Pasi Pohjola

Technical Artefacts

An Ontological Investigation of Technology

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ABSTRACT

This work is an ontological investigation of technological artefacts. The main purpose of the work is to provide a fully-fledged conceptualization and description of technological entities, i.e. technical artefacts, and their use through a philosophical analysis. The main argument of the work is that technical artefacts have a dual nature. Technical artefacts are both physical objects and social objects. The social aspect of technical artefacts, especially in relation to its physical nature, is less analyzed aspect of technology in philosophy.

The philsophical analysis in this work applies various notions and developments of contemporary philosophy. To analyse the social ontology of artefact use, the work exploits John Searle's recent writings on social institutions. John Searle's notions have been recently discussed also in the context of technological artefacts which makes Searle's work a useful platform for combining different discussions of technology and technical artefacts together with issues presented in this work.

What the analysis in this work shows is that creating novel artefacts is also a creation of new social practices through introudction of ways of use of new technology. Starting from two commonly held views of technology, technology as material objects and technology as a social construction, it is shown that both of these views are underdeveloped in various respects. The proposed alternative to the ontology of technical artefacts in this work has three parts: dual nature of artefacts, constitution relation between these two natures and practices as uses of technology. After giving an account of these central features of technology, latter parts of the work discusses the implications of the ontology for creating and designing of new technology.

Keywords: Technology, Artefacts, Ontology, Constitution, Collective Action, Social Ontology, Intentionality, Design, Innovations

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PREFACE

We are constantly surrounded by technology and technology has significant effects on our everyday life. The development of new technology has enormous effect on local and global economies and technological innovations have been one of the main issues in economical and political discussions. This work is a philosophical contribution to the investigations of technology. Although technology has been a subject of research and investigation recently in philosophy, there are only few authors who have engaged into the pursuit of exploring the foundations of technology and technological products.

Technology is a complex issue and therefore many existing accounts of technology and technological development have covered only single aspects of the issue. The whole picture of what technological development is has still remained as an open question. The purpose of this work is to provide a fully-fledged conceptual description and analysis of technical artefacts. This holistic approach to technology is the main novelty in this work and the work can be seen as a programmatic presentation of new and more holistic conceptualization of fundamental features of technology. The contribution of this work is to show how variety of different issues relating to technology are integrated into each other. The further analyses that can elaborate on the conceptualization provided in this work are a subject of another set of research.

The task in this work is to provide a common set of conceptualizations for different theoretical and practical enterprises stydying technology. The concepts of ontological ivestigation are about the general or fundamental features of technology. These conceptualizations should provide a common ground for people with different theoretical and practical backgrounds to engage in communication of the same subject. The developments of this work touches upon issues discussed in disciplines such as social theory, economics, engineering sciences and also in methodology and practice of technical design. Motivation for this kind of interdisciplinary approach in the work is based on personal experiences on how philosophical investigations can be applied to more practical issues. Before becoming a researcher in philosophy I was working as an entrepreneur and a manager in small-sized information technology company. Also before becoming a masters student in philosophy I was a studying mechanical engineering and industrial economics. These experiences have enabled me to realize the benefits that philosophical analysis can provide for further understanding and development practical and business-oriented issues relating to technology.

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1   INTRODUCTION

1.1   The ontology of artefacts

There are two issues that make technical artefacts a specific type of entity: purposeful use and social status. Purposeful use is the reason why artefacts have functionalities and why physical properties are manipulated and created to serve existing or developing needs of users. But purposeful use and functions of these manipulated objects are not determined straight forwardly by the physical properties of these objects alone. These (manipulated) properties exist as functions only in a social or a cultural context. Artefacts do not only have one proper use that is derivable from their physical properties, but, rather, their 'proper uses' are dependent on circumstances created by social structures and users. Therefore it can be said that technical artefacts are both physical and social or cultural objects.

The main goal of this work is to propose ontology of artefacts that can take into account the material existence of technical artefacts and the social aspect of artefacts in general. The driving force behind an ontological study of artefacts is the fact that existing ontological accounts are underdeveloped on many levels. This work intends to provide a fully-fledged ontological account of technical artefacts, including their social construction. The social construction view discussed and developed here differs from the methodological approach adopted in constructivist social theory by its inclusion of the physical world and its explicit consideration of causal and conceptual features. The reason for investigating the social construction of artefacts is the fact that the identification of technology as cultural objects is at least to a certain extent socially constructed.

The classical philosophical problem relating to artefacts has been the question of artefact identity. The problem dates back to Antiquity and it can be found, for example, in Plutarch's stories. This problem is referred to in Plutarch's writings as *The Ship of Theseus* and the question he deals with is how the identity of artefacts has survived through renovations and the other changes which have occured over time. This question will be discussed at the beginning of this work and I will reveal how that the reason why there is no direct solution to the prob-

lem is that traditional materialist conceptions of artefacts are too ontologically limited to answer it. As an initial solution to this problem (and to other problems related to the materialist views of artefacts) Lynne Rudder Baker has proposed a constitution view of artefacts, which is also discussed in this work.

Baker's view is discussed partially because constitution and constitution relations have a central role in this work. The constitution relation discussed and developed in this ontology of artefacts does, however, differ from Baker's view in various respects. In this work, the constitution relation between physical properties and artefact statuses exploits John Searle's idea of constitutive rule. Searle's constitutive rule intends to explain how some non-institutional phenomena are connected to institutional statuses. This idea is applied here in this ontology in order to explain how artefacts can and often do have institutional statuses as physical objects and how their functions are dependent on this connection explicated by the constitutive rule.

The idea of the constitutive rules and institutional statuses of artefacts is also given more thorough considerations throughout this work. This work will illustrate how the institutional statuses of artefacts are dependent on social factors such as collective acceptance and mutual beliefs. These are of course, standard issues in both social ontology and the philosophy of collectives and collective action. The approach to these issues in this work is rooted in the consideration of the intentionality in action (such as artefact use) and then develops into an account of the social ontology of artefacts from the perspective of intentionality. The main idea is to introduce a theoretical concept of conventional practices that intends to highlight the necessary role of collective action for the existence of artefacts.

It can be said that the social construction of technology plays a central part in this work. The view of social construction that is discussed here has some similarities with the notion of social construction in the contemporary social studies of technology. The similarities are, however, limited to the fact that both argue that technology is (partially) socially constructed. Whereas in the social studies of technology, and particularily in the research programme of the *Social construction of facts and artefacts*, social construction is taken as a methodological principle, the ontology discussed here goes beyond the methodology of the social sciences and argues for a dual nature view of technical artefacts. As one of the outcomes of this investigation, the aforementioned ontology should allow us to conduct a sophisticated analysis of how technical artefacts are developed and exist as social-cultural objects through the inter-relations between physical and social phenomena.

1.2   Features and concepts of artefacts

The key concepts of this work (illustrated in Figure 1.) are proposed to be the central ontological conceptualizations of technical artefacts. In materialist ontology the emphasis is usually on parts and a whole (comprised of parts), and the

