was done in the APS system while the S&OP was done in the ERP sales planning module, and the output of the process is stored as a so-called allocation table. This allocation table is interfaced to the APS system. Also, sales orders and product configuration data are been interfaced to the APS system. So that before orders were released from the APS system, they are interfaced back to the ERP system for costing purposes. Legacy systems will feedback the actuals both to the APS and the ERP system.
- In the second scenario, most planning functions were allocated to the ERP system, including the master planning and demand management. The APS was used to carry out the master plan, firstly orders are interfaced from the ERP to the APS system, secondly, the order were simulated (moving forward and backward in time), thirdly, the same orders with possibly changed start dates were interfaced back to the ERP system. Orders were interfaced from the ERP system to APS system for detailed scheduling and sequencing. The legacy systems will feedback the actuals both to ERP and APS system.
- In the third scenario, which is like the first scenario in the sense that most planning functions were allocated to the APS system, including Mas-

ter planning and Demand Management. The different with scenario 1 is that a copy of the plan resides in the ERP system. (Weirs, 2002).

4 RESEARCH METHOD

This chapter will provide the theoretical background, the research method used in gathering and analyzing the information that will be used to validate this master thesis final result, which will be based on the framework within which this master thesis will be presented, in line with the theoretical background. This chapter will also present the description of the current and targeted state of the and a similar case study of an organization that has previously carried out similar implementation process.

4.1 Theoretical framework

This master thesis theoretical framework is inspired by an article on information systems design science methodology presented by Peffers, Tuunanen, Rothenberger & Chatterjee (2007), in a manner that, in this article it was established and justified that theories from other disciplines such as economics and social sciences be applied to solve problems in situations where this problem intersects with information technology and organizations. In this way, this research effort is a careful combination of theories, model, technologies and methodologies (Pries-Heje & Baskerville, 2008).

This effort is guided by the seven guidelines presented in Von, March, Park & Ram (2004) article, where these guidelines were presented in the interest of developing knowledge and understanding of problems and solutions as a foundation for the application of the artifact that will be created. Important to point out at this point is the fact that, although this entire research study, perhaps is not entirely in the form of design-science research, however, this research study chooses to optimize the methodology presented in DSRM as a guide, Peffers, Tuunanen, Rothenberger & Chatterjee (2007). In this guideline, it was stated first and foremost that design-science research must produce a useful artifact in the form of construct, model, method or instantiation, secondly, that the objective should be to develop a technological based solutions that are important and relevant to the business problems, thirdly, that the utility, quality, and efficacy of the artifact must be rigorously demonstrated through a well executed evaluation

methods, fourthly, that the effective research must provide clear and verifiable contributions in the areas of artifacts, foundations and methodologies, fifthly, that the research must rely upon the application of rigorous methods both in construction and evaluation of the artifact, sixthly, that the search for an effective artifact requires utilizing available means to reach the desired outcome while satisfying laws in the problem environment, and finally, that the research must be presented to both the technology-oriented as well as management-oriented audiences.

To demonstrate or better still, in a way of laying the foundation to the approach that this master thesis research was built upon. This research study was based on the combination of the process theory approach presented by Markus & Tanis (2000), in an article presented by Fui-Hoon Nah, Lee-Shang & Kuang (2001), in this article four phases of events leading to implementation completion was identified as; chartering, project, shakedown, onward and upward. Somers & Nelson (2001) further extended these four phases to encompass six stages: initiation, adoption, adaptation, acceptance, routinization, and infusion. These six stages outlined are alongside has empirically collected success criteria that affect their effectiveness in any implementation project as: top management support, project champions, user training and education, management of expectations, vendor/ customers partnerships, use of vendors development tools, careful selection of the appropriate package, project management, steering committee, use of consultants, minimal customization, data analysis and conversion, business process reengineering, defining the architecture, dedicated resources, project team competencies, change management, clear goals and objectives, education on new business processes, interdepartmental communication, interdepartmental cooperation, and ongoing vendor support.

With respect to the premises within which this research study will be boarded, some of these factors will be used in formulating the interview questions and to evaluate how they have impacted previous systems implementations stages in the interviewees' respective organizations. In addition, these factors and stages will be validated with a practical case study to see how these factors and stages has played out in a this practical case study that will be presented later on, thus, guide the data gathering process as to what are the critical issues that were and were not factored in, in one hand in the interviewees respective organization during their implementation process, which has led to a successful or failed implementation, and on the other hand, in the referenced case study organization, all of these is in gnarring towards a careful tested and validated components that will be factored in while the constructing of the final result of this research study.

To make this effort a well-rounded one, also in order to simply building on previous research effort due to the limitation that has been noticed in Somers & Nelson (2001) six stages that did not clearly explicate how this implementation stages can integrate the organization business process with the organization BA. While this research study is building on this previous effort, this research has explored theoretically reviewed the BPM perspective and business architectural perspective previously as areas that directly concern and will influence this research, on the other hand, will be practically reviewing the case study organiza-

tion business process, IT capabilities, structure, or architecture with respect to the proposed system implementation in general and case specific.

The BPM and EA dimension, these two perhaps are main subject on their own, nevertheless, to view the entire effort from the business angle and the architecture angle, perhaps it was considered important. However, to specifically align this business process dimension with the EA dimension, a further look into business architectural perspective as presented in TOGAF with particular emphasize on the BA of the whole EA framework, this is because it is the business strategy and the business infrastructure that integrates elements in business process to elements in BA, relatively, all of these elements will be used in the composition of the empirical data gathering process and evaluation, furthermore, consequently, all of these are effort towards setting the foundation that leads to the construction of the proposed framework, also aiming at bridging the gap between the business process, IT capabilities, and the organizational structure that includes human and organizational capabilities, the result of which will be a new innovative artifacts (Von, March, Park & Ram, 2004).

Summarily, to put all of these differently, the EA dimension to this research study, was deemed necessary due to the inherent potential seen in that area to address this research objectives and build on previous effort in particular to compare the six stages presented by Somers & Nelson (2001) and the success criteria identified. In addition, because the EA dimension presented in TOGAF captures all those processes, methods, tools and responsibilities to a generic level, also integrates the views of the enterprise and allow for a continual alignment steering of business and information technology (Simon, Fischbach & Scholder, 2014). Winter, Buckl, Matthes & Schweda (2010), support the adoption of EA for the fact that it can be deployed in various scenario, and because it is associated with IT alignment and IT consolidation. The business execution (architectural realization) stage categorizes key elements such as capabilities, work packages, architecture contracts, standards, guidelines and specification, these elements are considered essential for sustaining and governing prior and post- implementation processes, which were not captured in Somers & Nelson (2001) presentation. Consequently, all these elements combined and extended into a single framework will integrate the business strategy and information technology of the implementation process of any organization, thus making provision for implementation governance, (Albers, 2010). Simon, Fischbach & Scholder (2013), suggest that apart from a general focus on IT issues, it is also important to focus on the operational elements too, that is the business process aspect.

4.2   Research Method

The qualitative research method was chosen for this master thesis, which was conducted in an interpretive form. According to Myers (1997) "Interpretive research method in IS are aimed at producing an understanding of the context of the information system and the process whereby the information system influ-

ences and is influenced by the context". The aim for this choice was to focus on understanding the phenomenon from a generic point of view of previous studies, the case organization and a similar case organization, in order to understand the context within which previous problems and solutions has been approached, so as to know how to approach similar situation in this research study. Yin (2003), explains that case study investigates a contemporary phenomenon within the context of a real-life situation when the boundaries between the context and the phenomenon are not clear.

The case research is defined as an empirical inquiry that studies current phenomenon within a real-life connection (Yin, 2011). This case study research method selected was also in an attempt to specifically gather insights from a real-life scenario and to consolidate this effort is the gathering of a collective phenomenon understanding from individuals in few organizations, which was further interpreted into critical issues that surrounds information system implementation in organizations especially ERP supports system. These critical issues were later categorized into organization strategy, structure, learning and governance. In which these critical factors were based on previous effort, data gathered from experienced individuals across various organizations of successful and unsuccessful implementation processes including the referenced case organization and the too, towards developing a better framework for the implementation project. Myers (1997), explains that the nature of IS interpretive case study and methods starts from the position that our knowledge of reality is a social construct that is influenced by human actions, which further emphasizes the different meaning that could be generated from an interpretive case study.

Yin (2011), describes that multiple case studies can be used to either predict similar results or predict contrasting results. Which leads to the use of two case study in this research study, one from the case organization in an attempt to understand the current issues in the organization and what are the expected result, on the other hand, a similar case study phenomenon that can be used in order to predict the possible outcome of the research case study. This is the reason this research focused on gathering insights from experienced users in similar organization to the case organization, in order to have a better understanding of the critical areas in the reality of the situation presented in this master thesis.

4.3   Case study description

Based on previous insights, that an organization can be described by the organization's business process and business structure, in line with this, the is been described below according to (figure 1). Which shows the visual representations of various support departments that are currently functional and visible in the organization, alongside this representation how each department feed in and out of ERP system in the organization.

The departments captured in the legacy system are the accounting department (ACCT), this department is responsible for all the financial activities carried

out in the organization and these activities are controlled, monitored and updated timely from the organization ERP system, then the human resource department (HR), which is responsible for employee' welfare, skills management and development, followed by the Purchasing department (PURCH), the purchasing department handles daily procurement and acquisition activities in the organization, also purchasing activities with third party like the contractors and subcontractors.

The SCM department is the supply chain department usually called MMO (Material management organization), this department is responsible for both raw and finished material shipment in and outside the company. Then comes the Engineering department which is made up of two sub departments, which are the facility and utility department, the utility department essentially support the production and the entire production plant (organization) with power supply and compressed air, also handles minor installations and repairs within the production plant. Sales department are engaged with the responsibility of marketing and time-to-time survey programs on the company's product for further development and collect feedbacks from customers, working together with the customer relation team for sales and marketing.
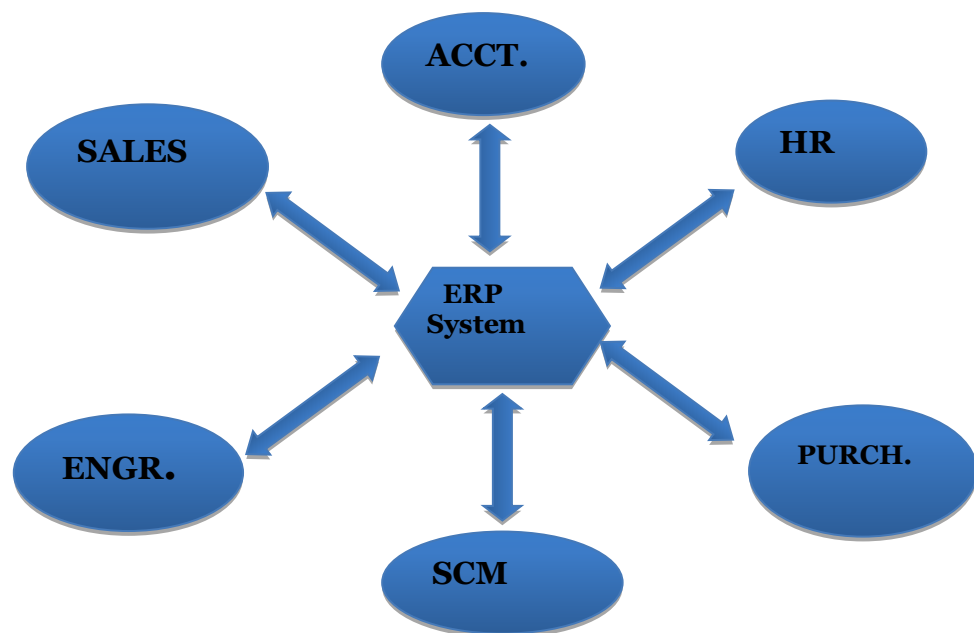