Technical Artefacts

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            Technical
            Artefacts
         ╱      │      ╲
   Natural   Institutional   Practices
   Facts        Facts        of use
      │      ╲    │    ╱        │
      │        Constitution     │
      │            │            │
   Structure    Status      Use Plan
        ╲          │          ╱
              Function
```
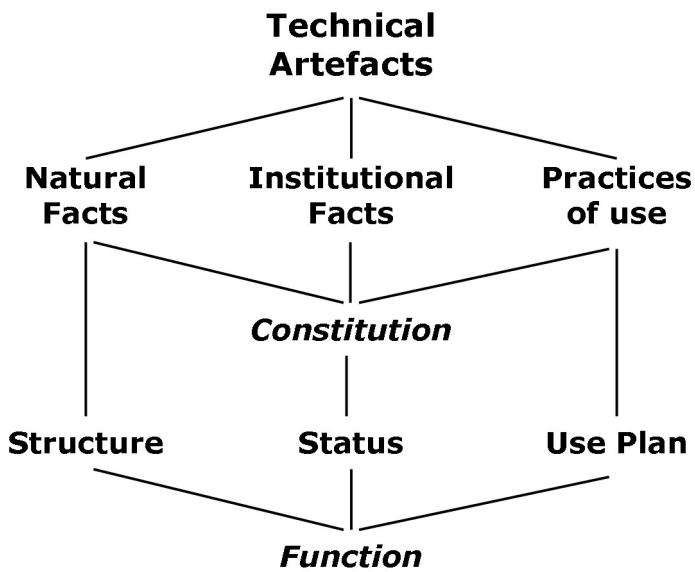
FIGURE 1   The concepts of the ontology of artefacts

question is how and what material parts comprise a certain entity as a whole (or as an artefact). In recent studies on social collectives and action, social ontology has been labelled as the discipline that describes general features of social phenomena. The approach in the ontology developed here is to combine *action as the use of artefacts* and the *social context* and *constitution of material properties and artefact statuses* as an ontology of artefacts. The work here is a combination of traditional (materialist) ontology and social ontology.

Facts and the dual nature: The first main issue of the ontology is the dual nature of artefacts. It is suggested that artefacts are essentially constitutive of two kinds of facts: natural and institutional facts. Natural facts, whose existence is independent on human involvement, refer to the physical structure and properties of artefacts. Institutional facts, which are dependent on human involvement, refer to the statuses of artefacts. These artefact statuses are also linked to their use. It is argued that the most important constitutive feature of artefacts is actually their institutional facts as opposed to the more general conception of social facts. It can be said that institutional facts are a higher-order sub-class of social facts. The most distinguishing characteristic of institutional facts is that they are dependent on collective acceptance, whereas social facts can be dependent on the beliefs or intentions of only two humans, a feature which is extremely significant to the ontology of artefacts.

Constitutive rules: As I discussed above, one central feature of this ontology is the notion of constitution relations and it is argued that John Searle's idea of constitutive rules is descriptive of something that is essential to the creation

and existence of artefacts. Searle's constitutive rule "*X counts as Y in context C*" conceptually integrates certain non-institutional facts (X) into institutional facts (Y) in a certain context (C). According to Searle, the performative act of stating or declaring this constitution relation is also essential, as its creation is dependent upon some kind of a performative act. This notion of performative constitution is descriptive of artefacts in the sense that while creating artefacts, an object with physical features is given an institutional status, such as being a mobile phone.

After discussing Searle's constitutive rules and their benefits and problems in describing the features of the existence and creation of artefacts, an alternative version of constitutive rule is discussed. This alternative is an XYZ-conception developed by Frank Hindriks. In his XYZ-conception some non-institutional facts X are connected to an institutional status Y, which is then connected to a behavioural dimension Z (in a context C). It is suggested that by considering the Y-term as representative of the institutional status of artefacts, it can include various functions of the artefact, an issue that Searle's account has had trouble explaining. Also the refinement of the addition of the behavioural dimension to the constitutive rule is also a better way of explaining the use of artefacts and how it is dependent on the constitution relation.

Institutions: The latter parts of the work are devoted to the discussion of the institutions and collective acceptance of artefacts. The central claim in these discussions is that the acceptance and existence of institutions is dependent on (collective) intentional action. In this section a typology of two paradigm cases of actions is introduced. These two kinds of collective action represent the same type of action upon which the collective action necessary for the existence of institutions is dependent.

The idea in these discussions is to provide an account of social-collective action that is necessary for the acceptance of the institutional status of artefacts. These discussions are also indicative of the social phenomena generating the context in which constitutive rules are applied. These social phenomena, such as collective intentional action relating to use of artefacts, create the context in which artefacts are either introduced and accepted or dismissed. In order to capture these central social elements of artefacts, a theoretical concept of conventional practices is introduced.

The creation and design of artefacts: The last part of this work includes a discussion of the manipulation and design processes involved in creating novel artefacts. The general intention of these discussions is to illustrate that there are certain boundaries with regard to the conditions of the creation of novel artefacts and that they are partially social. Following and elaborating on certain ideas developed both in the social studies of technology and also by Ludwig Wittgenstein, it is shown that these boundary conditions can be conceptualised. The discussion of the type of reasoning taking place in context of the creation and designing of artefacts is intended to elaborate on the claim that these socially existing conceptual boundaries are related to the ontology developed here. It is also proposed that these conceptualisations can be applied in order to manage and explicate the processes of design. These boundary conditions are created out of the possi-

ble constitutions of natural facts and institutional statuses, as well as intentional action (use) and the existing social context in general.

The idea of holistic ontology: In addition to the task of describing the essential features of technological artefacts, the work argues in favour of a more holistic ontology of artefacts. In his materialist ontology, Marx emphasised the essential connection between man, nature and productive activity. In this work, an alternative ontological standpoint is taken, but the general idea of Marx's philosophy of work and technology is also included in this work. The main point is that the elements of this ontology should not be thought of as independent and isolated features, but as constitutive of artefacts as a whole. Only this totality can make artefacts what they are, including two specific factors: the constitution relations and institutional statuses and intentional collective action.

In addition to the issues discussed above, there are also certain other concepts and conceptions that are central to the ontology of artefacts. Some of these concepts are familiar from discussions of traditional metaphysics and some are more closely related to the specific issues of the philosophy of technology. Certain concepts and their use are discussed quite intensively in this work and thus do not require further clarification. Other central concepts used in this work may have more varied uses in the literature used here and thus might require some clarification.

Parts and a whole: The typical approach when discussing individual parts and the combination of parts as a whole is the mereological approach. This means that artefacts can be analysed as a whole by summing up their structural parts. In other words, an artefact as a material entity is a totality of its material parts as they are combined in a certain way. The inherent problems related to this kind of mereological approach are discussed in the second chapter of this work. Another way of thinking about the issue is to divide an artefact into functional components, each of which having specific functions that contribute to the total functionality of the artefact as a whole. This idea can perhaps best be illustrated by considering, for example, a chemical process such as distillation. The process itself is a combination of different chemical subprocesses such as heating, vaporisation and condensation. These all are subfunctions which contribute to the process of distillation as a whole. Similarly, each of the components of a bicycle has its own function which contributes to the main function of the bike. In this work, an artefact, understood as a whole, as having a certain identity and certain acknowledged uses, can be conceptually dismantled into parts in various ways, none having any specific priority over the others. The parts can be thought of as material, functional or conceptual parts, and the decision to dismantle them should be made on a practical basis.

Systems: Especially in the fields of computer science, cognitive science and artificial intelligence, the approach to artificial things has been influenced by a Systems theory approach. The basic idea behind artificial systems is that, despite their complexity, they are always based on some kind of conceptually explica-

ble organisation. The emphasis in the systems approach is on connectedness or interaction, which distinguishes it from traditional analytical approaches, such as the mereological analysis of artefacts. One of the major topics in the systems approach has been human-to-computer interaction. The problem in the systems approach can be that the analysis is too strictly limited to the organisation of the technology and the functions of the components which contribute to the whole system (See Bijker 1995, 10).

Functions: Functions are dealt with here mainly from the perspective of the technology and functionality of an artefact as a whole. The primary reason for this is practical, because the perspective in this work is on the social aspect of artefacts. It should be acknowledged that functions take various forms and the literature used discusses various kinds of functions, such as biological or intrinsic functions and cultural-subjective functions. The intention here is not to undermine these issues, although they are discussed on a relatively general level in this work. The conviction that the functions should be taken for granted is based on the idea that the underlying functionalities in artefacts are created or exist in relation to their main functions.

1.3 The structure of the work

The chapters of this work are divided so that each of them discusses an individual theme related to the ontology of artefacts. The work begins from material or physical aspects of technical artefacts. In the second chapter, it is argued that materialism or the appeal to mere material properties is an underdeveloped ontological account of artefacts. The third chapter continues this theme by discussing the other side of the coin, i.e. the social or cultural aspects of technical artefacts. In the third chapter, it is shown that the social construction view of technology, which is prominent in the social studies of technology, also has certain shortcomings from an ontological point of view. The purpose of these two chapters is to argue that one-sided views of technology are not sufficient accounts when technology is considered from an ontological perspective.

The fourth, fifth and sixth chapters develop the ontology of artefacts in more detail. The development begins in the fourth chapter by explicating the dual nature of artefacts. The fifth chapter extends this idea by developing the constitutive rules of what constitutes an artefact as a way of understanding the inter-relation between these two natures of artefacts. The sixth chapter follows the idea of the constitutive rules and discusses the social phenomena related to artefacts, particularly the existence of institutions, institutional statuses of artefacts and how they relate to the use of artefacts. The seventh chapter of this work is devoted to the discussion of the creation of artefacts from the perspective of ontology developed here. The intention of this discussion is in part to demonstrate how ontological issues can have relevance for practical issues such as artefact design and manufacturing.

All of the chapters in this work has a similar kind of substructure. The first subchapter begins with a general discussion of the main subject of the chapter. These first subchapters also introduce the general question or problem of the chapter and outline the general line of argumentation. Each of the subchapters presents a more detailed discussion of the subject matter in the chapter in question. After these discussions, each chapter ends with a concluding subchapter in which the main lines of thought are summarised.

2 THE IDENTITY OF ARTEFACTS

This chapter illustrates how there is no easy, straightforward answer to the question of artefact identity; why, for example, object x is a statue or a power drill. At least there are no answers that are based solely on the material properties of an object. This fact is demonstrated with the classical example of the problem of the Ship of Theseus. The desire to find an indirect solution to the problem of artefact identity also gets support from the epistemological or knowledge-related underdetermination thesis, which has been adopted into some of the contemporary accounts of technology and technical artefacts. As a solution to this ontological problem of artefact identity, i.e. why the material object x (a piece of marble) is artefact y (a statue), Lynne Rudder Baker has suggested a constitution view of artefacts. In her ontology of artefacts, constitution is a general relation explaining why x is y and why x is not identical to y. One precondition of the constitution relation is that the constitution relation between x and y exists only in certain circumstances. After the central ideas of her constitution view are presented, it is shown that it requires some degree of enhancement, because her conception of circumstances is rather inexplicit as regards the relevant features of the circumstances making certain constitution relations possible. The last part of this chapter is devoted to showing that this idea of circumstances should be enhanced explicitly with social features and social notions. Technical artefacts are social-cultural objects and their existence is dependent on the (collective) involvement of users.

2.1 Artefact identity and constitution

Ontological accounts of artefacts have to respond to the challenge concerning what gives an artefact its specific identity and what constitutes artefacts. This problem concerning artefact identity is really two-sided, because the concept of identity has been used in two different ways in the majority of the literature on the topic. One aspect of artefact identity is discussed in the context of the para-

dox known as the Ship of Theseus and is aimed at the relation between a certain artefact, such as a ship, and its material structure. This type of approach to the question of artefact identity can be labelled as a *mereological approach*, in which the material organisation plays a central role in the explanation of artefact identity. The other way of discussing the identity of artefacts is more similar to the concept of identity in the discussions of human identity. The main problems in this kind of approach are related to what constitutes artefacts and what constitutes the relation between artefact identity and their material properties. (This is analogous in certain respects to the discussions in the philosophy of mind about the material/mental distinction. Houkes and Meijers (2006), for example, have discussed supervenience in the context of technical artefacts).

Because many artefacts, particularly technical artefacts, have a physical existence or at least exist in a physical medium, ontological accounts of artefacts have to take into account the material existence of these objects or the medium in which they exists (such as software in computers). As such, the materialism and explanations of artefacts that are grounded in material properties alone have encountered strong opposition in both classical and contemporary literature. But as is suggested in this work, the strong emphasis on material properties poses certain challenges that the ontological accounts of artefacts must take into account. One of them is the epistemological challenge known as the underdetermination thesis, which is a criticism of the idea that material properties (or the knowledge of them) have the potential to determine artefact identity. This issue is more familiar from late 20th-century historicist philosophy of science, but it has also influenced various accounts of technical artefacts and technology. It can be said that there is not just one version of the underdetermination thesis in technology, but that there are indeed various theses. For example, three versions of the underdetermination thesis are discussed in this work: Quine's thesis, which is the classical version adopted by theorists in the social studies of science and technology, and two-way underdetermination thesis presented by Houkes and Meijers.

The central challenges and questions in the ontology of artefacts are linked to the explanation of the relation between the material existence (physical properties) of objects and their status. The classical philosophical problems concerning the ontological status of artefacts have focussed on the identity of artefacts, such as the mereological issues related to the structure of artefacts and the time dependency of identity through changes in artefact properties. In contemporary discussions, the issues related to the status and material existence of artefacts are also approached from a different perspective. In a research programme in the social studies of technology, known as the social construction of facts and artefacts, the question of the relation between artefact status and material existence is overcome by the adoption of a stratagem in which technology is viewed exclusively as a social phenomena. In this programme, the research stratagem is based on the epistemological claim known as the underdetermination thesis. The underdetermination thesis discussed in the programme of the social construction of facts and artefacts states that the physical properties of artefacts cannot function as a determining tribunal of artefact status. On the contrary, the explaining fac-

tors of artefact identity and artefact statuses are based on social collectives which use artefacts.

In recent works by, for example, Houkes and Meijers, it is suggested that artefacts have an identity determining relation through the functions connecting the status of artefacts with their material properties. In an article published recently by Houkes and Meijers (2006), the underdetermination of facts and artefacts is discussed in the context of the ontology of artefacts. Where the social construction view of artefacts, prominent in the social studies of technology, states that underdetermination is a reason for adopting a social construction view of technology and a kind of relativism about reality, Houkes and Meijers take a different approach towards the issue. They suggest examining artefacts from an ontological perspective. They promote the dual nature of artefacts (discussed in more detail in the next chapter) and argue that underdetermination influences the ontological status of artefacts. Although the underdetermination thesis is usually seen as a criticism of the idea that the empirical verification of facts is actually possible, Houkes and Meijers argue that the underdetermination of artefacts should be seen as two-fold. Empirical data does not determine our conceptualisations of things and vice versa. What we think about things and what properties we impose on them are not independent of their properties as such.

The motivation for considering the underdetermination of artefacts as a relation moving in two directions is that artefacts are not objects which are independent of human involvement. In epistemology and the philosophy of the natural sciences, the underdetermination thesis (UD) states that our conceptualisations of the external world cannot be determined by the properties of the natural world, i.e. by the objects and events of the empirical world. Artefacts, in relation to natural facts such as mountains and trees, are manufactured or manipulated for some specific intended use. As such, certain properties which are constitutive of artefacts are intentionally applied to these objects. The properties of these objects do not exist independently of their intentional use or manufacturing, and their relation to determination should also be considered from the perspective of how the properties are applied to these objects.

The main question of this chapter is thus: 'What is the foundation or basis for identifying different kinds of artefacts and distinguishing them from other entities?' The first possible answer discussed here is the claim that the material properties of entities are the basis of artefact identity. The aim in the following sections of this chapter is to discuss some of the traditional ontological accounts of artefacts in order to demonstrate and explicate the general and fundamental problems related to the explanation of artefacts briefly touched on in this section. The reason for engaging in these discussions is that overcoming these problems is crucial to any attempt to answer the question of artefact identity. These discussions also reveal why the identity of artefacts cannot be determined by referring to an object's physical properties alone. After demonstrating these problems, some issues concerning the knowledge of artefacts related to the ontological problem of identity are discussed through different formulations of the underdetermi-

nation thesis. After the discussion of the underdetermination thesis, the rest of the chapter will be devoted to the discussion of Lynne Rudder Baker's proposal of some possible solutions to these problems. Her idea relies on the conception of *constitution*, which is a general relation that ought to explain the cleavage between the material existence of artefacts and artefact identity. Baker's answer is that material entities only *constitute* artefacts in certain circumstances. This proposal does have some problems, and I argue in subchapter 2.5 that it should be enhanced with the social factors which actually make up the circumstances in which artefacts become constituted. The last part of this chapter shows why the social issues that are usually neglected from the perspective of the ontology of artefacts actually play such a crucial role in it. The subchapter presents, through Marx's work on material ontology, the type of basic ontological idea upon which the developments of this work are based. The idea is to propose that the ontology of artefacts ought to combine social features and material properties in order to provide a thorough ontological account of technological artefacts. Following from these discussions it is argued that in order to overcome the problem of artefact identity, one must look beyond the material properties of artefacts and (also) into the social features of their constitution.

2.2   The identity of artefacts and its material origins

In their recent paper, Houkes and Meijers claim that the ontology of artefacts is a difficult problem to solve and that the most challenging issue is the determination of how certain functional properties are related to material objects designated as artefacts (2006, 118). This problem also includes the question of how certain functions and acknowledged properties of artefacts define the identity of artificial entities. In traditional philosophical literature, these ontological questions concerning the identity of artefacts are discussed in terms of the problem of the Ship of Theseus. The central philosophical problem in this example drawn from Plutarch's story is how the identity of artefacts is related to the material structure of objects and how this identity is maintained when changes in the material structure take place over time. The main question concerning the identity of artefacts is how material structure is related to the identity of objects and in what sense it is a determining factor in terms of the object's identity. This question is of course linked to more general ontological questions concerning material structure and the identity of entities in general, but according to various authors, there are certain questions related specifically to the ontological status of artefacts that need to be discussed separately from these general problems (See, for example, Baker 2004).

The classical puzzle concerning the ontological status of artefacts is included in the problem of the identity of artefacts. This puzzle has appeared in philosophical discussions since the Antiquity. The problem of identity is typically represented as a problem discussed in the context of the story of the Ship of Theseus.

In Plutarch's original writings, the story goes as follows:

> The ship wherein Theseus and the youth of Athens returned had thirty oars, and was preserved by the Athenians down even to the time of Demetrius Phalereus, for they took away the old planks as they decayed, putting in new and stronger timber in their place, insomuch that this ship became a standing example among the philosophers, for the logical question of things that grow; one side holding that the ship remained the same, and the other contending that it was not the same.[1]

In his writings on contemporary metaphysics, E. J. Lowe describes the philosophical problem embedded in Plutarch's story as follows:

> At a certain time t0 we have a ship A. Bit by bit, all its parts are exchanged for new ones. At time t1 we thus have a ship B consisting of these new parts. Now also at t1 the old parts are put together again to form a ship C. B and C are clearly different ships. But which of B and C (if either) is the same ship as A? (Lowe, 1983, 221)

Lowe's first solution to this problem is what he refers to as "the obvious solution". The obvious solution says that ship B and not C is the same ship as ship A. This argument is based on the claim that the identity of ship parts is neither a necessary nor a sufficient condition for determining the identity of ships. According to Lowe, a problem arises in the obvious solution if, for example, we assume that ship A is dismantled without the replacement of parts at t0, and at t1 the parts are used to form ship C*. In this case, C* is obviously identical to ship A. It becomes problematic, however, if this material identity is considered a sufficient condition for claiming that C* is the same ship as A. This latter case concerning ship C* can also be rejected because no ship existed during the time interval t0 to t1. (Lowe 1983, 221-223)

The problems concerning the identity of artefacts in this example and in general can be divided into two different types. One concerns the time-dependent existence as a necessary and sufficient condition of solving the problem of the identity of artefacts, which we can refer to as the problem of *synchronic identity*. The other type is related to whether the existence of a material structure is the primary condition for the identity of an artefact, and this case can be called the problem of *diachronic identity*. Both of these problems share a similar kind of appeal to the material existence of objects as the source of the identity of artefacts. The question of artefact identity in these two problems is whether the identity continues to exist and is transferred in the processes of renovation and replication. Because of these problems, it is reasonable to question whether the question of identity can be resolved by referring to material properties alone.

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[1]   Plutarch, *Vita Thesei* 22-23. tr. by J. Dryden.

From a common sense perspective, when related to material existence, these typical problems of artefact identity arise from the fact that replicas can have identical material structure. Although replicas are materially identical, we are still tempted to claim that the replica is not the same entity as the original. For example, we might agree that the replica of a 1965 Ford Mustang Shelby GT350R (built in 1995) is identical to the original when it comes to its parts and properties, but we would by no means consider it to be a (genuine) 1965 model Ford Mustang Shelby GT350R. Time-existence, on the other hand, creates questions such as whether Michelangelo's statue of David in its current form is identical with the statue Michelangelo created in the 16th century, because its material structure has changed over the course of time. In general, the question of identity and material structure leads to further questions such as the extent to which the original entity can change or be changed before its identity is altered and the criteria necessary for the artefact to retain its original identity.