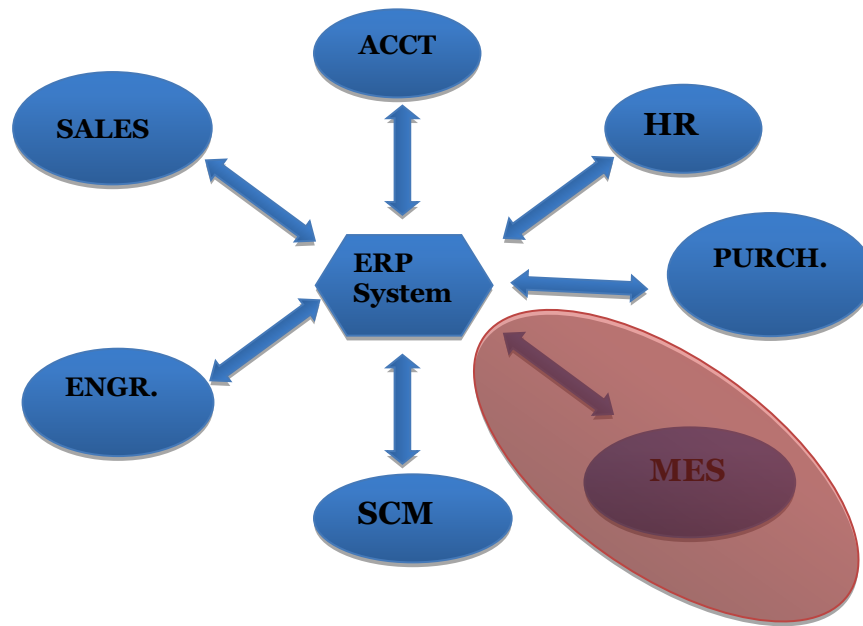Figure 1 Description of current state

Figure 2 Description of targeted state

Now, all the departments represented in (figure 1) are currently integrated into the current information systems architecture in the research organization, as it is indicated in (figure 1). Unfortunately, the production department is not present in the current set up, which according to (figure 2) the pro- duction department is included to representing the desired state of the organization, the inclusion of the production process (department) into the legacy system through the integration of the MES just as other departments are integrated through ERP system. Uniquely about this intended new system MES is that it will support the production floor (department) with real time production data and interface the production process with ERP system, in addition, it inherent in MES is the capability to handle the entire production process and also the ability share tasks with ERP system as a way of redundancy or better still back up for some tasks ERP system is handling, which in turn will easy ERP system of some operational functionalities it has the ability to do and allowing MES to do all these task on its own. However, this decision was born out of the limitation inherent in the organization ERP system and the fact that this department process comprises of huge, complex and challenging processes, these, therefore justifies the decision of the to integrate MES to assist this department process, in order to have a system that will be integrated into the centralized system ensuring traceability, visibility and automating, which will thereby increase the department productivity gains by eliminating manual task and wastages. This, in other words, implies the desired goal of this master thesis according to the research question, the integration of MES to the existing organization structure to improve the quality of production using information systems to track and man-

age production, scheduling, and labor. The MES inclusion into the current organization will include the existing systems and they will all feed in and out of the ERP system to gather timely data and monitor all activities going on in the production department.

4.3.1 Description of case organization production process

Briefly, the production process of the will be described, but to avoid complexity in the description of the production process, the description of the production process will basically be about the paper products specifically the diaper making process. Typically, the production process begins with the mixing of the raw fluffy material with a chemical substance known to function as the absorbent in a room called the doghouse, then this mixed product flows to a conveyor belt, this conveyor belt then carries the semi-finished product to a point where it connects with the long chain process line running at a revolution speed per minute of 350rpm, 500rpm it all depends on the size of product, from where it will mix with other materials like glue, perfume, a polymer covering layer and a design pattern which will be impress on the product. After all of these materials has been added, it then goes to the stacking line where it is been stacked and prepared into fine shapes that will fit into the bagging material after the product has been packed and bagged, this finished product is been palletized and delivered to the shipping department MMO.

Despite all of the complexity involved in this production process, it is unfortunate that there is no systemic way to track the production process, material utilization, labor, scheduling and control, everything is manually done, in short, there is no information system in place to clearly monitor or control the production process, these and other reasons has contributed to the need for the adoption of a system that can function in order to save cost, improve quality, productivity, efficiency and proactivity in the production department as it is in other departments. Also, it has to be a system that can be integrated to the legacy system in place, these challenges actually birth the research problem for a current best approach to the integration of a system that will put into account the existing business structure and business process, in such a way that this approach will yield productivity gains and enable the management and operations leaders the opportunity to automatically see what is going in the production department and make appropriate decisions, not to base every decision and action on intuition or speculation. So, for this research effort to adequately focus on the problem areas and seek for a holistic approach to these challenges, the business process perspective, architectural perspective and the support systems has all been established.

Important to mention at this point that as it is in the previous case study (referenced) presented that has already figured out what they wanted and just need to know the approach to their challenges, this also have already predetermined the system to be integrated and what want to know how to go about the integration process, in addition to knowing how to go about the integration, it should be

able to yield the desired result both in operations and the entire organization overall.

Relatively, this case study presents issues that surrounds all the information system implementation elements that have previously been discussed. In the sense that, the case study organization is indeed intending to change their business process (production process) to an autonomous one by integration MES into the organization system, whereby all their manually performed task or activities will be changed by the use information technology tools (ERP, MES), in light of this intention, these changes undoubtedly will in one or the other be affected by the use of technology to transform the current organization business processes, in this way, strategic decision has to be made in order make these changes tactical and operational, there is the need to clearly define the steps hierarchically what comes first and what follows, in fact, the business motive need to be made clear, vision shared, ensure alignment of goals with other resources, in short these following critical factors be affected: the top management support, project champions, user training and education, management of expectations, vendor/ customers partnerships, use of vendors development tools, careful selection of the appropriate package, project management, steering committee, use of consultants, minimal customization, data analysis and conversion, business process reengineering, defining the architecture, dedicated resources, project team competencies, change management, clear goals and objectives, education on new business processes, interdepartmental communication, interdepartmental cooperation, and ongoing vendor support (Somers & Nelson, 2001). In addition, it requires a certain path to follow to implement these said business changes, which brought about the six stages to information system implementation in any organization, in this case, the case organization. Also, to get insight from other scholars within the scope of BPM regarding strategies and approaches to a research challenge as the one presented in this master thesis.

Based on the fact that a sole consideration of the business process dimension alone will not be sufficient for the objective of this research effort coupled with the fact the production process is not in isolation and it is linked to other department and has a structure, for this reason the business structure (architecture) of the organization will also be affected by these changes, irrespective of whether the organization architecture in place is good or bad, also was said that EA are the constituents of strategic management, which are strategic analysis, strategy formulation, strategy execution and finally strategic governance, all of these strategically unveils the current and the destination of any organization thereby leading the focus of this research study to the explore more into EA perspective in order to gather insight from previous effort in line with knowing what elements in EA will contribute towards the desired goal, from where the business architectural dimension of EA unveils the three business architectural layers: business motivation, business model and execution, (Simon, Fischbach & Scholder, 2014) these elements which developed based on the generalized framework presented in TOGAF, from this framework the direction of this research study and virtual all components that are essential for the implementation of any information systems has this far been considered and relevant to the case organization.

However, in as much as the theoretically backbones has been considered, there is a need to practically validate these facts by using a case study approach towards understanding how those critical issues and those stages previously mentioned has affected the success or failure of previous implementation processes, also to be able to predict the outcome this research study, Yin (2003) to further support these actions data was gathered from experienced individuals and organizations, which will be used to finally validate the outcome of this research study.

4.4 Data gathering process

Yin (2003), explained that the evidence of case study could come from different sources, which includes documents, direct observations, interviews, records, participation observations and physical evidence. The objective of this empirical work was intended to gather data from experienced (practitioners) individuals and organization using ERP system and associated systems and the intending to integrate MES to ERP system, this is in order to know what were the issues encountered and benefits derived in the implementation process, most importantly to practically validate some of the issues identified theoretically by Somers & Nelson (2001), and use these issues in developing the framework that will be presented to Kimberly-Clark and on the other hand, the learning gathered from this process can also be reused and be developed upon.