When it comes to the identity of objects, identity relations tend to be tai are usually characterised by three typical intuitions[2]. The first is transitivity, which states that if A is identical with B and B is identical with C, then A is identical with C. The second is the dis/reassembly of an object, which states that an object can be disassembled and reassembled without the loss of identity. The third is renovation, which states that an object can retain its identity even when changes take place over time. When considered through these three intuitions, the main problem in Lowe's obvious solution is that both B and C are identical with A. B is identical with A in terms of renovation and C is identical with A in terms of dis/reassembly, which thus means that B and C are also identical. What is awkward in this situation is that we are more tempted to say that B is identical to A than to C. There are no materially-based reasons for this, and the situation is thus in need of additional criteria that can answer the question of artefact identity. One attempt to offer a solution to the problem of the identity of artefacts was recently presented by Lynne Rudder Baker (discussed below in subsection 2.4.). Another one, presented by the authors of SCOT and in keeping with the underdetermination thesis, states that the identity of artefacts is merely a social construction (discussed in the next chapter).

The general ontological problem concerning artefact identity is that material structure or material existence cannot be the determining component of the identity of artefacts. Material structure can play a central role in the identification and differentiation of entities, but the above examples illustrate that identity (as a property of objects) is not the identity (as a relation) of a proper name and material existence of an object. As such, identity as a property which distinguishes objects from one another cannot be characterised as the identity relation between the name and material properties of an artefact. The justification of this claim and the initial solutions to this problem are discussed in following sections.

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[2]   I wish to thank Dr. Kent Hurtig from the University of Sterling for clarifying these issues for me during a workshop in Jyväskylä in the winter of 2005

2.3 Underdetermination and artefacts

Although the underdetermination thesis is usually related to the possibility of the empirical verification of theoretical knowledge, it has received more varied interpretation in recent literature, particularly when it is discussed in the context of the methodology of the social sciences and technology studies, or in the context of the ontology of technical artefacts. In addition to the original formulation presented by V. W. O. Quine, two other conceptions of underdetermination which are relevant to the theory of technical artefacts are discussed in this work. One of them relates to the implications drawn from it in the social studies of technology and is discussed in the next chapter. The other is the call for a two-way underdetermination thesis presented by Houkes and Meijers in their ontological account of technical artefacts. This idea is discussed in greater detail in the context of the dual nature of artefacts in Chapter 4. Here, the discussion is mostly related to the original formulation and its epistemological implications for the theory of technical artefacts. One central reason for discussing underdetermination, in addition to the fact that these issues are discussed in the ontology of artefacts, is the fact that UD is a central backdrop for the social construction of facts and artefacts discussed in the following chapter. Another reason is that the underdetermination thesis is also an argument against the straightforward solution to the problem of artefact identity based on the material origins of artefacts.

Ontology and metaphysics are traditional subjects of philosophical investigation. Metaphysics, which is also some times referred to as "the first philosophy", has recently come under intense criticism by various authors in the philosophy of science. The positivistic traditions of the 19th and 20th centuries and the neo-positivistic tradition of the naturalists have attempted to exclude metaphysics from philosophy by arguing that it is mere speculation and should be replaced with real science (such as empirical cognitive psychology) and logico-linguistic analysis. These kinds of anti-metaphysical movements have attempted to replace speculative metaphysics with empirical science and to replace *a priori* investigation of the foundations of knowledge with an a posteriori scientific method (See Kornblith 1994). One of the most vocal proponents of such anti-metaphysical attitudes is V.W.O. van Quine, who has emphasised ontological relativity and epistemological naturalism (Quine 1969). Quine's fundamental ideas are also present in the relativist-constructivist tradition of science and technology studies.

Quine's central theses are stated in his two well-known dogmas of empiricism, which are also manifested in both the formulation of his underdetermination thesis and in his writings on ontological relativity and epistemological naturalism. The two dogmas are the primary basis for his philosophical ideas. These two dogmas criticise the beliefs that empirical evidence could verify our conceptualisations of knowledge and that there are true statements of knowledge that are inherently analytic (a priori) in nature. According to Quine, the first dogma is a false "belief in some fundamental cleavage between truths which are analytic,

or grounded in meanings independently of matters of fact, and truths which are synthetic, or grounded in fact" (1953, 20). The other dogma is the false "belief that each meaningful statement is equivalent to some logical construct upon terms which refer to immediate experience" (*ibid*.).

The underdetermination thesis is a synthesis which follows of the abandonment of these two dogmas and which states that our conceptualised body of knowledge cannot be determined by empirical experience alone. This thesis also includes the notion of holism, which is a result of the abandonment of the first dogma. The holism that Quine comes to support is based on the argument that the body of knowledge is confronted with reality as a whole. This holism is also the source of his further calls for ontological relativity and epistemological naturalism (Quine 1969). According to Quine, there is no analytic part of truth that exists independently of matters of fact and there can be no certainty of the constituents of our knowledge. As such, it naturally follows that there can also be no certainty as regards the fundamental ontological features of the world. As a consequence of these claims, there is no place for any kind of first philosophy (metaphysics) whose source of inquiry these fundamental truths of experience and knowledge represent. Following from these facts, Quine suggests that one should take a relativistic stance in ontology and leave the investigation of knowledge construction to empirical science, because speculative philosophy aiming at eternal fundamental truths independent of matters of fact cannot provide any answers to these questions.

Abandoning these two problematic dogmas of empiricism, i.e. the analytic or synthetic distinction and the verification of theory by empirical evidence, Quine certainly comes to propose much more relativistic approach to the truth of scientific theories than that posed by the logical positivists who are the main target of his criticism (1953, 20-46). According to Quine's criticism, one cannot distinguish the statements of scientific theories as analytic or synthetic, which makes a priori philosophical speculation on the foundations of knowledge impossible. These analytic a priori statements are, according to him, actually dependent on empirical evidence. As such, he also comes to claim that a scientific theory has the potential to confront reality as a whole. Scientific theory and its concepts have to be seen as a network of concepts and semantic relations in which no unit of conceptualised knowledge can exist independently. As such, no purely synthetic statements can exist independently of theoretical statements (such as pure observation statements, as the logical positivists tried to argue).

Quine's criticism against logical positivists of the Vienna Circle and their naïve idea that empirical evidence could verify our scientific theories is thus plausible. It has become evident that this kind of positivist verification thesis has to be abandoned. But Quine himself is not beyond criticism, and the central question concerning his philosophy, which has been puzzling some commentators for years, is whether relativism does actually follow from the abandonment of these two dogmas (See f. ex. Heal 1989, 75-81). Quine's underdetermination thesis states that scientific theories cannot be determined on the basis of mere empirical

evidence and that the theory as a whole is the result of something more extensive than an empirically confronted reality. Theories depend on non-observational content, i.e. on certain theoretical conceptualisations which cannot be drawn or deduced directly from observational evidence. This non-observational content of knowledge can be described as the ontological background of theories, and Quine's attitude is that although this ontological background does indeed exist, the relativism about it actually follows from the abandonment of the two dogmas of empiricism.[3]

We do have to concede that Quine's two dogmas and underdetermination thesis do provide good epistemological reasons for being sceptical about the potential verification of conceptualisations by empirical experience. In addition, they also justify the abandonment of the hope of finding a straightforward solution to the problem of artefact identity in its material origins. But it also leaves open the question of the foundations of these conceptualisations and merely suggests that one should be a relativist about ontology. The relativist's account can be criticised for its tendency to come to hasty conclusions. Being critical of ontology should not necessarily always lead to a reluctance of ontology. For example, a fellow pragmatist, C. S. Peirce, puts it as follows:

> Find a scientific man who proposes to get along without any metaphysics [...] and you have found one whose doctrines are thoroughly vitiated by the crude and uncriticized metaphysics with which they are packed. We must philosophize, said the great Aristotle - if only to avoid philosophizing. Every man of us has metaphysics, and has to have one; and it will influence his life greatly. Far better, then, that that metaphysics should be criticized and not be allowed to run loose.(Peirce 1932, 1.129)

The following sections of this chapter discuss the ontological issues of technical artefacts in a way in which they also become attempts to resolve the explanatory problem related to the connection of material properties and the status of artefacts. These sections, and in a sense this whole work, also attempt to explicate that although there are good reasons for being sceptical about empirical evidence, there are also good reasons, such as those presented by Peirce, for investigating and explicating ontological issues.

2.4 Baker's constitution view

In a recent article, Lynne Ruder Baker expands her idea of material constitution to the ontology of artefacts (2000; 2004). By applying this conception of constitution, Baker intends to explain some of the essential features which material

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[3]   Donald Davidson has accused Quine of developing a third dogma, i.e. empiricism without dogmas. See McDowell (1996), 137

entities classified as artefacts possess. Baker argues that a prevalent problematic philosophical conception has viewed artefacts as ontologically deficient objects. According to Baker, one example of this attitude is present in Wiggins' work, in which he states that:

> [i]t should go almost without saying that the distinction of natural thing from artefact is presented here in a fashion conformable at every point and in every particular with the plausible scientific belief that, however we have arrived at the individuation of a given thing, the thing will be subject to the natural laws of physics and chemistry. (Wiggins 2001, 90)

According to Baker, the ontological attitude that Wiggins has adopted in his work proposes that artefacts are describable in natural terms and thus do not require any kind of individuation. In opposition to Wiggins' view, Baker's intention in her work on the ontology of artefacts is to propose a theory (the ontology of artefacts) in which artefacts are on a par with other material objects. (Baker 2004, 99) According to her, the notion of constitution should answer the problems related to the identity of artefacts.

In describing the very notion of constitution, Baker begins by claiming that material constitution is commonly and indeed falsely believed to be identity. The core idea of identity can be described by Leibniz's law:

> (LL) x = y iff for any property F (Fx -> Fy)

Baker's intention in her work on constitution is to argue that constitution is not material identity. According to her, constitution is typically understood merely as a mereological relation between a thing and its parts (See, for example, Barnett 2005). The problem Baker tackles with her idea of constitution is how to explain the fact that material entities such as works of art have "non-intrinsic properties essentially" (2000, 28). According to Baker, "[t]o understand a thing whose identity is not determined by the identity of its parts and the parts' relations to each other, we need to look beyond mereology." (*ibid.*) The idea Baker emphasises here is that artefacts should be distinguished from natural objects because artefacts possess (manufactured) properties such as practical functions whereas natural objects do not.

The general idea in her argument, which states that constitution is not identity, is to represent a general relation of constitution and to argue against authors who have "claimed that the relation between a material thing and the thing that constitutes it is identity" (Baker 1997, 599). The argument she defends is the essentialist argument of the form (compare to the formulation of Leibniz's law above) (Baker 1997. 600):

> x is essentially an F
> y is not essentially an F
> x is not identical with y

The idea behind this kind of argument is to defend the claim that a given object includes something x that is essentially F, whereas some y of the object is not essentially F. This is demonstrated in her example of the statue Discobolus, created by the Greek sculptor Myron. By using this example she wishes to demonstrate her idea by saying that while the statue (x) is essentially Discobolus (F), the piece tai mound of bronze out of which it was carved (y) is not, which means that Discobolus is not identical with the piece of bronze. (Baker 1997, 601-605) Another example Baker provides is that of a river. Although the river is constituted by an aggregate of water molecules at a given moment in time, it is not identical with the aggregate of water molecules constituting it at that time (Baker 2004, 99). It can be said that Baker's constitution is a general relation, and in the context of artefacts it is a relation between the material property of an object and its uses and manipulations, which are dependent on intentionality. Baker says that

> what makes artefacts unique [...] is not just that they have functional essences, but that their functions are determined by the intentions of their producers. (2006, 132)

These functions are what actually define (constitute) the identity of artefacts and render them recognisable and distinguishable objects. These functions are also not reducible to the object's material properties.

Baker's ontology is labelled as essentialism (also by her), and she claims that objects have essential properties such as proper functions. As such, it might be surprising to learn that she argues that constitution is a contingent relation. According to Baker, an object such as the aforementioned piece of bronze could potentially have existed without ever constituting anything at all, or perhaps as constituting something other than the statue known as Discobolus. Although constitution is fundamentally a contingent relation, in order to explain constitution, Baker must tai is forced to make an appeal to the essential properties of things. When object x is essentially comprised of property F, a certain necessity is involved in this relation. In a constitution relation, the essential property F is necessarily related to object x[4]. In order to explain the connection of contingent constitution and the necessary essential properties, Baker is forced to enhance her idea of constitution with some additional conceptions. (Baker 2000, 29-39)

In order to explain the contingency and necessity issues of the conception of constitution, Baker introduces two conceptions: primary kind and circumstances. According to Baker, "[e]ach concrete individual is fundamentally a member of exactly one kind - call it its 'primary kind'." (2000, 39-40) For example, Michelangelo's David is a statue, i.e. being a statue is David's primary kind, to use the example that Baker herself provides. This idea of the existence of a primary kind clarifies the idea which Baker emphasises in her essentialist argument discussed above. According to her, the piece of marble out of which the statue is made is not

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[4]   Baker here discusses about *de re* and *de dicto* necessity and claims that having essential properties is *de re* necessity, see her (2000), 36

essentially a statue, but David is. There can be possible worlds, as Baker claims, in which the marble piece would be neither David nor a statue. In this sense, the constitution is a contingent relation. What, then, does it mean that David or any other thing necessarily has a primary kind, i.e. some essential and necessary property? According to Baker, "[i]t is only in certain circumstances [...] that one thing constitutes another." (2000, 41) The existing circumstances imply that the criteria that something must possess some essential property F which makes it a primary kind, i.e. "[t]he variable for 'circumstances' [...] ranges over states of affairs in virtue of which something is the kind of thing that it is." (Baker 2000, 41) (For Baker's taxonomy of concepts, see Figure 2.)

In the context of artefacts, Baker says that reality takes various forms, but that each existing thing is of a primary kind and that a thing's primary kind tells us what x most fundamentally is. For example, "being a coin is a primary kind property, but being an item in a pocket is not" (Baker 2004, 101). What she also says is that there is no one underlying criteria dictating what can actually be characterised as a primary kind. Primary kind is something that is essential to the existence of artefacts. According to Baker, it is impossible for an artefact to continue to exist once it has lost its primary kind. Therefore, it can be said that artefacts can only exist and possess a primary kind if certain favourable circumstances exist. Artefacts are intentionally designed to serve certain purposes and to be used in accordance with their intended purposes. Baker refers to the functions related to the primary kind property of artefacts as "proper functions". Proper functions are the intended functions of artefacts and they define what the artefact most fundamentally is. (Baker 2004, 102) Baker ultimately comes to describe these kinds of objects as "intentional objects" (2000, 35).

The concept of the material constitution of artefacts is based on the idea that an artefact has a primary kind in certain circumstances which makes it what it is, and it necessarily has some essential property (and proper functions). Although Baker is critical of Wiggins' idea that artefacts ought to be described according to their material properties alone, she reminds us that the parts of the artefact can be described as natural kinds. This also allows her to avoid accusations of idealism. Artefacts need to be thought of as aggregates of parts, and the aggregate is what materially constitutes the artefact. An artefact can be described mereologically by dismantling it into a collection of parts, but its constitution cannot. According to Baker, "[a]lthough artefacts are not ontologically deficient, the aggregates that constitute them are ontologically deficient" (2004, 108).

The idea of constitution as a solution to the problem of the identity of artefacts emphasises the relevance of context, or circumstances, as Baker calls it. When applying the notion of context to the discussion of the identity of artefacts, the question of how one solves the puzzle of which one of the ships, B or C, in the Ship of Theseus example discussed above is identical with artefact A is dependent on the existing context or circumstances (see the discussion of the problems in Lowe's obvious solution to artefact identity above). According to the idea of constitution, it is only in certain circumstances that the question of the relation of identity can be settled. What Baker says is that constitution does not rely solely
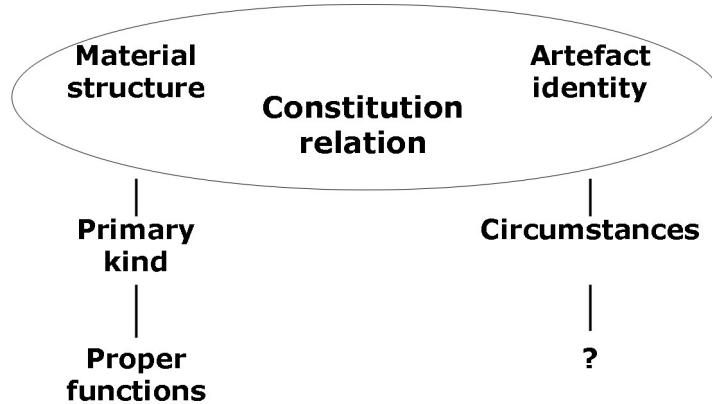
FIGURE 2   Baker's concepts of constitution

on material properties. Artefacts can and often do retain their identity in spite of the changes which take place over time, i.e. the disassembly and reassembly of their parts over a certain period of time. The tribunal enlisted to solve the case of identity in, for example, the case of the Ship of Theseus is relative to the existing circumstances in which the constitution relation is manifested and to which it is essentially connected.

Baker's intention in developing the notion of constitution is to provide a solution to the problem of dualism which exists in various versions of the mind/body problem (Baker 2000). She also wishes to treat artefacts as being ontologically on par with natural things, i.e. as objects belonging to an individual category. These intentions result in an ontological standpoint which is a version of essentialism. The problems she attempts to tackle state that neither material structure itself nor the intentional mind can explain artefacts, and that any potential explanation would require what she describes as constitution. The idea of constitution is to explain how material entities, such as artefacts, can have non-intrinsic essential properties. The material structure of things is a necessary condition of their definition, but artefacts are what they are only in certain circumstances. These circumstances are constitutive of something that can be described as intentional action or referred to in terms of design and use. Artefacts are designed for some specific use or are designed to fulfil a specific purpose, and their use as such is relative to their designed and manipulated proper functions.

Although the constitution view has many advantages over the traditional views relying only on material properties, there are certain problematic issues related to the ontology of artefacts which appear also to be underdeveloped in Baker's account. The first problematic conception, also found in Baker's discussion of artefacts, is her reference to artefacts as intentional objects (a problem which is discussed in more detail in Chapter 4). The idea behind discussing intentional objects is to emphasise that they possess certain functions and that this

kind of functionality is dependent on the intentions of their users. The problem of attributing intentional properties to a thing and defining it as an intentional object can be indicative of a possible category mistake. The problem arises when one attributes clearly mental properties to material objects. It is questionable whether this is the case in Baker's own work. For one thing, Baker emphasises that intentionality cannot be an intrinsic property of artefacts. According to her, there is nothing in the material construction of objects that could function as a definite designator of why some things are intentional objects while others are not.

This problem of intentional objects is similar to the problem of assigning specific functions to artefacts. Material structure is a necessary component of the specific function of a technical artefact, but there is nothing which actually determines what constitutes a certain structure or material property independent of its intentions, uses or practices. This is something about which I am certain Baker herself would also agree. The problem of the categorisation of intentional objects can arise if one discusses intentional objects in a way in which intentionality is attributed to some object as its essential property (to use Baker's terminology), because these intentional properties are produced and exist outside the object and its material properties. The environment outside or around the object to which intentionality belongs, of course, creates the 'circumstances' to which Baker is referring.

Another problematic feature of the discussions which attribute intentionality to objects is that intentionality as phenomena belongs to the category of 'circumstances', which is comprised of users and their intentions. They are actually the preconditions for the possibility for a given material object to actually possess 'essential' properties in the first place. Intentionality cannot be an intrinsic property of an object, as it is argued above, so the existence of intentional objects or certain proper functions of artefacts is dependent on circumstances. Intentionality cannot be an intrinsic and thus material property of an artefact and therefore cannot be an essential property of the thing. Intentionality has to be a feature existing according to the circumstances which make the constitution relation possible. Baker's solution was to introduce the conception of circumstances as the background in which primary kinds and proper functions can exist by relating them to the intentionality of the circumstances.

Another relevant question concerning the ontology of artefacts is related to the conditions required for the artefact to actually be what it is. These conditions are those in which the constitution relation is manifested. In Baker's ontology, constitution relation relates to the circumstances which function as conditions for the categorisation and recognition of artefacts. Although the appeal to circumstances as the boundary conditions for primary kinds is certainly correct, the problem in Baker's work lies in the ambiguous notion of circumstances. There are only few characterisations and examples of the circumstances and no detailed analysis of how they affect the recognition of primary kinds. It is, of course, evident from Baker's work that intentionality, material structure and physical properties have some kind of intimate relation to constitution, but her conception still lacks a detailed analysis of this relation. Baker writes that constitution is the glue

of the world, but it seems that the glue works only when an additional component, the circumstances, is added to the compound. Following Baker's own argument, the material structure is a relevant part of the constitution of artefacts, but explaining how some designed or manipulated structure can be a primary kind requires further explication.[5]

In Baker's conception, the constitution relation is something that intends to explain the existence of artefacts and how the structuring parts of artefacts create proper functions and primary kinds of objects. According to Baker, this constitution manifests itself in the context of circumstances. Houkes and Meijers have criticised Baker's view of ontological stacking and the problem of multiple spatially-existing coincident artefacts. One example used by Houkes and Meijers is aspirin, in which acetyl salicylic acid can function as a pain reliever and a blood-thinner. These kinds of cases are, according to Houkes and Meijers, challenges to the ideas of proper functions and primary kinds. (Houkes & Meijers 2006, 124-129) In her response to Houkes and Meijers, Baker admits that some of their suggestions, particularly those concerning the issues of design and malfunction, are justified (Baker 2006, 135). In her response to ontological stacking, she describes how, ontologically speaking, aspirin as a pain reliever and aspirin as a pain reliever with the discovered property of blood-thinner are actually two slightly different artefacts. The difference between the recognition of these proper functions and primary kinds and the complexity of essence is always relative to the circumstances at hand. The blood-thinning property of aspirin (as its proper function) can only be recognised in circumstances in which one possesses specific knowledge of the physical properties and effects of acetyl salicylic acid. (Baker 2006, 134-136)