Based on the qualitative analysis method chosen, a semi-structured form interview was deployed, the choice of organization to be interviewed was based on individuals and organization that has similar kind of business process as that of the research organization, that has at least 3-4 years' experience in the use of the system, because they are experienced, they were trained to use the system, they have the knowledge of the situation prior and after the implementation of the whatever system they are using in their organization together with MES or other systems they use, they are familiar with the production process, and they are familiar with the entire systems although it may have a different nomenclature. Another vital reason for the choice of organization and individuals is location, this is based on some of the reasons given that the extent to which an information system implementation can be achieved in any organization is dependent on the people, culture, location, (Holland & Light, 1999), Somers & Nelson (2001), suggestions which are the top management support, project champions, user training and education, management of expectations, vendor/ customers partnerships, use of vendors development tools, careful selection of the appropriate package, project management, steering committee, use of consultants, minimal customization, data analysis and conversion, business process reengineering, defining the architecture, dedicated resources, project team competencies, change management, clear goals and objectives, education on new business processes, interdepartmental communication, interdepartmental cooperation, and ongoing vendor support. So, people from the same geographical location can clearly explain and relate with some of these issues as it affects their organization.

The questions were constructed within the theoretical premises discussed above specifically those issues that affect has affected the implementation process in their organization, what is the result like before and after implementation compared to their competitions this is based on the reason behind the implementation, to gain competitive edge, efficiency and effectiveness, although there are personal information part, this is to help to validate the interviewees years of experience and the department where they belong to, so as to guide the issues that will be asked. The questions were open-ended in nature, and this is with the intention to allow the interviewee express themselves explicitly enough not trying to conditioned their answers to factors that has been theoretically established but to allow the interviewee say it the way it is, then it will be interpreted into whatever category the answer belongs. Although technical questions was not asked, the reason for this was because, it is not really the focus of this research study, moreover, the referenced case study has partially covered that aspect so as to support the entire research from all angle.

The interview was done through face-to-face, group discussion and via an online platform. The face-to-face and group discussion was quite few and were not sufficient so the online platform was deployed, the discussion was not taped, it was handwritten, and later transferred to the digital format for proper collation and interpretation of responses collected, the interviewees responses was written down on papers as the discussion was going and later interpreted and classified into the category they belong, this categorization was based on key issues previously gathered theoretically, but the online platform was created via Google questionnaire platform and the responses were collected together and also interpreted. However, it was the same structured questions that were asked both in the interview and the online platform. In all cases, there was provision for comment should the interviewee has some other thing to say that was captured in the question that they feel could be useful to the research study. Important to mention is that at the beginning of the question there was the introductory part that explains the basis of the interview and research study.

The interview was not too formal but at least it provided an atmosphere for fair expression of interviewee opinions and averagely lasted about 25 minutes each occasion, the questions as earlier explained were strictly within the objective of this thesis and the theoretical backgrounds established earlier which includes issue their organization competitive edge, knowledge and training, years of experience and years in their respective roles, the adequacy of training received before performing their roles, challenges with and without ERP support system, benefits derived in the use of the system, how has the system reduced or increased their daily tasks. Theoretically most these questions are meant to reveal their organizational strategies and how they are sustaining their business structure and processes, these are based on the two main dimensions considered as the main support for this research study so the responses received in these are will be interpreted to how these organizations are benefitting or going to benefit from their respective information system implementation processes.

The online questionnaire was prepared to supplement the difficulties faced in conducting an interview, so it was prepared in a manner that it will enable the interviewee the opportunity to express their views as much as possible. Alt-

hough, this approach was used in cases where an interview was not possible due to the work schedule of those that need to participate in the interview. The result was then categorized based on the themes under which they appear and the benefits and challenges were also outlined, so as to use them to suggest critical areas that should be identified in the preparation of the framework.

As at the time this report was compiled the total number of responses gathered was 12 out of which 2 was interviewed and 10 online questionnaires and 1 out of the online response was disqualified because the respondent did not respond accordingly and the responses were not complete and relevant. The responses was written down and later interpreted and categorized based on few selected themes that were based on previous research efforts. The respondents were given the opportunity to add a comment after answering the questions.

4.5   Data analysis process

The data analysis techniques is based on a general inductive approach as suggested by Thomas (2006), which involves the development of categories from the raw data or model to a framework, this model will contain key themes and processes identified and constructed through evaluation process and the outcome will be the description of the most important themes relevant to the objective of the research. This data analysis process is supported by interpretive analysis as justified by Bhattacherjee (2012) "that gave a comprehensive explanation to an interpretive analysis as the one presented in this research study and, that interpretive analysis attempts to simplify social reality through the subjective viewpoints of the embedded participants within the context where which the reality is embedded, and this analysis process is validated through rigorous criteria such as dependability, that is using two similar phenomena to set evidence independently and thereby arriving at a conclusion, credibility, this is using data triangulation between data collected, conformability, that is the confirmation of data by the data of another participant , and lastly, transferability, which is the generation of findings to other settings.

However, in order to make the data interpreted, it should be based on grounded theory which also based on the inductive approach of interpretation which further suggest that the interpretation of collected data about a phenomenon to should build theories about that phenomenon, and to achieve this, the data collected can be coded using a process of classifying and categorizing the text data segments into a set of codes (Concepts), categories (construct) and relationships, so then the process is grounded in based on the empirical data. In addition to the method must suspend any preexisting theoretical expectations or biases before data analysis and allows the data collected to dictate the formulation of theories".

Based on these justifications, the data collected covers the interviewees: role, sector or department, year of experience in current the role (system owner or users, department leader, manager, operation leader), challenges prior and after the system adoption, benefits of adopted systems, user training. The personal infor-

mation questions were collected so as to relate the respondent year of experience to how much he/she knows about the organization structure and business processes, also to be inform about the familiarity of the interviewee to systems that will be discussed, all in all, the personal information is to guide towards the finally validation of the response that will be collected and its value to this research study.

Another aspect of the interview questions was facilitated by the framework in TOGAF, which will inform about the similarities and differences of themes in the framework to the themes collected in the data gathering process. Moreover, in a way of validating these themes based on what category or class of concerns, phase, layer each belongs as presented by Rosemann & vom Brocke (2015). These concerns or critical issues were suggested according to Somers & Nelson (2001), which covers issues of systems implementation from initial to completion stages, the initial framework (TOGAF) covers implementation layers or level from top to bottom, so to rightly fit the evaluation or interview discussion within these premises, it covers issues before and after implementation of whatever systems is in use in these practitioners organization, from where all issues raised were noted on paper transferred into spreadsheet and analyzed under what theme or category they belong, level of concerns or implementation stage they fall and new issues were added based on the objective of this study.

The data analysis majorly was analyzed within the premises of the layers in the framework that has been created in TOGAF, the justification for this, is because the framework has already prepared a general board line where this implementation stages can fit into. However, this need to be justified and validated, moreover, the framework has mainly generic terms and in some cases, there is ambiguity in terms used. Nevertheless, the collected data was interpretatively categorized into whatever level it belong in the entire framework, fortunately, Somers & Nelson (2001), also has empirically collated critical issues that also surround some of the components in the framework, so all of these was used in formulating categories for the data collected. However, there limitations as how the interview question considered all these issues, but the few collected were analyzed based on these facts.

One of the layer of the initial framework (TOGAF) that shows the possibility to extend the element it contains, to actually enrich this research study is the business execution (Business realization) layer, because this is the layer that directly concern the research study but for the purpose of factoring in the areas that covers entire organization implementation layer, the entire framework was presented. However, in a way of emphasis the data was specifically analyzed and extended from the business execution layer (Architectural realization layer) to include issues that were considered not covered in the general framework or according to these research considered to be included with the to the research problem solution and also using terms that the can understand and relate with. The result and interpretation to these data are discussed in the next subsection.

4.6 Interpretation of result

The result gathered and the interpretation to each of the responses from the interview is thus explained and displayed in the following subsections. While the appendix to all the questions used in the interview and online questionnaire is presented as appendix 1 in the appendixes part of master thesis report. The result covers information about organization/sectors, role, experiences, training, level of training acquired, benefits of ERP support systems, and challenges of ERP support systems, task-related questions, and provision for additional comments.

4.6.1 Organizations / Sectors

The organizations and department of those that participated in the interview includes individuals from manufacturing companies, oil servicing and paper product manufacturing companies. The idea behind the selection of the interviewees was based on the fact that data required for validating previously established theories and concepts can well be tested and validated practically from practitioners with the same line of business process as the case study organization, also in order to internalize the result based on the premises they were gathered from, it, therefore, justifies the choice of organization.

Another important choice that was made was on the role of the interviewed participants, the role of the interviewee surrounds process leaders, system leader, managers and production leader, with respect to the issues of top management support, this will help in understanding the contribution the top management are supplying in the implemented systems in their various department and organization, also the way these systems has either contributed or causes challenges in the value chain of business process. The process leader and system are the ones that use these systems day after day and the operation leader technically knows the impact the said system has played in the production process and scheduling and labor planning, all together they tell if the system is really profitable or not, successful or failed, all of these will guide the outcome this research one area and on the other hand validate some the issues previously established theoretically.

4.6.2 Roles

These are the list of the roles of the individuals that participated in the interview: production manager, lean leader, operations administrator, materials planner, administration, line manager, facility manager, SAP production planning, supply chain manager, shift tower technician. Basically, their roles help this research to connect the response gathered based how valid it may be in terms of if the respondent is directly concerned or has any connection with the research data gathering process, that will help to know which data is valid to this research study or not. However, most the respondent are key users of these enterprise systems in their organizations, they can support the research in giving

firsthand information to how the implementation process was, the situation when the system has not be implemented, what was affected and was not affect- ed which further validate what should be really be included in the final result of this research study. The graph below indicates how long the participants have been working in their respective roles.

4.6.3 Organization competitive edge with the implementation of ERP and associated systems

One of the factors that motives organizations to want to be efficient and effective, these can be achieved based on the quality of their product and services, most importantly their business process, organizations seeking to meet internal and external demands pursuit the implementation information systems in order to gain competitive edge above their counterpart in the same business, so in know- ing how the implementation and non-implementation of these systems have real- ly changed these organizations, it is important to know how they are doing with respect to their competitors, so the responses gathered surrounds the fact that the implementation of the implementation has improved the organization, made the organization 21st century compliance in the area of ERP optimization and its re- lated system in the area of P2P (procure-to-pay), enhancement of business inte- gration which has propelled the organization to perform better, minimal time wastage

While on the other hand, before the implementation of the system, it was difficult for the organization to stand side by side before the advent of the system, less competitive, process availability was affected, undermines the building of transparency in the organization, nightmare tactical and operational level tasks, difficulty in task coordination

4.6.4 Current Organization status

This question the current organizational status was intended to see where the organization belong in the area of their capability level when compared globally and locally, basically it was intended to see how much the organization has ad- vanced with information system implementation, so the responses gathered sug- gest that there are still huge untapped opportunities for their organization in the area of information system capabilities, some said their organization has ad- vanced, become relevant, task accomplishment has been improved, developing, no standard architecture yet in place but functioning in a disjoint manner, just started using the system not too long.

4.6.5 Challenges encountered without the implementation of the system

This is a question that was intended to gather issues that surround the absence of these systems in some organization that is prior to the implementation of the sys- tem. The responses cover issues of high inaccuracies in production data, slow

and complicated production processes, unstructured business unit, business process not well integrated causing delay in business processes, excessive paperwork, lack of transparency and easy to commit fraud, more energy are wastage on facilitation of manual business processes, tasks are unnecessarily laborious, inefficient and ineffective, extremely herculean, frequent input of material stockouts, lack of coordinated execution along the supply chain (demand, materials, production, engineering, quality, etc.), due to excel based systems (even when augmented with MS-Access), coordination was highly prone to human error e.g. someone wanted to order 1200 cases of a product and inputted 12000 in the excel cell, digits error creating large ripple effect along the supply chain magnified in each SC node as at when moving further upstream and more rigorous.

Consequently, the data gathered based on previous subsections of the organizational competitive edge, current status and challenges before implementation could in all ways be identified as issues that surround the organization (Enterprise) directly or indirectly, as result of this they could be termed enterprise level concerns, Rosemann & vom Brocke (2015), the table will show how these issues are been classified and described.

4.6.6 Benefits derived in the adoption of the systems

This section gathered information based on the benefits that have been derived from the adoption of these systems in their various organization and the responses collected were interpreted as data accuracy and Integrity, tasks has been more organized and less tasking, effectiveness and time saving, proper business process integration, transparency and proper planning, good resource control, accountability & prompt response to the concerned quarter, good database, work is faster because there is transparency, staffs at different locations are able to access information quickly and perform their tasks on time, rapid communication between parties in a business process, better productive use of time, activation and completion of business processes are made easier, real-time data for proper planning and forecasting, visibility of responsibilities e.g. being able to see sales, inventory, supply chain planner behavior as it relates to inventory and cost policy and how that feeds into manufacturing, sales & marketing, business operation has been made more systematic and easy to run.