Baker also remarks in her response to Houkes and Meijers that the usage of artefacts plays a role in the assignment of (proper) functions to them. But usage is also an issue which challenges constitution as an ontological account of artefacts. In the case of natural facts, such as planets and planetary systems, constitution is much less problematic account. Planets can constitute planetary systems which are not necessarily identical to the collection of planets. In the case of artefacts, the circumstances in which certain constitution relations can exist are much more complex. For example in the case of aspirin, the circumstances of its constitution relation include facts related to its usage in addition to the facts of the natural properties of acetylic salicylic acid. As will be argued throughout this book, in the case of artefacts, the features of the circumstances which allow constitution relations to exist are social facts, such as institutions and social structures. Baker herself admits that: "I was cavalier in my reference almost willy-nilly to makers, producers, and designers as sources of an artefact's proper function." (2006, 135) My intention here is to examine the two accounts of technology and technical artefacts, which highlight the relevance of social phenomena, and then to develop an ontology of artefacts that explicitly takes into account these social aspects of circumstances in the constitution of artefacts by also emphasizing the role of the designers and producers of technology.

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[5]   See Baker's comments in her (2006) on similar kind of criticism

2.5   Artefacts, nature, and man

The discussions surrounding the ontology of technology and the ontology of technological production are strongly related to the conception of work and the manipulation of nature, because physical artefacts are products of the manipulation of natural resources. Actually, the main criterion that distinguishes artefacts from natural objects is that artefacts require some form of manipulation (or the deliberate lack of manipulation). Historically speaking, Karl Marx is probably the best-know classical philosophical author when it comes to the classification of work as a form of human action. His conception of work is typically discussed in a strong relation with one of his best known conceptions, alienation. In a capitalist society, work alienates the worker from the product of his work and from the entire working process itself, and the worker is connected to the working process only through a wage contract (Marx 1963, 120-134). Although alienation is one of the best-known themes of Marx's philosophical work, the alienating dialectics of master and slave cannot (at least exclusively) be applied in the analysis of technological production within the sphere of the discussion of the ontology of technology and the creation of technological artefacts.

There is, however, a more fundamental ontological level in Marx's conception of work, an ontological background, upon which the analysis of alienating work is based. These background ideas developed by Marx in his materialist ontology are also relevant to the contemporary discussions of the ontology of artefacts. Both L.R. Baker and other authors dealing with the dual nature of artefacts have emphasised the role of manipulation in the process of artefact identity in the ontology of artefacts. Artefacts are manipulated so that they serve certain specific functions designed to meet the needs of human users. This manipulation is strongly related to the fulfilment of needs, and the manipulation process can be seen as a means of attaining a certain goal. This kind of idea is already presented in Marx's work, and his fundamental materialist ontology intends to show how productive activity, i.e. the manipulation of nature in order to fulfil certain needs, is related to wants or goals that are founded in social life.

The more fundamental level upon which the dialectics of alienating work is based has its roots in the idea of nature. Here, Marx is referring to nature in terms of its being either external organic nature and or physical human nature. On this fundamental ontological level, Marx argues that material production or productive activity is the " 'mediation' in which the unity of man with nature is explained" (Arthur 1986, 5). This ontological view is already present in the manuscript 'Alienated Labour' (Marx 1963, 120-134) and is discussed in more detail in German Ideology (Marx 1994, 120-126). In German Ideology, the presuppositions of materialist ontology developed by Marx and Engels are based on the notion of productive activity as the medium uniting man with nature. (Marx 1994, 123-126). The fundamental ontology behind Marx's conception of work includes three essential conceptions: nature, man and productive activity.

Marx's conception of nature refers on the one hand to the external objec-

tive world to which man is related through his productive activity (Marx 1994, 123-126; Arthur 1986, 5-6). On the other hand, however, he is referring to the inorganic human body of man, which he sees as the natural condition of the existence of human history (Marx 1994, 123). Marx's discussion of human nature in terms of the natural prehistory of man is justified, however, as his material ontology aims to emphasise the idea that the basis of human needs always lie in human nature. This fundamental material ontology is the basis of Marx's criticism of German ideology and Hegel's conception of the Spirit (See Plamenatz 1975, 61-64). The conception of nature in Marx's version of material ontology also has a more profound meaning, partially because of his enthusiasm for scientific material explanations. It has been argued that the aspect of the natural as the natural human condition is, at least implicitly, a combination of basic human needs and the capacities which enable productive activity. These capacities enable productive activity in a way in which productive activity can be explained as a meditation that unites nature and man, where man ought to be understood as a socially constituted being (Plamenatz 1975, 46-49). In the context of humans, nature is the material basis which enables productive activity.

Marx's discussion of man in both his dialectics of labour and his materialistic ontology refers to a man who has already entered social life and is something more than a mere biological creature with natural needs and capacities (compare to Hobbes' account of man in the state of nature). In the Dialectics of Labour, this man is essentially someone who has put his existing natural capacities to use, more or less exclusively for the purpose of satisfying his own needs. In German Ideology, Marx and Engels state that the "first presupposition of all human history is naturally the existence of living human individuals" (Marx 1994, 123). Human history is created on the basis of these natural conditions and historiography must proceed through the actions that have put these capacities into use (*ibid.*). But a man engaged in the development process of productive activity is essentially engaged in social interaction. Man becomes involved in social relations with others through productive activity, which is also the initial precondition for the existence of social institutions (on technological artefacts and social institutions, see the following chapters).(Marx 1994, 124) The justifications for defining productive activity as a form of developing technology are also driven by the social reasons put forward by existing institutional structures.

As it is stated above, productive activity is one of the central components of Marx's material ontology. Productive activity is the " 'mediation' in which the unity of man with nature is explained" (Arthur 1986, 5). This mediation can be viewed in two inter-related ways. It is either the manipulation of natural resources for the production of artefacts or the manipulation of natural resources in order to create artefacts for the sole purpose of satisfying the natural needs of man. In the explanation of work, the latter is seen as more relevant to the explanation, while Marx labelled work without any direct relation to natural human needs as alienating work or labour. Although this mediation is the key issue in Marx's criticism of the capitalist society, mediation itself is seen as a much more

fundamental aspect of man in the first place. Human history is created by these productive actions and is only possible through these productive actions which unite man with nature, in which man should be understood as a man living in a social world.

The most important aspect of this material ontology in terms of understanding technological production is its key emphasis on the productive activity as mediating between nature (as a resource and basis of needs) and man (as a social being). It is also simultaneously a good reminder of the relevance of nature to the theorisation of technology. The relation between man and nature through productive activity has many implications for the theoretical accounts of technology, one of which is developed here. Marx's work is opposed to the physicalistic and constructivist views of technology, both of which undermine one of the essential aspects of technology.[6] In contrast to social constructivism, Marx emphasises the role of nature as a fundamental ontological element of both the social man and the productive activity. This view, of course, differs significantly from the account of the social construction view, which emphasises the social context over the natural.

Considering the inherent problems of the ontology of artefacts discussed above in the light of Marx's fundamental ontology, one can see that the materialist explanations of artefacts have certain deficiencies. One of them is functions. According to Marx's ontology, artefacts are products of the manipulation of natural resources, and this kind of productive activity is triggered by both natural needs such as hunger and by socially existent needs. As such, the functions assigned to and manipulated by artefacts are partially socially created. This is compatible with the underdetermination thesis, which is based on the argument against the claim that functions or statuses of artefacts are determinable by physical properties alone. This emphasis on social life and socially constructed needs and functions also extends the idea of circumstances, i.e. the context in which the constitution relations of artefacts are manifested. In the following chapter, we will engage in a more detailed discussion of social construction by focussing on the fundamental ideas behind the recent social studies of technology.

2.6 Conclusions

When considering what artefacts actually are and how they can be defined and described, it is important to begin the description on the basis of their given material properties. Technical artefacts are physical entities with physical properties, or they exist in a certain physical environment which makes the materialistic explanation of them an intuitively appealing alternative. Our discussion in this chapter challenges this view from different perspectives. In addition, the very idea of the material identity of artefacts is also problematic. It was argued above that the question concerning the identity of artefacts cannot be answered by an

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[6]   Although Marx was a ontological materialist.

appeal to material properties alone.

The problems related to these materialistic explanations challenge the dominant views of technology in the engineering sciences. In addition, this kind of limited view of technology has been identified as one of the sources of engineering design errors. Functional failures, i.e. cases in which a technological artefact fails to serve its intended purpose, are typically the result of underestimating the importance of the role of the users and the phenomena belonging to the user culture. As such, changes in the conceptualisation of both theoretical and practical technological enterprises are necessary. And these changes could be motivated by the ontological analysis of artefacts. There are also practical reasons for implementing these kinds of changes in various technological disciplines, such as technical design and the engineering sciences, because the kind of broader view of technology suggested here has the potential not only to enhance engineering and design practices, but also to reduce possible design errors.

The best way to incorporate users and user culture into the ontological conceptualisation of technical artefacts is by applying the conception of constitution and constitution relations. The basic idea of constitution relation is that a material object constitutes an artefact in certain circumstances. This also means that this constitution might not exist in different circumstances. This pair of concepts, i.e. constitution and circumstances, can be used to describe why, for example, seashells have monetary value in some South Pacific cultures and not in others, despite the fact that both have similar access to seashells. It is the circumstances that differ in these two cultures, and it has explanatory relevance when it comes to explaining the status of seashells in these cultures.

When appealing to circumstances, one has to be specific as to what it is that makes up the circumstances in which the constitution relations are manifested. This specification can be made in a way that has been applied in the field of descriptive sociology[7], which aims at describing the existing relevant beliefs, practices, events, etc. that make up the surrounding framework in which certain artefacts exist. But the inherent problem in such descriptive exercises is that of relevance. The main question in analysing the existence of artefacts is: What are the relevant features of the circumstances that make up the constitution relation? Should one include everything available through observation, questioning and analysing, or are there limits and structures that can answer the question of relevance and extract the relevant phenomena of the culture? This work proposes that the answer to this question should be ontological. By providing an ontological description of technical artefacts, including social ontology, the fundamental issues of constitution can clearly distinguished . Certain material objects, whether manipulated or not, become artefacts in the circumstances created by social phenomena. As was already briefly mentioned above, the functions and purposes of artefacts are dependent on their socially existing uses and needs, and the status of an artefact should be seen as a constitution between an object's material properties and the relating social phenomena.

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[7] See f.ex. (Mauss 1990) for application of descriptive sociology in investigations of cultures of South Pacific

The claims of this chapter can be summarized as follows:

- The mereological view of artefacts cannot provide sufficient conditions as to why artefacts have certain identities and purposeful functions, although material properties provide the necessary foundation for the identification of the possible functions and uses of artefacts.

- In the context of artefacts, the underdetermination thesis should be understood as an argument against the idea that neither human intention nor material existence is the foundation of artefact identity and functionality. As such, artefacts need to be considered as material objects which are dependent on human involvement.

- One prominent proposal for explaining how certain material entities make up an artefact tai how certain material entities become artefacts is constitution relation. In order for the constitution relation to be an effective theoretical conception in the ontology of artefacts, it has to be enhanced with social notions which are descriptive of the circumstances in which the constitution relations take place.

3 THE SOCIAL CONSTRUCTION OF TECHNOLOGY

Nowadays we know quite a bit about the (social) construction of scientific and technological facts, thanks to the works of scholars like Collins (1985), Bloor (1991), Latour (Latour & Woolgar 1979), Pinch & Bijker (1984), and Woolgar (1991). These works have intensively investigated the both actual processes of science and technology and the everyday work of scientists and engineers. The research carried out in the social studies of science and technology has identified the social mechanisms that have influence and affected an entire generation of scientific facts and technological artefacts. One of the main arguments and working hypotheses in these studies has been that facts and artefacts are socially constructed. This idea has been presented in a detailed research programme in the field of technology entitled The Social Construction of Facts and Artefacts (SCOT) by Pinch and Bijker. This chapter is devoted to the discussion of the social construction aspect of technological artefacts, an issue that extends the initial discussion of social mechanisms, socially created needs and artefacts in the previous chapter. I also propose that the ontological investigation of artefacts can have relevance to the theoretical developments of the social studies of technology. Social construction is a central issue in the ontology developed in this work. The intention of this ontology is to enhance the idea of social construction in various respects. In this chapter I will discuss the problems or underdeveloped aspects of SCOT and other prominent alternatives in the field as a point of departure for further developments. I will also focus on the potential role of other prominent alternatives in the social studies of technology as theoretical accounts of technological artefacts[1].

3.1 The sociological turn in technology studies

There have been at least two major turns over the past decade which characterise the study of scientific knowledge and knowledge in general. The first is the

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[1] For more extensive account of problems of SCOT and its alternatives see f. ex. (Hyysalo 2004, 38-43)

linguistic turn, in which the investigation of knowledge and scientific theories took a turn toward the investigation of the linguistic elements and meanings of theories and the consideration of theories as logico-grammatical formulations of knowledge. The thematic interest in the linguistic turn is on the various types and forms of expression and how the expressions they formulate refer to the world. In the sociological turn, the main focus is on the social aspects of knowledge, and social phenomena have become the target of investigation as the constructors of both knowledge and the repository of knowledge. Influenced by the sociological turn in the scientific fields, a kind of sociological turn has also taken place in the field of technology studies over the last 20 or 30 years.

The social or cultural construction of knowledge and beliefs has been an influential approach in the contemporary theories of the social sciences. This idea of social construction has also emerged in recent developments in the field of science and technology studies. Authors who have promoted or influenced these developments in science and technology studies include D. Bloor, H. Collins, T. Pinch and W. Bijker. Their work is also discussed here. The basic doctrines of this social construction in the social sciences were already presented in the 1960's in, for example, Garfinkel's Ethnomethodology (1967) and especially in a paradigm book on the social construction of knowledge by Berger & Luckmann (1966). The version of social constructivism put forth in particular by Pinch, Bijker and Collins has developed since the 1980's into much more sophisticated version of social constructivism than that proposed, for example, by Berger and Luckmann.

The version of social constructivism discussed here in the context of technology studies, is strongly related to a research programme in the field initiated and developed by Trevor Pinch and Wiebeke Bijker (1984). Their research programme of technology is referred to as *The Social Construction of Facts and Artefacts* (SCOT for short), and it is, as its name implies, strongly committed to the idea of the social construction of knowledge. Although the idea of the social construction of scientific knowledge is not new, Pinch and Bijker have introduced these ideas, following some refinements made by Bloor and Collins, in the specific context of technology. Their main idea is that artefacts can exist only in relation to social collectives.

The main theoretical issues behind the social construction of artefacts programme are the empirical programme of relativism, which was initially developed by H. Collins (1981), and the social construction of artefacts. These initial ideas propose a thesis that has a central role in their research programmes. The main claim of the research programme is developed on the basis of the notion of the interpretative flexibility of scientific findings, which is realised in the context of technology in the multi-directional model of technology (or the development of technical artefacts). This multi-directionality of technological artefacts is an alternative to the traditional theories of innovation processes, and it proposes an alternative to the linear models of traditional innovation theories. The view of the social construction of artefacts proposed by Pinch and Bijker is a methodological perspective on how technology should be investigated or interpreted.

Various authors in the field of science and technology have also developed their own alternative conceptualisations for their research in the field. SSK has developed an alternative to empirical relativism, which is referred to as meaning finitism. It has been developed by various authors belonging to the Strong Programme in the Sociology of Scientific Knowledge, and it intends to serve as a more sensitive approach to the study of the effects of the external world on the theorisation of the processes of knowledge construction. It has been said that some of the conceptions of meaning finitism attempt to bring the external world back into the study of scientific knowledge, and finitism can indeed be seen as mere refinement of constructivism proposed by Collins, Pinch and Bijker. Although meaning finitism strongly relies on the idea that scientific knowledge, and arguably also technology, is socially constructed, some developments in meaning finitism intend to reserve a role for the external world of meaning as a constituting process. The external world does not play a role in the determination of meaning as such, but instead plays an arbitrary role in the process of meaning creation. Meaning finitism is discussed below as an alternative to or enhancement of technology studies.

The following sections of this chapter focus on the idea of the social construction of technology and the question of what kind of alternative, if any, meaning finitism can represent. After discussing the main features of SCOT and its foundations, the final section will be devoted to the evaluation of a recent discussion in technology studies concerning reflexivity in science and technology studies. Where the first parts of this chapter are more devoted to the epistemological issues of science and technology studies, the question of reflexivity as a methodological issue is more related to the ontological assumptions behind these epistemological accounts. The purpose of the discussions in this chapter is to emphasise the relevance of the social construction view to the theory of artefacts, as well as to serve as a kind of precautionary tale of the limits of social construction in explaining artefacts. The problematic issue regarding to the social construction of facts and artefacts, at least in some of its forms, is that its authors are often reluctant to make any kind of ontological commitment to their phenomena of investigation. This problematic situation also serves as one of the main discussion in the following chapters and is one of the motivating factors behind the ontological developments in this work.

3.2 The social construction of artefacts

One of the most influential theoretical developments in contemporary social studies of technology is the programme of the Strong Programme in the Sociology of Scientific Knowledge (SSK). Building upon the ideas originally presented in the works of such scholars as T.S. Kuhn, Quine and L. Wittgenstein, SSK has developed into a sociological turn in science studies. The shift of focus in the programme is from the natural to the social world of conventions and institutions.

The turn toward the social world of conventions has also changed how scientific knowledge is understood and investigated, and this has arguably been one of the most significant developments in 20th-century science studies. In SSK, scientific knowledge is studied as a social phenomena which clearly differs from the perspective of logical-linguistic analysis adopted in the traditional 20th-century philosophy of science (See, for example, Popper 1995).

This sociological turn in science studies emphasises more relativistic approaches to science and scientific knowledge. The typical relativistic approaches are inherited from the views of scientific knowledge presented in the works of the predecessors to SSK, such as Quine, Kuhn and Wittgenstein (See, for example, Brown (1984)). The relativistic approaches to scientific knowledge have been explicitly formulated in certain developments in the field of the social studies of science, and one of the most influential relativistic programmes in the field is The Empirical Programme of Relativism by Harry Collins (1981 & 1985, 16). According to Collins, scientific knowledge should be investigated exclusively as a social construction. Scientific knowledge, like any other body of knowledge, is based on conventions, and it is not something that can be determined by properties of the external world. Knowledge is or should be understood as a social convention.

The idea that knowledge is socially constructed is, of course, not a novel one within the sphere of social theory. A paradigm example of a relativistic approach in the social sciences is the account of the social construction of knowledge presented in *The Social Construction of Reality* by Berger & Luckmann (1966). As it has been noted on various occasions, a naïve version of social construction of knowledge is a self-refuting presupposition. This problem of self-refutation is present already in Mannheim's sociology of knowledge (See Woolgar 1991). The general problem in naïve social constructivism is as follows: Social construction, being a universal statement of the status of knowledge, becomes a self-refuting thesis, because constructivism thesis is also applicable to the constructivism thesis claim itself. When considering the truth or validity of the statement that all knowledge is merely a social construction, the truth of the statement cannot be anchored to anything outside the sphere of the social context, if, of course, we wish to hold on to the constructivist claim. As such, it is a typical example of this semantic paradox. In addition to the fact that all knowledge is socially constructed and that the truth of any claim of knowledge is dependent only on a social convention, the implicitly presupposed universally valid claim that all knowledge is socially constructed also becomes a part of the claim itself, which is that all knowledge is socially constructed.

In Pinch and Bijker's more sophisticated version of constructivism, Bijker argues, similarly to Collins, that relativism in the social studies of technology (and science) is merely a methodological assumption. The methodological claim does not imply any ontological commitments (Bijker 1993, 115). In their programme, the support for the social construction of knowledge follows from the methodological decision to investigate phenomena as socially constructed. In keeping with this claim, SCOT investigates technology as a social construction. Although it is an appealing and strong methodological view, the kind of relativism that the

Pinch and Bijker have developed on the basis of Collins' suggestions has not been accepted as such by all of the scholars in the SSK. Barnes (1983), Hesse (1974) and Bloor (1997, 9-26) have been particularly critical of Collins.