4.6.7 Challenges with Adoption of the system

These are meant to explain issues of compliances and sustainability, basically critical issues that were encountered and noticed after the implementation (Implementation level concerns) so as to be aware of the probable challenges can be included if they are not included in the general framework and the list of critical success factors presented theoretically and the response gathered were as follows; that there is difficulty in remembering the right navigation code, knowledge gaps, error detection while using the system, the system takes in whatever that has it is been fed with without vetting it, people's approach or believe, network issues, difficult to use the system at the beginning,

the need to be trained to master the system, resistance to uptake of new technology, Learning how to use the ERP and the associated system is challenging, zero difficulty, garbage in-garbage out, challenges with the master data quality is the biggest problem in the sense that the adoption of ERP and the associated system are not designed to mimic or represent the organizational entire supply chain element by element, difficulty in accessing long-range historical data may not be available due system short memory capacity, difficulty in getting users to follow recommended pattern of usage and adjusting to the new change is taking employee long time to achieve which is affecting the production master data quality.

Most of these concerns or issues identified in this section and that of benefits derived with the adoption of the system could be classified under the process level and some under other forms of concerns that will be discussed in detail in the table below and where each belongs.

4.6.8 Users Training

This is the area that addresses the quality and if the users are actually trained to use the implemented systems and there is any plan in place to train and develop the skill of users over time. The responses shows that most are trained while some are not adequately trained which bores down to the some of the challenges encountered after adoption of these systems, some issues surrounds the inadequacy of training leading to not knowing the navigation path, forgetting the way to use the system, these leads to the issues assessing users capability even after the training and adoption of the system.

Summarily, from all responses gathered, it is obvious that most of the issues outlined surrounds issues encountered prior and after implementation of the system used in their respective organization together whatever system that is being integrated into the centralized system (ERP). However, some of the responses may be wordy and hard to classified based on the premises of what is to be validated, nevertheless, they were interpreted based on the issues outlined in BPM as factors that may fall under the process levels, enterprise level concerns and implementation level concerns that were presented by Rosemann & vom Brocke (2015), Somers & Nelson (2001) critical success factors, and most importantly the issues identified in TOGAF generic framework.

In order to classify or categorize the collected data based on the critical issues they represent from all issues that has been studied earlier, so as to include the ones that may or may not have been included, which may have generic impact or case specific impact, so that the knowledge about these issues can be included in the framework construct and can also be investigated further or developed. In addition to this analysis effort, each of these issues mentioned was classified based on what level of concerns they are associated with (Enterprise, process and implementation level concerns), Table 4 below will present these critical issues, description, consequences and concern level.

Table 3: Classification & interpretation of result

Critical Issues	Description	Consequences	Level of process concerns affected
Knowledge gaps	This is the artifacts that explains the know of the organization, people, and business process	Closing the knowledge gap advances the organization tactically and operational, it also makes the organization relevant within their sphere of business.	Enterprise level
User training	These are artifacts that show how the individuals that are required to use this system are well trained before and after implementation	Lack of adequate training resulting from wrong navigation code, error data input, negligence of recommended procedures	Implementation level
Organization information systems Capabilities	These are artifacts that indicate the organization information system capabilities, how the IT is being use in the organization and how it aligns with the organization Process	Improper IT alignment leading to disjoint functions, in the sense that other processes are working in parallel with IT process, this will lead to failure and lost in IT investments, lack of strategies	Enterprise level
Work Pack- ages (Tasks related)	These are artifacts that explain how day-to-day activities are been carried out or structured	With good structure in place and proper use of IT tools guarantees that tasks will be simplified and less laborious, but manual data input makes task huge and laborious e.g. difficulty in procurement, data management	Process level

Organization competitive edge	These are artifacts that inform how the organization is doing locally and globally, which directly or indirectly represents	The adoption of IS in the organization advances the organization, enhances business integration, organization performs better, minimal time Wastage	Process level & Enterprise level

		Improve productivity and quality management	
Transparency and Visibility	These are artifacts that show how visible and trans- parent the organization business process is and how it is been monitored and con- trolled	Lack of transparency and visibility in organization business process can breed fraudulent act, in- coherent data management.	Process level
Planning and Forecasting	These artifacts that captures the way the organization business process make plans and predictions based on available of in- formation.	Improper planning and forecasting leading to time wastage, material wastage and complicated data management	Process level
Systems se- lection	These are artifacts that captures the nature of packages that are chosen to be implemented into the organization for their business processes		Process level
Communicatio n	These are artifacts that captures how the organization interacts, cooper- ate and communications changes (information communication)	Lack of cooperation and visions, goals and mission will not be properly shared, thereby affecting the entire organizational performance	Enterprise level

Resistance to change	These are artifacts that addresses how employees embraces change (organizationally and technologically)	Low performance and lost on investment, backwardness, stagnancy, laborious, wastage of resources	Implementation, Enterprise level & Process level
Interdepartmental cooperation and	These are artifacts that captures how Departments and	Improper business process alignment, lack of cooperation	Enterprise & Process level

integration	units interrelate and cooperates with each other, also how the functions in the organization are integrated into each other		
Network Issues	These are artifacts that captures how the information systems are implemented, networked and structures	Improper alignment of IT and busies process, lack of policies and strategy, downtimes, time wastage	Enterprise, Process, and Implementation level

The table above (Classification and interpretation of result) displays the collection of all relevant critical issues based on the data collection process, these issues fall under the category of enterprise, process and implementation concerns, however, some of these issues in Table 4 above, when considered in isolation they are closely related to each other based on the impact they will have, and on the other hand, when compared with previous concepts Somers & Nelson (2001) Rosemann & vom Brocke (2015) and TOGAF), they either fall under issues or concerns and also on some architectural layer. So, for these reasons these interpreted data are further be reduced and categorized under the architectural layer each belongs with reference to TOGAF comprehensive framework and issues that are considered similar are combined as indicated in Table 5 below.

Table 4: Reduction & Categorization of result

No	Critical issues	Architectural layer
1	Organization competitive edge,	Architecture Principle, Vision, and Requirements
2	Interdepartmental cooperation and integration	Business Architecture
3	Systems selection, Planning and Forecasting, Transparency and Visibility, Organization information systems Capabilities.	Information Systems Architecture
4	Network Issues,	Technology Architecture
5	Communication, Work Packag-	Architecture Realization

	es (Tasks related), Resistance to change, user training, knowledge gaps		

4.7 Limitation

Data gathering process presented some serious challenges in the area of respondent availability and willingness to be interviewed from a long distance, because it was almost impossible due to location, the organizations needed for the interview were located far away in Nigeria, so the interview was done in Nigeria, all of these was in the effort to physically see the current structure in place in the organizations and to see the organization currently using the systems.