Basing their own work on SSK in general and the work of Harry Collins in particular, Pinch and Bijker have introduced the relativistic methodology suggested by Collins to the social studies of technology. The ideas of relativism and the social construction approach also appear in other accounts of technology studies that are founded on the idea of social constructivism (Woolgar 1991). In their highly influential paper, Pinch and Bijker introduce an initial research programme of technology studies which they refer to as the social construction of facts and artefacts (1984). As I stated above, the foundations of their research programme lie mainly in SSK in general and Harry Collins' Empirical Programme of Relativism in particular. Although there has been intense and critical discussion surrounding their programme (Woolgar 1991), the fact is that they outline certain constitutive preconditions of the contemporary research and development of research methods in the social studies of technology. The most fundamentally influential issue in their programme is probably the relativistic social perspective on the investigated phenomena. Evidence of this can be found by going through the issues of the Social Studies of Science journal published over the past 20 years.

In the beginning of their paper, Pinch and Bijker question whether technology and science share any similarities and whether science studies can be applied to the study of technology. According to Pinch and Bijker, there are similarities between science and technology in the sense that certain methodological principles of science studies are applicable to technology studies. Following Collins, Pinch and Bijker argue in favour of a constructionist view of knowledge, claiming that technology and science studies should benefit each other, and the programmatic task of their paper indeed follows this suggestion. Their intention in the paper is to develop a programme of technology studies that is founded on the idea of the "social constructivist view prevalent within the sociology of technology" (1984, 400) or in short, social constructivism (See also Winner 1993, 364). According to their view, the programme of technology studies should benefit from the Strong Programme in the Sociology of Scientific Knowledge (SSK) initially developed in the field of science studies by David Bloor (1991) and further developed by Harry Collins in his own thematic direction (1981 & 1985). Because technological and scientific facts are similar forms of knowledge, SCOT can benefit from developments in SSK tai sit the development of SSK.

The Social Construction of Facts and Artefacts integrates two approaches: The Empirical Programme of Relativism initially introduced by Harry Collins and the social constructivist approach labelled as The Social Construction of Technology (Pinch & Bijker 1984, 399-400). As one might infer from the names of these approaches, both of them emphasise the post-Kuhnian tendency to to oppose the scientific realism supported, for example, by Popper and Lakatos in their philosophy of science. The enthusiasm for relativism and constructivism have, of course, been strongly influenced by Kuhn's conceptions of scientific paradigms and sci-

entific revolutions and Quine's underdetermination thesis (UD) of scientific theories (discussed in the previous chapter), although following Collins, Pinch and Bijker want to restrict relativism to a methodological level of commitment (Bijker 1993, 115). Empirical relativism is also one of the main ideas behind the multidirectional model of technology in SCOT.

The task in Pinch's and Bijker's programme is to apply the programmatic view of scientific knowledge developed in the Strong Programme in the Sociology of Scientific Knowledge to technology. At the same time, the initial ideas behind the Strong Programme legitimate its existence in the following way. The shift from the natural to the social world of institutions and norms in SSK is also a shift in the ways of understanding knowledge. In SSK, the body of scientific knowledge is treated as similar to any other kind of body of knowledge. This is also the insight that makes it possible to apply SSK studies to technology, as is argued by Pinch and Bijker. The bodies of knowledge in science and technology can be treated as similar, and therefore the methods used in SSK are also applicable in the context of technology. (Pinch & Bijker 1984, 400-402)

The Empirical Programme of Relativism (EPOR), which has had the most significant influence on SCOT, is a research tradition that was initially developed by Harry Collins. The programme emphasises the idea of the interpretative flexibility of scientific findings, claiming that scientific findings can have more then one interpretation. (Pinch & Bijker 1984, 409-410) The research carried out within this tradition has been targeted at the social mechanisms which limit the interpretative flexibility of scientific practice. Interpretative flexibility states that scientific findings can be interpreted in different ways and that social mechanisms influence the way scientific findings are interpreted and thus also how they are defined and developed. These social mechanisms are the power relations, practices, institutions and other social structures that have normative power over the interpreters.

According to Collins, EPOR comes to a conventionalist conclusion about the nature of the phenomena of investigation. Collins himself sees his programme as belonging to those works which embrace "explicit relativism in which the natural world has a small or non-existent role in the construction of scientific knowledge" (1981, 3). Collins' main line of thought about knowledge, which is also adopted by Pinch and Bijker, is that knowledge is a social convention that is constructed and maintained by a social group. Being a convention and thus merely socially constructed, knowledge can always be reinterpreted and reconstructed. The potential limits of these possible interpretations are the existing social mechanisms and power relations. Because the claim is merely a methodological decision, scientific knowledge should be studied as a social construction.

The emphasis in the Social Construction of Technology is on the social construction which takes place in the process of the development of technological artefacts. The Social Construction of Technology (SCOT) is based on the 'multidirectional' model that intends to explain the various aspects and stages of this development process. This 'multi-directional' model has many similarities to the

Empirical Programme of Relativism, for example the emphasis on the possibility of alternative decisions and interpretations in the development process of technological artefacts. (Pinch & Bijker 1984, 410-419) The 'multi-directional' model is used to describe the process of constructing technology. It is used to describe the alternative directions the development process of technology can take, for example in decision making, especially by describing the relationship between decisions and the existing intentions of relevant social groups. (Bijker 1995, 249-254)

The 'multi-directional' model of SCOT is a critical alternative to the more linear models of the processes of innovation and technological development applied, for example, in order to determine the economic success of technological innovations (Pinch & Bijker 1984, 405; Bijker 1995). In SCOT, the "developmental process of a technological artefact is described as an alternation of variation and selection" (Pinch & Bijker 1984, 411). Pinch and Bijker use the example of the process of developing a bicycle in order to illustrate how existing social structures influence the way decisions are made in the development of artefacts and how the linear history of artefacts ought to be replaced with a 'multi-directional' model that can explicate the alternative decisions which are present tai which exist in the processes of their development. These alternatives are discussed through the meanings, interests and interpretations given by different relevant social groups involved in the development process of an artefact.

These two programmes, SCOT and EPOR, combine the main idea of the social construction of facts and artefacts, which is the fundamental idea behind the programme Pinch and Bijker put forward in their paper. The methodological suggestions of Pinch and Bijker's programme can be summarized into these five claims:

> C1: Scientific findings are open to more than one interpretation.
> C2: Existing social mechanisms limit the interpretative flexibility of scientific findings.
> C3: In the context of technology, C1 and C2 claim that in the development process of technological artefacts, technological knowledge is open to interpretations and decisions during the process of developing artefacts. These interpretations and decisions are restricted by the existing social mechanisms.
> C4: According to Quine's UD thesis and the Strong Programme of SSK, knowledge cannot be founded on objective empirical experience. The creation of knowledge is dependent on an existing social community, its rules, practices and constitutive role.
> C5: Social mechanisms, C4 and interpretative flexibility show that scientific and technological knowledge and technological artefacts are socially constructed.

The third claim (C3) states that the description of the processes of technology creation and manufacturing can be multi-directional. Decisions made over the

course of the development process are influenced by relevant social groups. Pinch and Bijker discuss the development history of the bicycle as a sociohistorical example of this. According to them, the bicycle's development process contains phases during which a range of possible variations have existed and that the decisions which led to their acceptance and rejection have been influenced by various attitudes within different social groups. For example, the common conception in 1885 was that tricycles were the only suitable machines for women. (Pinch & Bijker 1984, 410-419)

This idea of multi-directionality also has methodological implications for the practices of investigation in technology studies. According to Bijker, the deconstruction of technology is one relevant step in the study of technology. This deconstruction of technology is intended to both demonstrate the interpretative flexibility of the findings of technology studies and to highlight the possible alternative outcomes which could have resulted from different decisions. The idea of deconstruction is to use existing socio-historical examples in the analysis of the social mechanisms generated by relevant groups and their impact on the development process (Bijker 1995, 242-254). As such, the kind of investigation that Pinch and Bijker are suggesting is not merely a linear historical description of the actual processes of technology development, but, rather, the deconstruction of the process can also bring to light the other possible decisions and influences of the various social powers in different relevant groups.

In conclusion, it can be said that the idea of the social construction of artefacts, particularly in the form presented in SCOT, promotes the idea of the possibility of various alternatives to the actual histories of technology. It is also an argument stating that relevant social groups influence the sociohistories of technology. How technologies develop is influenced by the interests of social groups such as users, developers, managers etc. The most important idea in the social construction of technology is that social collectives play a crucial role in the development of new technologies. One of the potential problems that can emerge, as will be argued in following sections, is that too much emphasis on social construction can undermine the role of the physical aspects of technology, especially in theoretical conceptualisations and methodological decisions.

3.3 SCOT and meaning finitism

Although authors like Barnes and Bloor have not been intensively struggling with the epistemological and ontological questions related to relativism, their work has tried to come up with alternative approaches to the strong social constructivism suggested by Collins and Pinch. Questions related to the problems of relativism in the social studies of science and technology are discussed by Hesse in terms of physics and physiology (Hesse 1974; Collins 1985, 172-174). These problems are also discussed briefly by Barnes (1983) in his development of the N- and S-devices related to his abstract model of pattern recognition, conceptualisa-

tion and classification. In more recent works, approaches which intend to avoid this kind of strong constructivism have been introduced under the heading of meaning finitism. In contrast to Collins, the style of meaning finitism suggested by Barnes and Bloor emphasises the relevance of observation in the processes of generating concepts and meaning, i.e. knowledge and beliefs (Barnes, Bloor & Henry 1996), although there have been some recent disputes as to the extent of its role (Bloor 2004; Kusch 2004).

It can be said that the boundary conditions of the interpretative flexibility of observations and facts is the most critical issue for social constructivists in general. In the context of technology, the question concerns the boundaries of the possible deconstructions of technological artefacts. From a philosophical point of view, we can question whether the shift from the natural to the social world undermines the relevance of experimental evidence as a boundary condition for possible interpretations, especially when the natural world is methodologically set aside. It is true that any scientific theory, paradigm, research programme or form of life produces certain boundaries[2], and these boundaries can be conceptual, political or social in nature. These boundaries partially comprise the possible interpretations or understandings of observations and anomalies. But when targeting only the social boundaries as forces limiting the interpretations of observations, we can question whether the social construction of artefacts and SSK actually undermine the fact that external reality does affect them. Kicking a table or a stone reminds us with empirical evidence that our knowledge of the external world is something more then a mere social construction, and the critical question is thus how we ensure that this common sense intuition is included in the investigation of objects. The question of whether SCOT incorporates this common sense intuition into its theory or whether it excludes it based on the methodological decisions of the programme remains open.

Within the Strong Programme of SSK, the developments of meaning finitism put forth by Bloor, Barnes and Kusch can be seen as attempts to move away from the well known constructivism supported by Collins, Pinch and Bijker, although Kusch's conception of meaning finitism (2002, 197-279) is more in line with Collins' work than with Barnes' and Bloor's thought (Barnes 1983; Barnes, Bloor & Henry 1996; Bloor 1997). In their book on scientific knowledge, Barnes, Bloor and Henry engage in a detailed discussion of the relevance of observation in the conceptualisation of facts about the world, i.e. the construction of scientific knowledge (1996, 1-80). It can be said that meaning finitism is opposed to meaning determinism in a somewhat similar way as Popper's falsification thesis was opposed to the verification of scientific theories. Meaning finitism claims that the meanings of terms are always created by a finite number of examples, although the applications of these terms refer to a larger scope of (possible) examples than those which constitute the meaning of the term. The concept of a 'duck' gets its meaning from a finite set of observations about ducks, but the applicability of the concept is more general. It is used for labelling these observable entities also

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[2]   See f. ex. Hanson (1958 & 1971) on theory-ladeness of scientific observations and Kuhn's paradigms (1996, 42-51)

in the future. Especially in the case of scientific terms, meaning finitists argue, similarly to Collins, that the future uses of concepts remain open-ended and the meanings of terms are never fully determined. It would seem, thus, that facts and the meanings of the terms representing facts have interpretative flexibility.

If this is all that meaning finitism is really about, it would seem that it does not go any further than social constructivism in terms of the explication of the possible non-social boundaries of interpretative flexibility. But as the authors of meaning finitism, Barnes, Bloor and Henry are explicitly critical of the constructivism developed, for example, by Collins (See Barnes, Bloor & Henry 1996, 73-80; Collins 1990, 3-16). The authors of meaning finitism are willing to state that there are certain 'real world' limitations to interpretative flexibility, although they are not explicitly formulated in the account of meaning finitism. The problem in meaning finitism, for someone who wishes to tackle this question surrounding the limiting cases of interpretative flexibility, is that it becomes entangled with quietism when it comes to perception, the world and the creation of meaning (i.e. about the epistemological problem of meaning), especially in the version Martin Kusch has developed in his work on epistemology (Kusch 2002, 197-211).

One way of trying to understand the difference between constructivists and meaning finitists is to look at what each has to say about the role of observation in the creation of meaning (and about the construction of facts in general). While the constructivists exclude observation from their account of knowledge and meaning in the sense that it would have a non-social effect on knowledge creation, meaning finitists emphasise the necessary role of observation. The most problematic issue in the writings on meaning finitism is that the authors have more or less chosen to adopt a quietist stratagem as regards the role of observations in the developments of their accounts. One central issue that is, however, present in these discussions is the idea of patterns and pattern matching in observation. This idea was initially developed by Barnes, and his account has been widely discussed in the literature on meaning finitism since its publication.

In his paper on bootstrapped knowledge, Barnes (1983) distinguishes two idealized types of referring terms, 'N'-type terms and 'S'-type terms. 'N'-type terms are idealized natural kind terms without any self-referential features and the application of these terms can be described as pattern-recognition. Whenever pattern p appears, term n (belonging to 'N'-type terms) is applicable. Conversely, no pattern recognition occurs in the application of 'S'-type terms. 'S'-type terms are idealised social kind terms that are merely self-referential. Barnes can be seen as emphasising two relevant issues in his paper, which he describes through complex examples in his paper. The first is what he refers to as "bootstrapping induction". The inductive inferences people make are bound by self-referential and self-validating social institutions. This is an argument which supports the essential role of the social context in the construction and existence of knowledge. This argument claims that knowledge is, at least partially, self-referential and socially constructed. The other argument in his paper is a critical view against formulations of knowledge which claim that self-referring knowledge is the only possible

form of knowledge. According to Barnes:

> Natural science is the crucial case as far as the distribution of bootstrapped inferences is concerned. Their pervasive role in social life generally is clearly evident: if they pervade science also, then they are present everywhere. Should we think of discourse generally as to some extent self-validating, as partially self-referring? This indeed is roughly my own view. (Barnes 1983, 540)

The accounts of meaning finitism in particular and SSK in general have been strongly influenced by Barnes' works. *Scientific Knowledge*, which was written by Barnes, Bloor and Henry, is probably most sophisticated presentation of SSK aimed at avoiding mere constructivism. The book begins with a discussion of observation, which the authors claim is the correct point of departure in the discussion of scientific knowledge. According to the authors, they wish to avoid the kinds of misinterpretations that would cause them to be categorised as authors of the sociology of scientific knowledge, who have a tendency to undermine the relevance of observation. They claim that "[t]he aim will be to show how the sociological analysis of knowledge can and must proceed on the assumption that at the basis of knowledge there lies a causal interaction between the knower and reality." (1996, 1)

Although there is a strong emphasis on both the open-ended future application of terms and the revisability of conceptual classifications, the social study of scientific knowledge carried out by Barnes, Bloor and Henry reserves a place for the restrictive role of the natural world in their theoretical account. Although Barnes et al develop a sociology of scientific knowledge, their account ought to have relevance as an alternative methodological approach also in technology studies. Especially if one takes seriously the claim by Pinch and Bijker that science and technology studies ought to benefit each other, even if the finitist position fails to offer any systematic theoretical account of the observational limitations of interpretative flexibility. The dispute between the constructivists and meaning finitists concerning epistemological claims can ultimately be summed up like this: According to both views, observable patterns cannot determine meanings, but the finitists claim that meanings cannot be mere constructions independent of the non-social content of observations either. According to them, at least the role of observational content and the causal role of observations ought to be incorporated into the theoretical framework. The initial reply offered by finitists is this: To some extent, observational experiences do have content (observable patterns) that exists independently of the conventional sphere of social construction.

A few examples are discussed here following the Wittgensteinian discussion of rule following and seeing-as (and ornament figures) in order to investigate the possible reasons and motivations for adopting the finitist claim[3]. These common

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[3] Especially the discussions written in his manuscripts on the foundations of mathematics have interesting ideas, see (1996, 330)

sense examples are intended to propose that there are reasons for considering the relevance of the non-social aspect of observation, even in the sociology of scientific knowledge and technology. For example, consider the case of a retiring master of ornament painting and his apprentice. The ornaments are examples of pattern matching, because ornaments are usually generated by repetitive patterns. The master teaches his apprentice by making the young boy reproduce the ornaments he has used for embellishing his works of art. The apprentice learns through trial and error to produce exact copies of his (the masters) work. When the apprentice has learned to reproduce the patterns used by the master, he and the master can both visually see the identity of both the original and the reproduction without socially constructing a convention about it. The identity between the paintings is thus not resolved by any kind of convention but by the mere observation of matching patterns.

Another common-sense example of acknowledged mutual content of observations is 'hidden' in the classical duck-rabbit example (See Wittgenstein 1995, 194). When the duck-rabbit figure is shown to people, some see it as a duck and others see it as a rabbit. Despite the differences in seeing-as, when observers are asked to draw a copy of the figure, anyone with even the most basic artistic skills can produce a figure that is (at least almost) identical with the original, whether they saw it as a duck or a rabbit. It is this kind of capacity of identical reproduction that serves as a good example of a common-sense experiment of shared perceptual content. These examples of reproductive capacities suggests that we reconsider the claim that knowledge is a mere social construction and encourage us to investigate the possibility that there might be a more realistic approach to perceptual experiences in knowledge creation. These examples should at least challenge straightforward epistemological constructivism, especially in terms of the possible boundaries of interpretative flexibility[4]. The suggestion here is not that we return to strict or nave realism, because the existence of shared content in perceptual experience does not always imply meaning determinism (or foundationalism in terms of empirical evidence).

What these examples intend to show is that the strong accounts of constructivism and relativism in the social construction view of technology can have alternative approaches, such as the one suggested by meaning finitists, although quietism makes their account quite hard to grasp. It seems that there are reasons to presuppose that the knowledge of facts and artefacts exists, at least to a certain extent, independently of social construction. The authors of EPOR and SCOT might well also agree, but their stratagem is to methodologically avoid ontological commitments to or statements about these issues. They restrict themselves methodologically to the investigation of scientific knowledge and artefacts as social constructions. The suggestion here, taken from the discussions of meaning finitism, is that the accounts of technology as a social construction ought to re-

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[4]   Recent argument for the realism concerning perceptual experience is presented by Brewer (2004). See also McDowell (1998). It should be remarked that constructivism of Collins, Pinch & Bijker is methodological and epistemological and ontological implications of this methodological choice are not clear.

serve a place for the (causal) role of the physical properties of artefacts as limiting mechanisms of the interpretations and deconstructions of technology. It has been argued that the social studies of technology lack methodological sensitivity in various aspects concerning social collectives (Hyysalo 2004, 43). It is suggested here that these artefact-centred views in SST should also adopt siiis at least some level of methodological sensitivity towards the causal roles or physical properties of artefacts.

The major development that the authors of SCOT have initiated into technology studies is the central role of the social construction of artefacts. It is evident that technical artefacts are social-cultural objects, as was argued already in the previous chapter. SCOT has also provided sophisticated tools and methods of analysis for use in the social construction of technology. These theoretical and methodological issues also have significance for the consideration of the ontological status of artefacts. The initial concern also in the alternative meaning finitism is the question of how we should understand the limitations of social construction and interpretative flexibility. This is, of course, an ontological concern which is excluded, mostly on a practical basis, from the theoretical formulation of SCOT. As such, there are differences between the perspectives in this work and that of Pinch and Bijker, because the purpose of this work is primarily to answer these ontological questions concerning the nature of technical artefacts.

3.4 Social construction and the ontology of artefacts

In the initial version of SCOT, Pinch and Bijker used four central concepts to describe the multi-linear model of technological development: Artefact, problem, solution and relevant social group (1984, 410-419). The relevant social groups are the collectives of people that influence technology and its development. They also have power over others and are able to influence how technology develops through social relations. Paradigm examples of relevant social groups are the users and manufacturers of technology. Different relevant social groups also have a diverse set of relationships to and requirements for technology. In the developmental stages of a technical artefact, problems and their solutions are created and affected by different social groups. When the developmental process comes to an end, i.e. an artefact becomes a paradigm artefact, stabilisation occurs in and among a variety of groups (Pinch & Bijker 1984, 425).

In his more recent works, Bijker has argued that the unit of analysis in technological studies should be socio-technical ensembles and not artefacts (1993, 117 & 1995, 242-252). According to Bijker, artefacts themselves represent an overly limited view of technology for the social construction view. In the works written after the initial introduction of SCOT, Bijker has introduced the concept of *technological frame* to describe the totality of the interaction around technical artefacts. According to Bijker, technological frame is "proposed to explain the development of heterogeneous socialtechnical ensembles" (1995, 252) and it "structures