Power outages also made the interview little more challenging, the incessant power outages in Nigeria and individuals in the organizations selected for the interview reduced the number of expected audience for the interview, this power issues made the staffs very busy trying to tidy up one task or the other and had little or no time for other "non valued added tasks".

Although, it was assumed that the response expected would be about 20, but the total of valid responses collected was 11 including the one presented through the online platform provided for further response. This somehow made data gathered a little bit difficult to analyze and limited the critical issues gathered.

Finally on the limitations from this research study generally seems to have focus more on the issues that impact information systems implementation in organizations, although the theoretical concepts identified some key components that boarders around the business process dimension and EA with respect to this research study and objectives, but on the contrary these issues did not really play out word for word, concept for concept in the data gathering processes. However, the collected data was still validated on the premises of previously collated issues, which later made these data relevant on the bases of which category of concerns they may appear to fall under.

5   FINDINGS & DISCUSSION

This chapter will present the discussion of findings from the theoretical and practical concepts reviewed towards the outcome of this research, also the find- ings from the empirical analysis. This chapter will present the framework that has been constructed for the implementation & Integration of ERP & MES in the case study organization.

According to the objective of this master thesis to present a framework that presenting a research effort that has been geared towards the completion of a master level studies, and this research effort will have the potential for knowledge elicitations and further research efforts, by theoretically and practically reviewing previous research efforts within this research domain, which will provide a path towards the solution of this research problem and this will be empirically validated through the data analysis processes. To set the direction for the entire effort the research study presents the research problem was presented thus:

- How can MES be integrated into the existing organizational structure using information systems to improve productivity, saving time and cost?
- What are the steps or framework to follow for improving productivity, transiting from manual to automated system using information system management?
- How best can MES-ERP be integrated for effectiveness and efficiency on the production floor?

Based on these research problems, this research objective was refined solely towards the provision of a framework that will assist in the implementing and integrating of ERP-MES systems into the existing case organization business process, to improve production process, save time and cost. However, it is important to mention at this point that the yardstick for measuring success may differ depending on the perspective of the person defining it with respect to ERP success and information systems implementation. "Critical success factor are those characteristics, conditions or variables that when applied, properly sustained, maintained, or managed, can have a significant impact on the success of a firm competing for a particular industry"(Asemi & Jazi, 2010). In addition to that the ben-

efits of any implementation process cannot be quantified at the point of implementation by any yardstick, (Winter, Buckl, Matthes & Schweda, 2010).

5.1 Findings from theoretical concepts

The findings of this research study were viewed from different dimensions from previous research efforts, nevertheless, the premises within which the research effort was developed further towards the framework construct from the theoretical perspective is detailed in (Table 5) below.

Table 5: Theoretical findings

Critical Issues	Stages, Phases, Levels & Architectural layer	Authors
Top management support, project champions, user training and education, management of expectations, vendor/ customers partnerships, use of vendors development tools, careful selection of the appropriate package, project management, steering committee, use of consultants, minimal customization, data analysis and conversion, business process reengineering, defining the architecture, dedicated resources, project team competencies, change management, clear goals and objectives, education on new business processes, interdepartmental communication, interdepartmental cooperation, and ongoing vendor support	Initiation, adoption, adaptation, acceptance, routinization, and infusion.	Somers & Nelson (2001)
Strategic alignment, governance, methods, information technology, people and culture	Enterprise, Process & Implementation	Rosemann & vom Brocke (2015)
	Architecture Principle, Vision, and Requirements, Business Architecture, Information Systems Architecture, Technology Architecture, and Architecture Realization	TOGAF

From the table above, it was observed that there are critical elements that affect the implementation process either from the phase, stage or layer perspective, but these issues are presented with different names and perhaps conceptualized differently, so this research study consolidate all the relevant sections of these concepts as displayed and in order to validate these elements data gathered from the empirical study was reviewed and reduced to the ones already mentioned in the theoretical concepts and the ones that are relevant and not mentioned or belong to the same category.

5.2   Findings from the steel production process

The case study of this research is a production process of paper products and about to integrate MES to ERP into an existing business process, while the referenced case for predicting the outcome of this research output is a steel production process implementing & integrating APS to ERP to an existing process also. However, from this parallel case study, it was observed that the architecture of the business process facilitated the discussion on the functionality of each system and it presented a visual state of the systems, also the construction of different scenarios further facilitated discussions on to integrate and implement the changes. In addition to that the discussion on the current process problem facilitated how the business process or the BA can be approach and when that has been done responsibility were allocated to skilled or trained individuals to handle the problem.

Another finding was that the primary process led to the implementation of APS, instead of the business processes being the basis for an ERP implementation. In other words, the business set the basis for ERP implementation while the primary process set the basis for APS implementation, this is also similar to the case study in the sense that the production process needs set the basis for the implementation of MES, and ERP has since been implemented based on the organization business processes.

The approach to APS & ERP implementation in the parallel case study was different, in the sense that the implementation of ERP system in the business process was approached based on how the business process expands and the requirements were stated before the implementation, and when the APS was implemented it was through an outsourced team. This, in the case organization was the same all through, in the sense that, both systems will eventually be implemented by an outsourced team, which is the reason they need to know how it should be done, to avoid a loss on investment

Another finding from the parallel case study was that the process description for planning and scheduling tasks are usually not done because, planning and scheduling tasks are difficult to decompose into sequential order. But the implemented ERP system was used to prepare flowchart used in all the processes that are supported by the ERP system.

In summary of findings from the steel production process that in the first scenario of the implementation process to determine how functions will be allocated to each system when implemented, there was planning on how will be allocated separately to the APS system and the ERP system, how backup tasks allocation will be done by allocating the tasks of production processes to APS and S&OP was allocated to APS. In another way, tasks related to production processed are backed up in ERP systems with no tasks allocated to APS and vice versa.

5.3 Findings from data gathering process

From the data gathering process, although the interview discussion was not directed towards the steps and stages of implementation, however, it seeks to gather issues that surrounds the success of enterprise implementation system, which was used to validate previous theoretical concepts, the findings shows that the gathered data are directly or indirectly are linked to the collated critical success factors by Somers & Nelson (2001), and from another dimension linked to the concerns level posited by Rosemann & vom Brocke (2015) and These two concepts put together are an integral elements of the comprehensive EA framework in TOGAF.

These, therefore, has enabled this research study to categorize these critical issues to themes of concerns, and the layer it particularly concern, on the other hand, newly found issues are also added to layers this research study considered them to belong based impact and level of implementation that they probably belong. As an emphasis, the research study did not seek the validation of technically issues, but holistic solutions that was not classified based either managerial or operational critical steps to implementation.