the interactions between actors of a relevant social group" (*ibid.*). In other words, technological frame is representative of the ways in which humans perceive and interact with technology (Hyysalo 2004, 67).

The view of artefacts in SCOT is that they ought to be seen as socio-technical ensembles as opposed to individual objects. As was stated above, Bijker claims that a kind of artefact-centred traditional approach to technology and technological artefacts is too narrow and limited. Bijker has actually categorised the approaches in technology studies into three different types of models. The first group is the materialistic models, which, according to Bijker, are often technologically deterministic and tend to stress an autonomous logic of technology development. These materialistic models can be seen as the most artefact-centred of all the models. The second type of models are the cognitivist models, which, according to Bijker, come in many shapes and forms. In the cognitivist models, the role of problem solving and technological knowledge is emphasised. The third group is the social shaping models, which is the category to which SCOT also belongs. The main idea in these models is that technology is shaped by social factors. Where the first model emphasises the autonomy of artefacts and the second stresses the role of rational cognitive enterprise for the development of technology, the approach discussed in this chapter considers artefacts as elements of a wider social context including relevant social groups and other social factors. (Bijker 1995)

This basic idea of social construction is also shared in the ontology presented in this work, and the basic motivation for discussing social ontology as part of the ontology of artefacts in the following chapters is the view that artefacts should be discussed in relation to social features including creation and use. A similarly fundamental view of the construction of technology can already be found in Marx's work, in which artefacts are created by productive activity as the manipulation of natural resources, and the triggering factor of productive activity comes from the social context of man. The needs and uses for artefacts are founded on and existent in the social reality of humans. It is therefore not surprising that authors in the social studies of technology have tended to emphasise the role of Marx's analysis of technology (Bijker 1995, 235; MacKenzie & Wajcman 1999, 141-157). Other points of departure in this work come from the ideas of SCOT, and some of them reflect the criticisms discussed in this chapter.

Steve Woolgar has been one of the most critical voices among the researchers of the social studies of technology. According to Woolgar, Pinch and Bijker have lacked reflexive attention and sensitivity in the development of their research programme on the social construction of facts and artefacts. One of Woolgar's critical arguments is that SSK and the social studies of technology include self-referential implications that follow from the relative nature of knowledge in general and the methodological assumptions that this relativity should be included in the programme in particular (Woolgar 1991, 23)[5]. Woolgar's insistence on re-

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[5]   See also Pinch's reply to Woolgar in his (1993)

flexivity in technology studies is related to a problem which already appeared in Mannheim's work. According to Woolgar, the denial of self-referential implications "would suggest that whereas the relativity of truth holds for all other types of knowledge enterprise, SSK is to be considered a special case" (1991, 23). Woolgar's own suggestion for rephrasing technology studies is to introduce a kind of methodological reflexivity to them. His reflexive account of *technology as text* introduces the idea that studies ought to "ask how and why technologies can be read as relatively robust pockets of interpretation in a sea of interpretively flexible texts." (1991, 39) His account is intended to "reaffirm the power of the SSK formula" (1991, 27), while still continuing along the relativistic footpaths of technology studies.

The issue of reflexivity has a long history in the sociology of knowledge, which is based on the fact that social phenomena are self-referential, including not only the social phenomena of investigation but also the social context of theory within which the investigation is conducted. Another well known issue related to reflexivity is that conventions and social institutions share a self-referential property. A similar idea was exposed in Barnes' conception of 'S'-type terms (see discussion above). This kind of circularity concerning social reality and social institutions has not been thought of as vicious circularity among theorists of social reality (See f. ex. Lagerspetz 1995 & Searle 1995). Although the self-referential nature of institutions might not create a vicious circularity, there are, however, good reasons for Barnes to introduce the 'N'-type terms to his account of reference. There are similar ontological justifications for the emphasis on observations as the point of departure in of the work of Barnes, Bloor and Henry. Treating knowledge (and ultimately also the world) as a social construction can lead to two problems from an ontological standpoint, namely self-refuting theoretical premises and the ontological problems of the exclusively self-referential nature of knowledge. Assigning too much value to methodological decisions can lead to an unreflective and uncritical view towards ontological commitments, which is also Woolgar's primary concern. The ontological problems that this strong version of constructivism as a social theory might face if one is not reflective about the presuppositions relates to the methodological decision to treat knowledge as a social construction, which results in the undermining of the phenomena of investigation.

It is not at all clear, however, whether Woolgar's own approach to technology as text is any more sophisticated than the aforementioned constructivist view, at least in respect to the ontological and epistemological background of the theory (See Pinch 1993 & Bijker 1993). Collins, Pinch and Bijker claim (i.) that relativism and constructivism are methodological decisions that do not have ontological implications and (ii.) that constructivism can be considered plausible because it cannot be proven empirically to be right or wrong. (Bijker 1993, 115) By claiming that their constructivism is not an ontological thesis and that it cannot be empirically tested, their position becomes immune to the kind of criticism that is applicable to less cautious forms of constructivism. Adopting this kind of quibbling and clever theoretical stratagem, they can exclude themselves from

time-consuming and nasty philosophical questions concerning, for example, the problem of the reference to or ontology of artificial things and just get on with the sociological investigation at hand. This can, however, be seen as one of the necessary practical conditions and stratagem for practising empirical sciences.

In order to avoid beating around the bush on the issue of reflexivity in social theory, I will begin further discussions on the ontology of artefacts here based on the initial ideas of SCOT. I prefer to use the investigation of technology included in SCOT here, although my purpose in this work is to first consider artefacts and then uncover how they become socio-technical ensembles. The purpose of the following discussions is to enhance the view of technology and technological artefacts from an ontological point of view. It has been argued recently that (at least the earlier versions of) SCOT has certain explanatory problems concerning the development process of artefacts. According to Hyysalo, recent criticism against SCOT has targeted the fact that the strong social shaping model cannot totally take into account the sophisticated nature of the technological development process involving the interaction between users and designers (Hyysalo 2004, 67-75). Hyysalo's own alternative to technological frame is *practice bound imagery*, which intends to capture continuity, change and other relevant phenomena related to an artefact in a more sophisticated manner (Hyysalo 2004, 68-75).

What Pinch and Bijker offer in their initial development of SCOT and in its later formulations is a powerful theoretical programme for investigating technology as a social phenomenon. The ideas of interpretative flexibility and the multi-directional model present an alternative to and more sophisticated conception in the analysis of technological development. Bijker's suggested conception of technological frame also enriches the initial conception of SCOT. The enhancement of their initial conception of social construction proposed here is ontological in nature, which is something which they do not address. It is argued that the background conception of the social studies of technology can be made more explicit through the ontological analysis of artefacts in general and through their analysis in the context of social ontology in particular. This theoretical explication includes the proposal that this kind of foundational analysis can benefit the development of theoretical and methodological ideas in the social studies of technology. Whereas the authors of SCOT wish to remain silent about the ontological assumptions of the social phenomena investigated, this work intends to penetrate the phenomena through ontological analysis.

One theoretical concern related to the ontological quietism of SCOT is that the background assumptions of methodological decisions are not clearly outlined. In his recent book on social epistemology, Martin Kusch argued that surprisingly few authors in the field of epistemology expose their ontological commitments (Kusch 2002, 165-169). It is evident that certain epistemological theories adopt certain kind of ontology and that this connection can also be expanded to include methodological decisions. Making a methodological decision about the phenomena under investigation is simultaneously a statement about their ontology. The construction view of technology (and science) can be seen as a

methodological decision with an epistemological view including certain implicit ontological commitments about the phenomena tai about the phenomena under investigation. If this is not the case, then the social studies of technology (and science) should be understood as a study of the partial social processes involved in knowledge construction in the context of technology (or science).

In the following chapters, an ontological account of technical artefacts is developed. The ontology developed here begins from the idea that technology is socially constructed with certain boundaries. In relation to SCOT and other social shaping models of technology, the ontology of artefacts developed here also intends to take issues from the materialistic and cognitivist models into account and to argue that these issues have an essential role in our understanding of artefacts and technological development. The idea is to argue in favour of a social construction view while simultaneously investigating the boundary conditions for social construction. It is argued throughout the work that these boundary conditions for social construction lie also in the phenomena of the materialistic and cognitivist models. As a result, this ontological investigation offers both a more sophisticated view of technological artefacts and their social construction and an account of technological development by technical design.

3.5 Conclusions

SCOT's main innovation regarding technology studies is its general idea of a 'multi-linear' model of technology. This is a major advantage over the traditional linear innovation models, which describe innovations as step-by-step procedures from their scientific foundation to their development into matured user products. This idea of multi-linear models is also something that should be extended from the description of possible (alternative) means of technology development to the normative implications of technology development. The fact that social factors affect the way technology is developed implies that these social factors, including both the users and developers of technology, should be part of the analytical enterprise of design and manufacturing of artefacts. The fact that technology is partially socially constructed does not imply that social construction is external to the practices of engineering. Technical design is also partially cultural design, and the products of design are cultural objects, as it is argued in the next chapter in more detail.

Although the social studies of technology and especially SCOT have developed progressive theoretical tools and concepts for analysing technological development, their methodological constructivism also creates certain conceptual limitations for the study of technology and technical artefacts. Some of the epistemological threats or concerns were discussed here through the discussion of meaning finitism. One of the ontological concerns that a philosopher can have in this context is the methodological decision to not consider any ontological issues that might relate to or influence their work. In fact, this decision can be seen as

a kind of ontological commitment, if one takes seriously Peirce's claim (quoted in the previous chapter) that one who wishes to go on without metaphysics is actually totally entangled with metaphysics.

The suggestions that we enhance the social construction perspective here has two inter-related aspects. One of them is methodological and extends Woolgar's appeal for a more reflexive account of technology studies. Where Woolgar's suggestion remains sympathetic to constructivism and is aimed at the acknowledgement of the epistemological presuppositions of the perspective under investigation, the suggestion here is that the theory should also explicitly outline its ontological presuppositions. For example in the case of SCOT, this would mean that the research programme ought to explicate the presuppositions underlying the methodological choice of constructivism (or epistemological relativism).

The consequences of explicating and evaluating the ontological and theoretical presuppositions of these research programmes ought to result in more sophisticated theoretical conceptualisations of the phenomena under investigation. The purpose of the following developments in the ontology of artefacts is to engage in some kind of communication about the fundamentals of technology and technological artefacts. It can be argued that the problem of why theoretical approaches to technology have remained stuck in two distinctive camps of investigation, the physical and the human-centred views, is due to the lack of common conceptualisations[6]. The target of this ontological investigation is to provide a common conceptual ground for integration and communication theoretical approaches to technology.

The main purpose of this chapter was to discuss the social construction aspect of technology, to evaluate the various aspects of the social construction view and their benefits and limits. The central claims of this chapter are:

- Social construction is a central feature of technology and implies that social factors such as interests, powers, etc. play a relevant role in the developmental phases of new technology.

- Although social construction is a relevant issue of technology development, social construction views tend to be conceptually underdeveloped due to their emphasis on mere social construction.

- A fully-fledged ontological account of technology needs to take into account both the material and social features of artefacts in general and to explain how these features as a whole constitute technical artefacts in particular.

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[6]   For similar kind of appeal to philosophical analysis of central concepts, see (Love 2000)

4   THE DUAL NATURE OF ARTEFACTS

In this chapter, the relation between the material or physical properties of an arte-
fact and its social dimension is investigated more closely. Artefacts become part
of a culture as physical objects, and regardless of what new technology is intro-
duced, its patterns of usage are always integrated into the previous practices and
technologies. As has already been noted, technology creates cultural objects, and
the blending and overlapping of new technologies does indeed have an effect on
cultural and social practices. In this chapter, the underlying nature of artefacts as
physical-social objects is described and this dual nature lays the foundations for
the further analysis of the mechanisms of how new technologies actually blend
into our culture and practices. The central issue in this chapter is the dual nature
of artefacts, and it is argued, on the basis of the idea of dual nature, that the cre-
ation of new technologies also creates new or enhanced social institutions. So the
blending of new technologies takes place through the creation of new institution-
alised structures and practices in a culture of users. After evaluating the various
aspects of the natural-institutional relationship of artefacts, the main purpose of
this chapter is to define or identify an artefact condition that outlines the relevant
conditions for the existence of artefacts.

4.1   The physical and social aspects of artefacts

For as long as humans have manipulated their surrounding environment for
their own needs, they have also searched for and developed ways of enhancing
this environmental manipulation. The history of human cultures has been a his-
tory of the creation of knowledge from the surrounding environment, which has,
at least to some extent, enabled us to change the practices involved in our so-
cial life and culture by developing new technologies. From simple artefacts like
stone axes to complex industrial facilities, all of these developments have been
the result of human creation. This cultural development of technology, clearly
advancing simultaneously with the development of human societies, involves

the development of institutional forms of environmental manipulation.

Although advances in the natural sciences have had a particularly major impact on this historical development over the past two decades, the creation and manufacturing of artefacts has traditionally been guided by the needs of humans and cultures, and this technological development has also had a major impact on the shaping of cultures. New technological innovations have had an impact on the development of cultures by creating and enabling new kinds of forms of life. For example the invention of printing technology has had a huge impact on knowledge distribution and has also enabled the birth of new kinds professions and business opportunities. Similarly, Internet technology and mobile phones have changed the way we live and shaped the societies in which we live by creating both new practices and forms of behaviour and new rules and restrictions. The emergence of novel artefacts has not only been influenced by the designers of technology but also by the actions of users and the practices and needs of various social groups. In technology studies, the interest has recently shifted form issues within technology (or engineering practice and design) to heterogeneous resources as creators of new artefacts.

The question that Pinch and Bijker asked in the beginning of their paper (discussed in the previous chapter) was how science and technology are alike. In his discussion paper on technology studies, Cristopher Hamlin also considers the same question (Hamlin 1992, 522). In order to come up with a preliminary answer to the question posed by both Pinch & Bijker and Hamlin, one should concentrate on the question of what kinds of facts these disciplines deal with. The main question should be what kinds of facts these disciplines are based on and what kinds of facts they ultimately create. It is suggested here that this question should be answered only after answering the question of what kind of entities artefacts actually are. Pinch and Bijker argued that science and technology share a certain similarity in terms of the fact that they are both similar types of bodies of knowledge in sociological studies (1984). By claiming this, they enable themselves to apply work done on the sociology of scientific knowledge to the study of technology. Following this basic idea, their research programme is based on the claim that technology is socially constructed (Pinch & Bijker 1984, 419). According to them, when an artefact is designed, the design process always involves some form of cultural construction. An artefact is created to exist and influence the life of a certain culture. (1984, 421)

There are also some similarities to Hamlin's view of artefacts, although he does not totally accept the claims made by Pinch and Bijker. Hamlin emphasises the functional properties of artefacts in formulating an understanding of what technological development actually is. In his view, failures in the creation process of an artefact are inherently tied to a functional failure. When a functional failure occurs, the artefact does not fulfil the purpose intended by its design. In the cases of a malfunction or functional failure, the technological paradigm confronts an anomaly, because the knowledge and skill used to create artefacts has caused them to fail. Hamlin also makes a remark stating that the functional properties of an artefact can be seen to include a teleological explanation of its existence. The

process of the development of artefacts can be seen as an achievement of certain ends by certain means through which certain physical structures are intended to function in certain ways in the culture for which it is produced. Technological artefacts are created to fulfil a certain purpose, and the properties of the artefact are designed and manipulated in order to achieve it.

As Bijker has remarked, the social construction view of artefacts investigates the practices of relevant social groups around an artefact and its multi-directional model exposes the influences of other social groups and possible variations in the development processes of artefacts. Hamlin's remarks on functional failures pose the same question as the one posed earlier in this work about the limits of interpretative flexibility. In functional failures, which is when an artefact fails to fulfil its intended function, the reasons extend beyond social construction. Although artefacts can only exist within a certain relevant social group and although they have cultural meaning, the limitations of the social construction of artefacts are the physical properties, which are founded on facts that extend beyond social construction.

In order to uncover the nature of artefacts and their social and material aspects, I will now consider the kinds of facts we ultimately refer to as artefacts. We are surrounded in our everyday lives by natural facts, such as the existence of mountains and trees; social facts, such as existing societies and their legislation; and artificial facts, such as mobile phones or a paper mills. The existence of natural facts seems to be independent of humans: the trees and mountains would still exist even if humans were to disappear off the face of the Earth. The existence of social facts, in contrast to natural facts, is necessarily dependent on human existence. The institutions of money or fashion, for example, exist only because people believe they exist and act in accordance with their beliefs. Artificial facts are peculiar types of facts falling between natural and social facts. Artificial facts are clearly dependent on what we know about nature (natural facts), but they are what they are simply because they are declared to be what they are and what they are used for (social facts).

This peculiarity of artificial facts provokes us to question whether the physical products of technological development have a similar kind of influence on social life and culture as typical social facts, such as facts relating to the institutions of marriage or legislation. The argument of this work is that the creation of new artefacts involves the creation of an institution which makes the artefact what it is. The fact that something is an institution, for example the state of France, is dependent on people, particularly those who constitute it (i.e. the French people), in order to recognise it as the state of France. Similarly, something is a mobile phone only if there is a culture of users who acknowledge it as a mobile phone and act in accordance with the rules of using mobile phones (its intended use, the cultural limits and habits involved in using mobile phones etc.). It is argued here that the existence of artefacts such as mobile phones has, as a necessary condition for their existence, requires the existence of institutions, such as the institution of mobile phones.

This duality of social and physical aspects is not always explicitly existent in the studies on and practices of technology. The social construction view of technology discussed in the previous chapter investigates artefacts as social constructions. Other approaches, especially in the engineering sciences, consider technical artefacts primarily as physical objects. According to some authors, this kind of dichotomy between the physical and human aspect of technological artefacts is common in the approaches towards artefacts (Love 2000; Kroes 2002). It has also been noted that this kind of one-sided approach to artefacts results in a kind of blindness towards them when they are considered as merely physical objects (Dipert 1995, 119) or social constructions. The intention in this chapter is to develop an alternative to these one-sided approaches and to argue in favour of a dual nature view of artefacts.

In his study on the sciences of the artificial, Herbert Simon introduces a description of artefacts that is quite similar to Hamlin's. Generally speaking, however, Simon's view is clearly very different from the social construction view discussed in the previous chapter. Simon also comes to emphasise the dual nature of artefacts, an idea that is proposed here in this chapter. According to Simon, artefacts have both an inner and an outer environment. He writes that artefact can be thought of as an interface "between an 'inner' environment, the substance and organization of the artefact itself, and an 'outer' environment, the surroundings in which it operates" (Simon 1981, 9). In a similar manner, John Searle discusses the intrinsic properties of an object, for example that something is a stone, and its observational relative properties, i.e. that something is a paperweight (Searle 1995, 12). In his more recent papers, Peter Kroes has attacked both Searle's and Simon's way of distinguishing between the inner and outer aspect of artefacts. In his paper, Kroes argues that Simon is reluctant to admit that they both play an essential and constitutive role for artefacts (Kroes 2002, 291-298).

The relevance of Simon's work for the theory of artefacts is that he emphasizes the interrelation between the inner and outer environment, i.e. interaction between the natural and the social world. In technical or naturalistic views, the emphasis is merely on the inner environment of the artefact, the physical properties of artefacts. In the social construction view, the emphasis is on the outer environment, the social structures and mechanisms relating to the physical object. The underdetermination thesis (UD) and its implications for the ontology of artefacts was discussed briefly in the previous chapters of this work. According to the social construction view of artefacts, the core idea of the underdetermination thesis was seen as implying that entities known as artefacts are socially constructed. Proponents of the social construction view are often reluctant to make any ontological commitments to or statements about the nature of investigated phenomena. This has similarities to Quine's ontological relativism, which is a philosophical statement drawn from the underdetermination of facts. According to Quine, empirical evidence cannot ultimately justify or determine our knowledge of the external world, nor do we have any kind of necessary true a priori knowledge about the external world.

According to Houkes and Meijers, the underdetermination of artefacts runs in two directions, from their uses and intentions to entities and vice versa. The idea of the dual nature of artefacts states that artefacts are essentially (to use this term loosely) of two natures, the physical and the intentional use. In their account of the ontology of artefacts, Houkes and Meijers provide two criteria for what they see as an adequate ontology of artefacts: Underdetermination (UD) and Realizability Constraints (RC) (Houkes & Meijers 2006). For them, UD is a two-way underdetermination that intends to take into account the cultural and intentional aspect of artefacts. Their UD criterion states that a function should be realisable in different structures and that a single structure can realise various functions. The RC criterion emphasises the interaction between the material basis and the artefact and states that the relation between the function of an artefact and its material basis is not arbitrary. An account of the ontology of artefacts "should enable us to understand the possibility of deriving conclusions about the material basis from claims about an artefact and its function, and vice versa" (Houkes & Meijers 2006, 128).

The main question as regards the view proposed by Houkes and Meijers is how the RC criterion works in artefacts, i.e. how is it possible to derive conclusions from the material basis concerning functions. The proposal that Houkes and Meijers suggest in their version of UD is that the structure - function relation of artefacts is a two way street. In this way, their idea of artefacts are opposed to the views of SCOT and the views of materially oriented accounts. Their view is more in keeping with the basic idea of dual nature in Simon's work. Following the idea proposed by Houkes and Meijers (and some other authors), the dual nature view of artefacts is developed in the following way in order to provide an initial answer to the question of how artefacts and their functions are realised and recognised.

The central question of this chapter is thus: 'How should this duality of artefacts be described and theorised?' The following discussion begins by explicating three possible answers to this question. Peter Kroes, as a representative of the research programme on the dual nature view of artefacts, suggests that artefacts are both physical and intentional objects and that the three essential features of artefacts are their physical structure, technical function and intentional actions. Randall Dipert's account emphasises social recognition as one of the central features of artefacts. Dipert suggested that one central feature of artefacts is the ability to communicate its functional properties.

The third possible answer to this question is presented by John Searle, who provides an account in which artefacts are constitutive of natural facts, institutional facts and constitutive rules. My personal preference is for Searle's view, with certain enhancements from Kroes' and Dipert's views, because it avoids the problematic discussion of intentional objects and extends the social aspect emphasised by Dipert with the notion of institutional facts. There are, however, certain problems in Searle's account, for example its capacity to handle cases of the malfunctioning of artefacts.

4.2 Kroes and Dipert on artefacts

In general, the existing work on the philosophy of technology in general and the theory of artefacts in particular has been surprisingly limited in until recent years, especially when compared to the influence and relevance of technology and artefacts on our daily life. With the exception of the dual nature research group lead by Peter Kroes and Anthonie Meijers, there are only a limited number of philosophical works on artefacts available. One reason for the lack of detailed analyses of artefacts might be that in the contemporary social studies of technology artefacts are seen as insufficient subjects of technology studies and the emphasis tends instead to be on more general social systems and structures. Bijker claims that the social studies of technology should take "sociotechnical ensembles as the unit of analysis" (Bijker 1993, 117). In the contemporary philosophy of technology, one detailed analysis of artefacts has been written by Randall Dipert. Dipert's intention is to define or characterise both artefacts themselves and some of the notions related to them.

In his recent study of technological design, Peter Kroes argues that technical artefacts have a dual nature. Kroes claims that technological artefacts have both a physical nature, which makes them the physical objects that they are, and an intentional nature. What Kroes means by claiming that technical artefacts have an intentional nature is that they possess properties which are more than the mere physical existence of the object. These properties, described as intentional by Kroes, are meaningful only in accordance with the use of the artefacts. (Kroes 2002) This idea, also present in Herbert A. Simon's book *Sciences of the Artificial*, emphasises that certain natural and physical properties are (functionally) meaningful only when they are acknowledged as something by users (Simon 1981). The authors of the dual nature of artefacts claim that the attached purpose of an artefact is the fact that makes them something more than the mere sum of their physical components tai more than their physical nature (Kroes 2002, 292; Kroes & Meijers 2006, 1-2). For example, a paper machine has certain physical structure, and this structure is actually constitutive of the fact the paper machine is used for making paper.

According to Kroes, what distinguishes artefacts from natural objects, such as mountains and trees, is the function attached to these objects, and this function is distinguishable only in the specific context of intentional human action. Drawing attention to intentional human action as the relevant feature of the existence of artefacts, Kroes comes to speak of artefacts as intentional objects (Kroes 2002, 291). Kroes is certainly correct in emphasising both the ontological significance of this duality of artefacts and the relevance of the context of human action for the existence of artefacts. The technical functions of artefacts cannot be (merely) intrinsic functions of the object. They are established in a context that is external to the object itself. This view is similar to L. R. Baker's constitution view of artefacts, in which constitution is seen as a relation between a material structure and the identity of artefacts established in certain circumstances. The manifestation

of existing artefacts is dependent on two contexts, an object's physical structure and the context of use (as context of human action). It could be said, following Vermaas and Houkes, that technical functions form a conceptual drawbridge between the structural and intentional natures of technical artefacts (Vermaas & Houkes 2006, 5).

Although Kroes is certainly correct in pointing out the dual nature of artefacts, his discussion of the intentional nature of artefacts can be misleading (see also the discussion of Baker's ontology in the second chapter). It can be misleading at least in the sense that it might fail to reveal something significant about the existence of artefacts. What Kroes refers to as intentional nature should be understood through the functionality that is embedded in or attached to the artefact. This functionality is, as will be described in greater detail below, social by nature. This is actually one of the points that Kroes makes when discussing technical artefacts, as he claims that there are three key notions of technical artefacts: physical structure, technical function and the intentional actions of humans with the technical artefact, in which intentional use creates the social group in question (Kroes 2002, 295).

In a more recent writing, Kroes emphasises the dual nature of artefacts in terms of physical structure and functions, and also by applying a structure-function conception of artefacts (Kroes & Meijers 2006; Kroes 2006, 137-143). This is also a more convenient conception, because any reference to the intentional nature of artefacts always runs the risk of misunderstanding. This risk is an issue that Kroes is evidently aware of, i.e. assigning a kind of mental capacity to physical objects. The discussion of intentional objects can only be metaphorical in the sense in which the intentionality ascribed to objects comes from the intentions related to their use and the relation of material objects to these intentions by the assignment of a specific function to them. The objects possess intentionality only in the sense that they have functions that can serve as a means for attaining a specifically defined goal, and the act of attaining a goal is thus intentional action.

In order to avoid the ontological problems that might result from the discussion of intentional objects, the existing conceptualisation can be revised by treating artefacts as having a social in addition to a physical nature. In the following sections, I will also illustrate why this is a more convenient way of analysing technical artefacts. What is argued below is that social structures play an essential role in the construction and constitution of artefacts (see especially the discussion in the next chapter). For example, when we refer to artefacts, we make references to physical facts on the one hand and to social or institutional facts on the other. Instead of explicitly attributing the concepts of the natural and the intentional to artefacts, it is more convenient and indeed more accurate to discuss artefacts as constitutive of natural and social (or institutional) facts. The ontology of artefacts developed in this work will come to suggest certain terminological refinements to Kroes' theory, although on a fundamental level I agree with Kroes' account of the dual nature of artefacts.

Another recent philosophical account which emphasises the dual nature of artefacts is that developed by Randall Dipert (1995). His intention in the work is to define or characterise artefacts and some of the notions related to them. His analysis distinguishes between three related notions of artificial things: instruments, tools and artefacts. These three categories of artificial things intend to classify artificial things into specific types, and the classification process is based on the necessary involvement of human action for the existence of these objects. One of the necessary conditions for the existence of these three types of artificial things is human intentionality, and their classification is based on the amount of involvement that is needed. For example, according to Dipert, whereas instruments are dependent solely on the mental states of an individual, artefacts require the intentionality of a larger collective.

In Dipert's classification, instruments are objects possessing at least one quality which has been thought to be means for intentional goal attaining action (Dipert 1995, 120). According to Dipert, the concept of instrument is the weakest notion in the same general ontological family of objects as artefacts. Therefore, the designation of something as an instrument does not involve any kind of mutual activity, and the instrumentality of objects can be seen as a subjective notion. The conditions required in order for something to be characterised as an instrument are stated in the IC condition:

> (IC): A certain agent A has thought of the certain property-set P of object O to be means for attaining goal G and, thus, has used the object for achieving G.

One can easily come up with various cases that would challenge this classification of instruments, at least if the conditions stated above are thought to be necessary and sufficient conditions for something to be an instrument. For example accidental instruments, for which a given property-set is invented accidentally, does not satisfy the condition that A has thought of a certain property-set as the means for achieving G. Similarly, property-set P can conceivably be seen as the means for achieving G without ever trying to achieve the actual goal. Dipert himself is aware of the problems related to these definitions and discusses both the case of contemplated instruments, in which the usefulness of certain properties is acknowledged but never used, and other cases that only partially satisfy the criteria for the given characterisation (Dipert 1995, 121). As such, IC can be thought of as characteristic of and a necessary condition for object O to be characterised as an instrument, although it alone is not sufficient.

In Dipert's analysis, tools are seen as objects that are one grade above instruments. According to him, a tool "is an object, one or more of whose properties is believed to have been intentionally in order to make it a means for a goal, or for making it a more effective means in achieving a goal than it was before." (1995, 121) The main difference between tools and instruments is that instruments are considered in terms of their usefulness and tools are seen as intentionally modified or enhanced in respect to usefulness. For example, a thick branch on a tree can be considered to be an instrument which provides a good source of shade, but

by sawing it off and tying some leafs together and using it as a fan, the branch becomes a tool for cooling oneself on a hot afternoon. The notion of a tool is different from that of an instruments in respect to the number of minds which is required for the construction of beliefs about the object and related property-set. The necessary conditions for something to be characterised as a tool are stated in the tool condition TC:

> (TC): Agent A1 uses object O with the property-set P as a means for achieving his goal G if A1 believes that another agent, A2, has intentionally modified (or deliberately left alone) the properties of O in order to enhance the achievement of G.

According to Dipert, the recognition of something as a tool involves the existence of the beliefs of some other agent in a way in which the intentions of the other agent coincide with the intentions and goal aspirations of the first agent. (Dipert 1995, 121-123) Whereas instruments are dependent solely on individual beliefs, tools are also dependent on the beliefs about beliefs, i.e. about the intentions of manipulating the activity targeted at the object.

The third category of artificial things in Dipert's paper is artefacts. In short, in his analysis, artefacts are tools which possess self-communicating properties. According to him, the "artifactual property is an intentionally-added property that is intended to get us to believe [...] that the object possesses creating tool properties" (1995, 126). Dipert provides three characterising conditions of artefacts, the tool condition (TC) described above and two additional conditions: the tool-communicating condition (Tcc) and the communicative success condition (Csc). The tool-communicating condition and the communicative success condition state that there are certain tool properties communicated by the object through certain other properties.

> (AC): (TC) + (tcc) + (csc)

According to Dipert, the difference between a tool and an artefact is that an artefact is capable of self-marketing its tool properties with some additional properties (1995, 126). An artefact is "a mixed communicative-tool object" (*ibid.*), equipped with tool properties and an overlapping set of properties that communicate that the object in question possesses certain tool properties. This ability to communicate properties is quite similar to the RC condition proposed by Houkes and Meijers, in which artefact functions are derivable from the material existence of objects. Although Dipert claims that these two sets of properties of artefacts "might perfectly overlap [t]hese are nevertheless different functions of the same perceived or conceived "property" of the object" (1995,126). Dipert and Kroes come to share the same kind of intuition about the duality or dual nature of artefacts that is intensively connected to the intentionality of human action.

The relevant issues in these two ontological accounts of artefacts are the dual nature of artefacts and the (partially implicit) reference to social collectives. Intentional use, the (collective) recognition of functions and communicative properties all point towards the existence of a social aspect of human involvement

that is relevant to the existence of artefacts. Kroes also makes explicit reference in his dual nature of artefacts to the physical nature of artefacts, which extends the scope of investigation from socio-technical ensembles to artefacts and physical-social objects. The most relevant aspect of Dipert's conception is the classification of different kinds of artificial objects, particularly in terms of its requirement of the involvement of other agents, including collective involvement. By taking this idea of the dual nature of artefacts as his point of departure, Dipert's notion of the necessity of human involvement for artefacts is extended into the claim that the dual nature of artefacts consists of both natural and institutional facts.

4.3 Searle's constitutive rule

Based on the idea of the dual nature of artefacts and following some of the prominent ideas of Searle's work, the central feature of the ontology of artefacts developed here, which distinguishes it, for example, from Baker's view, is that it takes facts as the point of departure in the development of artefacts. Thus, the fundamental idea in any *fact based ontology* s the importance of concentrating on facts as the source of investigation. This is quite similar to Baker's perspective in her own ontology. She states that "[u]sing [...] down-home observations as a starting point, I want to sketch a philosophical picture of the world that we all encounter" (Baker 2002, 31). The difference between Baker's view and the view taken here is that the ontology examined here attempts to avoid the kind of essentialism to which Baker is explicitly committed. The ontology outlined here does not propose the use of conceptualisations such as primary kinds and proper functions. The ontology outlined here takes the building blocks of social reality as its foundation, including the assumption that natural and institutional views do exist. There are also constitutive rules and assigned functions that can mediate between the distinction of natural and institutional facts.

Once central issue in Marx's ontology of technological production, discussed briefly in the previous chapters of this work, is the distinction between three categories: nature, man and mediating productive activity. As was stated in the discussion on Marx's ontology, tai in his view, the concept of man is not that of a pre-historic or natural man, but, rather, a man who is engaged in a social life. The concept of man in his material ontology refers to a man who exists in a social world. It can be said that Marx's material ontology distinguishes between three essential features of technological production: (i.) a man in a social world, (ii.) nature, and (iii.) mediating productive activity.

A similar or analogous distinction to Marx's ontology can be found in John Searle's notion of constitutive rule when applied to technical artefacts. The idea of constitutive rule is based on the distinction made by G.E.M. Anscombe between brute and social (or institutional) facts (Searle 1969, 50-53). In Searle's work, and also in this work, the distinction between these two kinds of facts is discussed in terms of natural facts and institutional facts. The reason for using Searle's

work to describe the social constituent of artefacts is its explanatory power, particularly when his initial ideas are moulded into a more suitable form. Searle's writings also have include other interesting aspects which can be helpful in attempting to explain technology, especially those found in his latter writings on social ontology, although, for example, Kroes has been quite critical of Searle's work, particularly in the context of technical artefacts (see below).

In his social ontology John Searle has explained the creation and maintenance of institutions by his constitutive rule *X counts as Y (in context C)*. (Searle 1995, 31-57) This rule regarding the declarative act of defining something as an institution (i.e. stating a certain kind of social fact) is used for assigning a status function to something X in order to get it to function as Y. To a certain extent, this constitutive rule can be applied in the explanation of the institutional mechanisms involved in the creation of artefacts. For example, the process of creating a novel artefact can be described as the assignment of a status function (making it an institutional fact) using this constitutive rule that X counts as Y (in context C). Certain physical and functional features constitute the artefact in the context of actual and potential users. The idea John Searle wants to emphasise with his constitutive rule is that the creation of an institution necessarily involves a performative act which makes it accessible and acceptable to others. The performative act is needed, as private institutions cannot exist. The creation of an artefact involves the performative act of declaration, which is the act of stating that a physical object possessing its own specific physical properties function as the intended artefact. At the same time this performative act is also the creation of an initial institution.

For example, the intentional use of heart beat measurement and pulse meters to analyse training effects in sports can be described by the assignment of a status function: *heart rate counts as the training effect measurement in the context of endurance sports*. It should be noted that when using heart rate measurement, a natural property is used as an artefact, albeit in a simple form and as a very primitive artefact. Although heart rate is a very simple and straightforward natural property, its use in exercise is dependent on social facts. For example, the conceptions used in training and coaching, such as the appropriate heart rate zones for effective aerobic capacity training, are socially constructed facts which are not directly measurable data. This relation between social institutions and the use of heart rate measurement in exercise is even more evident in the context of contemporary pulse meters (sometimes also referred to as wrist computers because of their complex functionalities). Pulse meters can suggest the best exercises and the best level of exercise for achieving the goal of fat burning etc. based on your own personal data.

One possible means of explaining the conventions or institutions belonging to an artefact is to examine the linguistic acts of referring to it. These linguistic acts can be seen as representations of the knowledge that exists and is maintained in a social collective. By examining a classification of different types of linguistic acts of reference, the difference between the various linguistic references to artefacts and natural facts can be better understood (see also the discussion of

meaning finitism in the previous chapter). Where the reference to natural facts is targeted directly at certain properties with a specific physical existence, the reference to artefacts must also refer to social conventions and practices as important components of artefacts (for statuses and uses, see the more detailed discussion in Chapter 6). When we take a closer look at the various forms of reference, the property of the self-reference of artificial facts becomes more evident. Whereas a statement of natural facts is a speech act about external things (existing independently of humans), statements of artificial facts are more speech acts about speech or statements referring to the expression of natural facts. For example, when we refer to someone's heart rate, we are referring to tai making reference to a natural entity. But speaking about heart rate as a means of controlling and evaluating training is actually a reference to the institutionalised use of this natural entity (involving the rules and conventions that influence its uses).

Following Searle's example, linguistic acts about natural facts are statements about facts that exist without human constitution. Mountains and trees would still exist even if the entire human culture was to cease to exist. This is not the case when we refer to institutional facts. The fact that some entity is a pulse meter and is used to fulfil a certain purposes is dependent on the existence of human culture. As such, linguistic acts related to the heart rate as a means of measuring the rate of exercise necessarily also refer to the institutional facts about a level and type of training. In addition to the fact that any reference to artefacts is dependent on institutions, the creation of artefacts is also the creation of an institutional fact. In a sense, declaring that something is an artefact based on a performative act such as manufacturing, manipulation or design can be seen as an initial classification of certain natural properties (in a certain context) as something. Innovations in the mobile phone industry, such as mobile phones with digital cameras and the possibility to send MMS's [1], have extended our understanding of what a mobile phone is and how we apply the concept of the mobile phone. This kind of a classification process is also a process of definition by declaring something to be an artefact, and it has influence on the meaning of the terms we use to refer to the artefact.[2]

The application of this constitutive rule to the explanation of the performative acts involved in the technological developments which produce new artefacts can function in two different ways:

- If we are dealing with a new innovation, the performative act is used in the creation of a new institution relative to the physical object(s) and constitutive rule can explain the birth of an initial institution. In the context of new innovations, the performative act is a declaration that turns physical things and properties into a specific artefact (such as a pulse meter) by a assigning certain status function to the physical objects and its properties.

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[1]   Multimedia messaging service

[2]   On reference and on how referring terms have meanings in social context, see (Barnes 1983) and (Barnes, Bloor & Henry 1996, 46-80)

- If we are dealing with the enhancement of an artefact (a new version, update etc.), the performative act is used to describe the changes to and reconstructions of the existing institutions. Introducing a means of measuring stress based on heart rate monitoring is an example how the institution of pulse meters is enhanced by the assignment of a new property to it[3]. This of course has also influence how these artefacts are used.

It can be said that innovation processes, such as those relating to mobile phones and pulse meters, are not just enterprises for combining certain existing theoretical and technical ideas and technical devices together (inventions), but are also performative acts declaring that certain types of properties combined together in a certain way are artefacts, such as mobile phones. Artefacts have a certain kind of physical structure which makes them recognisable as artefacts and distinguishes them from other artefacts (for those who have gone through the socialisation process of a culture familiar with the artefacts in question), as well as other physical and functional properties. These properties and functions also create certain kinds of rules, habits and practices in the communities of users. We can ultimately claim that the technological development of creating artefacts changes our forms of life to the extent that the reconstruction of the way of life of an era prior to the introduction of a certain new artefact into the community becomes virtually impossible.

It is suggested here that the dual nature of artefacts is an argument claiming that artefacts are constitutive of two kinds of facts which are necessary for the existence of artefacts: brute or natural facts and institutional facts. In Dipert's analysis of artefacts, he argued that (technological) artefacts are dependent on more than mere individual constitution. Following Dipert's classification, it is suggested here that certain social (or human) processes are necessary in order for something to be an artefact (distinguished from Dipert's other artificial things, i.e. instruments and tools). Dipert's solution to the problem of the requirement of a distinguishable property of artefacts was to argue that artefacts have communicational properties. These communicational properties cannot, however, be the intrinsic properties of artefacts and therefore it is claimed here that they are dependent on existing social structures, i.e. institutions.

4.4 The fundamentality of the dual nature

When considering the benefits of the conceptions of artefacts developed by Kroes and Dipert, it can be said that their conceptions challenge the one-sided aspects of technology and suggest a more developed view of technical artefacts. Their approaches challenge one-sided views of technological artefacts, such as social construction or technology-centred views. In contrast to these one-sided