The summary of all the findings of this research study, which can lead to further discussion, has been collated as presented in (Table 6) below, the framework for the implementation and integration of ERP-MES system. This is an extension of based of the EA framework in TOGAF to include elements from the research data, which can be reuse in any organization or case specific implementation project.

Table 6: The framework for the implementation & Integration ERP-MES systems

Phases, stages, or Layer	Issues	Description
Architecture Principle, Vision, and Requirements	Organization competitive edge	These are artifacts that are intended to capture the surrounding context of formal architecture models, including general architecture principles, strategic, the context that forms input for architecture modeling, and requirements generated from the architecture. The architecture context is typically collected in the preliminary and Architecture Vision phases.
Business Architecture	Interdepartmental cooperation and integration	These are artifacts that capture the architectural models of the business operation, looking specifically at factors that motivate the enterprise, how the enterprise is organizationally structured and, what functional capabilities the enterprises have.
Information Systems Architecture	Systems selection, Planning and Forecasting, Transparency and Visibility, Organization information systems Capabilities.	These are artifacts that capture the architectural models of IT systems, looking at applications and data in line with the framework phases.
Technology Architecture	Network Issues	These are artifacts that captures procured technology assets that are used to implement and realize information systems solutions.
Architecture Realization	Communication, Work Packages (Tasks related), Resistance to change, user training, knowledge gaps	These are artifacts that captures change roadmaps showing the transition between architecture states and binding statements that are used to steer and govern an implementation of the architecture.

6   CONCLUSION

This chapter will present the concluding part of this master thesis research study, by closing the entire effort at this point with an overview of all the concepts explored to the result validation and then to the construction of the framework for the implementation and Integration of ERP-MES system that will be presented as the fulfillment of this research study.

In conclusion, first and foremost at this point it is important to reiterate the objective of this master thesis as it relates the title and effort to this end. The framework for the implementation & Integration ERP-MES systems: A case study of an industrial production process. The background information of the research case organization Kimberly-Clark was presented and the willingness of this subsidiary production plant to embark on the integration of ERP-MES system, which was a decision that was based on the current organizational structure and willingness to invest in order to improve production productivity. Which led to the objective of this master thesis research to deliver a framework that present a research effort that has been geared towards the completion of the master level studies, and this research effort will have the potential for knowledge elicitations and further research efforts, by theoretically and practically reviewing previous research efforts within this research domain, which will provide a path towards the solution of this research problem and this will be empirically validated through the data analysis processes. As a result of this, the direction for the entire the research study was presented with the following research problem:

- How can MES be integrated into the existing organizational structure using information systems to improve productivity, saving time and cost?
- What are the steps or framework to follow for improving productivity, transiting from manual to automated system using information system management?
- How best can MES-ERP be integrated for effectiveness and efficiency on the production floor?

This research presents the global state of organizations on how they are steadily and quietly connecting and networking one business function with another, one business unit with another and one business process with another. These organizations are doing all of these by putting information systems in the place where it can yield more and better information, and managers are assigned to monitor this system and they are able to gather real-time information, which has greatly enhance the growth of organizations through the end-to-end connection provided by IT innovations, which has attempted to integrate all departments, functions and unit in an organization to a single computer system.

Specifically looking this growth from manufacturing perspective, they equally affected with same issues that affect organizational holistically. In addition to that, it brought out the willingness to want to want to invest information systems to achieve productivity gains and competitive advantages in the market, fortunately, the emergence of new classes of packaged application software over the past years has made the implementation of enterprise systems especially ERP system gained a major status in the market in response to these needs. This now

led into exploring all dimension to meeting the need of organizations from process, architecture and strategic dimension still by information systems.

In an approach to establish the starting point for the construct of this research study, information technology was explored and presented as a tool that can enable any information system implementation, which further led into exploring the potential IT has offered organization in quest to be efficient and effective in their business process and improving their competitiveness in the global business environment. So, BPM was reviewed, BA was also reviewed and at a point of intersections, these two concepts were further built upon towards answering questions surrounding the implementation and integration of enterprise systems especially ERP and MES systems. In addition, ERP system evolution was presented and that of MES also, while their similarities and functionalities was also reviewed.

The business process dimension was presented in the light of decision-making and how managing a business process is not just about the process but also to include how the organization reacts to business changes, however, irrespective to the change decision mechanism, there should be alignment of all the elements of business: strategic alignment, governance, methods, information technology, people and culture. Unfortunately, because BPM all alone cannot shoulder the responsibility of an enterprise- wide change decision yet as presented in the study; the EA dimension was also explored where both concepts intersect at the layer of BA.

The BA dimension set a building block further for this entire effort to build the conceptual path to the framework construct at the point where the BA has finally included elements of BPM into the element it is made up of the business model, business motivation & business execution. Building on all these premises and finally optimizing the comprehensive and holistic EA framework in TOGAF, which was also empirically validated through the data gathered by conducting interviews and questioning with practitioners and system users. In addition to this effort was the parallel case study presented to be able to predict the outcome of this research, which was about a steel processing business, which is similar, the case study. All these efforts yielded issues that were tested against different concepts cutting across pre-and post-implementation processes, which captures issues previously presented by Somers & Nelson (2001), Rosemann & vom Brocke (2015) & TOGAF. These issues were categorized into layers according to EA framework leading to the framework for the implementation and integration of ERP-MES system.

This framework was extended and optimized to present the final framework of this research study. However, this constructed framework now includes issues that were not captured that are relevant to the research objective and that carries terms that are familiar to the case organization and that can assist in the implementation processes, this research did not make provision too detailed or core technicality in the implementation process. Nevertheless, the elements in this framework are subject to change and further development, but within the context of this research is considered useful, although, the justification for benefits cannot be quantified according to this research which leaves opportunity for further research effort towards evaluating the benefits of using the framework for project implementation & integration, moreover, towards explicating more elements that should be captured the framework artifacts.

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APPENDIX 1-INTERVIEW AND ONLINE QUESTIONNAIRE

S/N	Questions
1	Name
2	Industry/Company
3	Role
4	How long in current role
5	How much do you know about ERP system and associated systems e.g. Procurement, MRP, Accounting, and HR?
6	What can you say about your organization competitive edge without ERP system and associated systems?
7	How can you describe your task without the ERP and associated systems?
8	Can you describe the benefit you derive from the use of the systems?
9	Can you describe the challenges you encountered with the adoption of ERP system and associated systems?
10	Were you given required training before the use of the system?
11	If Yes, do you consider the training received adequate to use the system?
12	Do you regard the adoption of the system an added task?
13	Can you describe the current state of your organization with respect to ERP and associated systems e.g. MES?
14	What can you say about ERP and associated system implementation in your organization?