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[3] The conceptual change from pulse meter to wrist computers is, of course, an attempt to create a new kind of status for these new artefacts in order to distinguish them from traditional pulse meters.

views of technology, the ontology of technological artefacts developed here makes a distinction between socially constructed facts, such as conventions and institutions, and brute facts, which are not conventional in nature. By following the initial ideas developed by Kroes and Dipert, and by promoting refinements and terminological changes to their views, it is suggested that the dual nature of artefacts should be enhanced with two descriptive conceptions, natural and institutional facts, which are constitutive of artefacts. In addition to distinguishing between these two features of artefacts, the intention here is to argue that together these two features are constitutive of artefacts. Following the previous discussions, an ontological point of view sees the inclusion of both nature and institutions into the theory of artefacts as essential.

Both Kroes and Dipert emphasise the dual nature of artefacts. A similar kind of emphasis on the dual nature of artefacts is shared here, although certain critical reminders of the conceptions of Kroes and Dipert have to be made. As was stated above, Kroes' distinction, also made by L. R. Baker, between the physical and the intentional as two aspects of artefacts can be misleading. Kroes rightly admits that the intentionality of an artefact cannot be an intrinsic feature of physical objects. It is something that is externally attached to the object as a result of human action. Therefore it would be misleading to discuss the intentionality in Kroes' account as a property of the artefact as an object (i.e. by stating that artefacts are intentional objects). As Kroes correctly reminds us, intentionality is surely a feature of human action and not an intrinsic property of artefacts. In a somewhat similar yet more problematic manner, Dipert attributes communicative capacity to artefacts, although the communicative property of functions cannot be an intrinsic property of artefacts, but must be dependent on human institutions and intentions. It is therefore suggested that the intentionality related to artefacts should be seen from the perspective of institutions, particularly from the perspective of the collective action that creates and maintains these social institutions.

As was stated previously, L. R. Baker's approach has certain similarities to the approach applied here, especially in that it begins from everyday experiences and moves on to reveal certain essences. A similar line of thinking is present in Searle's distinction between natural and institutional facts[4]. For Searle, the existence of the world (as we know it) is dependent on the facts that we have about the world. The ontological classification of entities into categories, such as natural and artificial entities, is dependent on the facts that are constitutive of them. This line of thought can also be found in Dipert's classification of instruments, tools and artefacts, although it is somehow ambiguous. In Dipert's theory of artefacts, the use of some (natural) thing with suitable properties for attaining a certain goal is dependent on the beliefs that represent certain facts about these entities.

In Marx's materialist ontology, the three elements of nature, man and productive activity were woven together as the constitutive features of (the production of) technology. Searle also reminds us that although natural facts are in-

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[4]   Although Searle's realistic project comes to contradict certain aspects of his higher level conception of the social reality of institutions. See, for example, Chapter 6 in his (1995).

dependent of human constitution, social facts, such as institutional facts, cannot exist without (shared) beliefs about them. In the case of artefacts, entities are constituted by both institutional and natural facts, and it would be awkward to argue that artefacts could exist without human involvement. In contrast to other artificial things - such as instruments and tools in Dipert's classification - an essential element of artefacts is that they are constitutive of certain physical and institutional facts. There exists a certain fundamental physical property that is acknowledged as a natural fact or as based on a natural fact. There are also certain institutional facts, i.e. shared beliefs and collective actions, related to the functions and uses of the object. In minimal terms, an object is an artefact and distinguishable from a natural object if (and only if) there are some institutional facts concerning its use or existence.

Following Searle's work and his distinction between natural and institutional facts, a refinement to Dipert's artefact condition can be made. The two central issues in Dipert's classification that distinguish artefacts from tools were the tool-communicating condition and the communicative success condition. According to the tool condition, the criteria for something to be a tool is that a certain entity has manipulated properties that are believed to been manipulated for a specific purpose. This condition can be refined here as a function condition (fc) stating that a certain object O has intentionally modified (or deliberately left alone) properties for the enhanced achievement of a goal G. The tool communicating condition can be replaced with a constitution condition (cc) stating that there exists a constitution relation between the natural facts of the properties of O and some institutional facts that is describable with Searle's constitutive rule that satisfies the function condition (fc). The communicative success condition can be modified as a reference condition (rc) stating that there is a linguistic act expressing the properties stated in (fc) by referring to a relation stated in (cc) as the means for intentionally achieving G.

The aforementioned modifications to the conditions above are more conceptual than substantial, for reasons that will become evident in the following passages. Following the idea of the dual nature of artefacts, Dipert's artefact condition (AC) can be refined and modified here as follows:

(AC*): (fc) + (cc) + (rc)

And by translating it into the terminology adopted from Searle's work and which is used here throughout this work, the dual nature of artefacts can be characterised as follows:

An object O is an artefact if:
(i.) There are natural facts X that state the intentionally modified (or deliberately left alone) properties of O for the enhanced achievement of a goal G.
(ii.) There are institutional facts Y that state the means for achieving a goal G.

(iii.) There is a constitutive rule that states that such natural facts X count as Y in certain context C.

The above characterisation, which can be labelled as the ontological artefact criterion (OAC), does not extend Searle's constitutive rule dictum to any great extent. The reason for spelling out Dipert's AC in a refined manner and the OAC is to demonstrate how Dipert's communicating conditions become embedded in institutional facts. There are practical reasons for this in terms of the developments of this work. The intention in the following chapters is to further analyse both the content of the institutional facts of artefacts and the criteria according to which such institutional facts exist. These discussions in the two following chapters should show how the communicative properties of artefacts, i.e. the manipulated (or deliberately left alone) properties, communicate themselves only in the specific social or cultural context of institutions. This is also why the fundamentality of the dual nature is promoted here.

According to the OAC criterion outlined above, artefacts are entities which possess some features that can be described or theorised in terms of natural facts. In addition, artefacts are entities to which some institutional facts apply (the nature of institutional facts is discussed in more detail in the following chapters). This is, however, an incomplete characterisation of artefacts, at least when it comes to the description of the necessary and sufficient conditions for the existence of institutional facts or constitutive rules and action. Similarly to Marx, Dipert draws attention to the manipulation function that is essential in the process of producing or inventing artefacts. According to Dipert, natural facts and institutional facts relating to an artefact are interrelated in the process of the creation of an artefact. As Searle states in his work, a certain status function is attached to the object through a performative act in the creation of institutional facts. This was described in his constitutive rule stating that certain natural (and physical) properties X count as a certain artefact Y.

According to dual nature of artefacts, along with the modified artefact condition (OAC) given above, there are certain central elements that need to be discussed in greater detail in order to provide a thorough account of the ontology of artefacts. One major subject is the intentionality and action related to the design, modification and manipulation of properties. Another major topic is how intentionality is related both to the use of artefacts and the acknowledgement of the manipulated properties of an artefact. The third issue is how this Searlean constitution relation and functions of artefacts are related to actions and what kind of role institutions have in this context. In Marx's material ontology, nature and man were integrated through productive activity. This basic idea of technology has been developed here by applying some of the initial ideas adopted from the works of Simon, Kroes and Dipert, in which intrinsic properties are distinguished from external or observer relative properties. However, the approach suggested here differs from Marx's material ontology and in some aspects also from the ontological accounts of Kroes, Dipert and Simon. It was suggested previously in this work that the ontology of artefacts should be approached from a point of view that considers the world as a fact. The classification between natural objects and

artefacts ought to be made on the basis of the kinds of facts that are connected (essentially) to the entity when it is referred to or considered in terms of its role in performative acts of creation.

The offered criterion (OAC) states that the classification of something as an artefact presupposes the existence or a creation of an institution, which classifies certain natural properties and physical properties under certain functions and rules of use. The advantage of this theoretical choice is to avoid problems that tend to occur especially when simple natural entities are discussed as artefacts. The following chapters further develop the idea of the institutional statuses of technological artefacts. The aspects which are further discussed here are the constitution of artefacts and the attainment of functions and institutions as conditions for artefacts and as determinants of the collective features of artefacts. The last part of this work is devoted to the discussion of the creation of artefacts and manipulation of the properties of artefacts.

4.5 Conclusions

This chapter has been devoted to explicating and developing the dual nature view of artefacts and to the argument that it is institutional statuses that differentiate artefacts from other artificial things. Although it is argued that artefacts do have a dual nature, it does not mean that there is some kind of dualism of substances in the case of artefacts. Rather, it is argued that what is central to artefacts is that they are members of 'both worlds' and that this membership is based on the facts that we impose on these objects. In addition, it is argued here that artefacts are dependent on both natural and institutional facts.

This notion of dual nature and the appeal to institutional statuses as the defining case for artefacts has certain important practical implications for the designing and manufacturing of technology. Institutional facts are a special kind of of social facts. In principle, a social fact can be developed by only two people, but institutional facts require a certain level of stability and broader collective involvement. If we think of technological innovations as enterprises producing novel artefacts, the social aspect of these innovations ought to produce institutional facts which require both a certain level of stability and the collective involvement required for an institution to exist. This can be also used as a criterion for distinguishing between proper artefacts and other artificial things such as tools and instruments.

As a fundamental conceptual distinction of artefacts, this dual nature can thus be used as a basis for understanding the reasons why some innovations fail and other become successful. Although every innovative process is a complex process with many variables that can affect its outcome, this dual nature view can be used as a characterisation of the fundamental requirements that an innovation must fulfil. First of all, it has to have material and physical properties that

can produce or be used to produce a certain (intended) functionality. Secondly, these properties which propose a certain functionality must be used in such a way that the artefact has a relative institutional status. Having an institutional status means that the artefact's functionality and uses are the common property of the people belonging to the community of users.

This requirement of institutional facts also implies that in order for novel artefacts to be successful innovations, they must exist within a culture of users. When a new innovation is produced the existing culture is already a repository for other institutions, conventions practices and uses, which thus creates certain limits regarding the restrictions and possibilities for the introduction tai creation of new innovations. When a new innovation is produced, it has to be embedded into the existing culture. This way of looking at novel innovations makes traditional accounts of innovations problematic and poses a threat to technological determinism (See Bijker 1995b, 6-7). The creation of new technology cannot be seen as a linear process moving from research to production. Nor can the scope of relevant knowledge be limited to the knowledge of the physical phenomena of artefact production. Innovation processes must take into account the existing cultural context of the potential users, which promotes interaction between the designers/manufacturers and the users.

What has been argued in this chapter can thus be summarised as follows:

- The dual nature of artefacts, when thought of as constitutive of natural and institutional facts, is a fundamental feature of technical artefacts.

- Institutional status is a feature of artefacts that distinguishes them from other artificial entities such as tools and instruments (to use Dipert's terminology).

- Constitution relation is the glue between natural and institutional facts, and this relation was originally presented in Searle's constitutive rule.

- Intentionality and intentional action play a central role in the way these constitutive relations are constructed or created.

5 CONSTITUTIVE RULES AND RELATIONS

The general idea of constitution in the ontology of artefacts has already been outlined and briefly discussed in the previous chapters. The task of this chapter is to state what the constitution relation in artefacts is and how this relation is explicated by the notion of constitutive rules. Constitutive rule, initially introduced by John Searle, is applied to the ontology of artefacts and some of the problems related to it are discussed. The latter parts of this chapter first discuss how artefact functions relate to this constitutive rule and then how the idea of constitutive rule can be enhanced. After these discussions, the Ontological Artefact Condition (OAC) outlined in the previous chapter is refined in accordance with ideas developed in this chapter.

5.1 A different approach to constitution

As has been stated previously in this book, Lynne Rudder Baker is an author who has been developing the idea of constitution in the context of artefacts. According to her view, constitution is a very general relation that explains how certain physical entities are what they are (Baker 2000, 29). In the context of artefacts, the constitution relation describes the relation between an artefact and its material origins (Baker 2004). What should be understood as a constitution of artefacts is any relation which actually makes an artefact something more then the mere sum of its physical properties (for example, the collection of its parts as a whole). In earlier chapters, some of the differences between the approach taken here and Baker's idea of constitution were pointed out. In this chapter, a different kind of idea of constitution relation in the context of artefacts is developed in more detail.

An alternative approach to the ontology of artefacts presented here builds on the developments carried out by, for example, P. Kroes and John Searle. I have already discussed the aspects of their work covering topics such as dual nature in terms of natural and institutional facts and the constitution of artefacts in terms of constitutive rules. The subject of this chapter is to further develop the

idea of constitution by developing Searle's conception of constitutive rules. The main difference between this account of constitution and Baker's perspective is the ontological framework. She describes her ontology as a kind of essentialism, which is also the general ontological framework explaining her idea of constitution. The alternative ontological approach suggested here is based on the conception of facts and distinction between different kinds of facts, and it intends to explain constitution in terms of the institutional statuses connected to physical properties and structures.

In the previous chapter, the idea of the dual nature of artefacts was discussed. The dual nature of artefacts was founded on the two kinds of facts that are constitutive of artefacts, i.e. natural facts and institutional facts. These developments were influenced by ideas initially presented by Peter Kroes about the dual nature of artefacts. According to Kroes, artefacts are physical entities which possess certain physical properties and objects with functions that relate to the intentional use and manipulation of objects (Kroes 2002 & 2006). He also places a certain emphasis on the interrelation of these two natures by arguing that both of these types of facts are relevant to the existence of artefacts. To further demonstrate this interrelation, Searle's idea of constitutive rules was applied to the explanation of the constitution relation in the creation of novel artefacts. Searle's constitutive rule combines natural facts and institutional facts as the basic components of artefacts. Following Searle, it was argued that these two kinds of facts are essential features of technological artefacts.

In this chapter, the idea of constitutive rules is developed even further. As some authors have noted, there are some general problems concerning Searle's idea of constitutive rule in particular and his social ontology in general. The intention here is to refine some of Searle's ideas about constitutive rules in a way in which the idea of constitutive rule becomes more applicable to the ontology of artefacts. The enhancements in this chapter begin by discussing Searle's conception of constitutive rules and some of the central problems related to it. Some authors, including Kroes, have criticised Searle's account as containing a number of problems. One central problem of constitutive rules, especially when connected to artefacts, is Searle's notion of the existence of different kinds of functions and their statuses, or so it has been argued at least. Kroes' main criticism is targeted at Searle's notions of intrinsic and observer related functions. The refinement of constitutive rule in this chapter intends to avoid this problem. After discussing the problems in Searle's conception and their possible solutions, an alternative formulation of constitutive rules is proposed. In another context, Frank Hindriks has developed a XYZ-conception of constitutive rules which intends to overcome some of the central problems of, for example, Searle's conception (Hindriks 2005, 117-140). It is suggested here that some refinements, such as the ones in the XYZ-conception, help to create a more convenient description of constitution, also in the context of artefacts.

Yet another aspect of constitutive rules that has has yet to be properly discussed is the question of context and its relevance to and influence on the consti-

tution relation. One of the central issues in Baker's constitution view of artefacts was *circumstances*, a context in which the existing constitution relations are manifested. In both the social construction of artefacts and other social studies of technology, the context of artefacts has been described as a social context of power relations and other social structures. Here, the context of the constitution relation is also treated as a social context, but without undermining the physical reality existing in the (manipulated) structure and the properties of artefacts. Here, the idea of context shares at least some similarity to Baker's circumstances by serving as the framework in which a certain kind of constitution relation exists. The difference or alternative to Baker's circumstances is that the concept of context is explicitly referred to here as a social context of institutions, practices etc. As such, the relevant features of this context can be described with the vocabulary of social ontology, which includes concepts such as institutions, collective acceptance and cooperation.

One major benefit of the ideas presented in the conceptions of constitutive rules is their ability to include functions of artefacts in the description of constitutive relation. According to Vermaas and Houkes, functions are a conceptual drawbridge between the two natures of artefacts (Vermaas & Houkes 2006). In their account, Vermaas and Houkes describe the two natures of artefacts as structural and intentional. The reference to these two natures of artefacts is made here in terms of natural facts and institutional facts, which is more compatible with the idea of constitutive rules, as was argued in the previous chapter. The idea in here is also to show that by enhancing Searle's initial idea of constitutive rules, it can be applied in order to make sense of the technical functions of artefacts and how functions relate to the use and statuses of artefacts. By applying a refined version of constitutive rule, the connection between the two natures of artefacts can be made more explicit in the broader context of the ontology of artefacts.

The main argument in this chapter is that the constitution relation between the two natures of artefacts manifests itself only in the context of (purposeful) use. An artefact's institutional status is relative to its use, which is why some authors are tempted to speak of intentional objects. Searle's initial ontology of institutions has certain limitations in both this and other respects, and this chapter intends to offer an enhanced account of constitutive rules that has the potential to avoid the problems Searle's account is claimed to have. The proposed alternative to constitutive rules makes explicit reference to the use, goals and functions of an artefact, and this alternative conception is also a preliminary development of the discussions in the next chapter on artefact use as a social practice.

5.2 Searle and artefacts

According to the dual nature of artefacts thesis extended in this work, objects recognised and designated as artefacts are constitutive of both natural and institutional facts. Natural facts are something that exist, according to Searle, without

human involvement, and they are the facts upon which the physical properties and structure of an artefact are founded. Institutional facts, as opposed to the more simple social facts, are essential feature of artefacts which distinguishes them from other sorts of artificial things, such as tools and instruments, and from natural entities (as they are described in Dipert's classification). According to Dipert, artefacts are distinguished from tools and instruments in terms of the social recognition of the communicating properties of an artefact. In addition, the existence of an institutional status is also dependent on acceptance and collective involvement. According to Dipert's analysis of artificial things, tools require only minimal social status and instruments require no more than individual conceptualisation and beliefs (Dipert (1995). Whether one accepts Dipert's classification or not, it is important for the ontology developed here to distinguish the institutional nature of artefacts, which distinguishes artefacts from other kinds of artificial things and their uses. As was argued in the previous chapter, things that are distinguished and recognised as artefacts have an institutional status.

In addition to the initial idea of the dual nature of artefacts, Searle's constitutive rule that *X counts as Y in context C* was initially introduced in the previous chapter in order to explain the constitutive role of natural and the institutional facts of an artefact. This chapter is devoted to the investigation of this constitutive rule and some of the related conceptions in the context of technological artefacts. Through a critical examination of Searle's ideas, a further developed ontological account of performative constitution is developed. In their analysis of artefacts, Dipert and Kroes both emphasised the relevance of events such as use, manipulation and design for the existence and recognition of artefacts. For Dipert, relevant action was aimed at the communicative property of artefacts, while Kroes emphasised intentional nature of artefacts, which is dependent on the context of human action. The events in the ontology of artefacts are discussed here in connection to the idea of constitutive rule, following Searle, in terms of performative constitution. Performative constitution is realised in the creation of artefacts as an assignment of a status function to objects.

The idea of the dual nature of artefacts outlines the essential features of artefacts, although it is still only an initial and incomplete ontological description of them. While the dual nature of artefacts was about the classification of things (or kinds of facts imposed on things), the two other essential parts of the ontology of artefacts deal with the events which are prerequisites of the existence and classification of artefacts. The first, discussed in this chapter, is the performative constitution involved in the creation of artefacts (which is also related to the manipulation of artefacts discussed in following chapters). The other class of events in this ontology is related to the collective acceptance of institutions, which in itself is a necessary condition for the existence of institutions. The latter issue is discussed in the next chapter. In the creation of novel artefacts, constitution can be seen as a process that gives an artefact institutional status. This is comparable, although not necessarily identical, to the productive activity in Marx's ontology, and here the Marxian material ontology is replaced with an ontology based on facts and in which artefacts are comprised of two types of facts.

The idea of constitutive rules was initially introduced by Searle in his early work on speech acts, in which he begins the characterisation of the kinds of rules by distinguishing constitutive rules from regulative rules. According to Searle,

> [r]egulative rules regulate a pre-existing activity, an activity whose existence is logically independent of the rules. Constitutive rules constitute (and also regulate) an activity the existence of which is logically dependent on the rules. (Searle 1969, 34)

For Searle, constitutive rules create or define new forms of behaviour and constitute behaviour. Behaviour which is in accordance to constitutive rules are describable only if a certain rule exists. On the contrary, regulative rules do not share this kind of constitutive role. As an example of regulative rules, Searle discusses the rules of etiquette. According to him, people can perform an action whether certain rules of etiquette exist or not. For example, a person can behave politely at a cocktail party even without the existence of any regulative rule of etiquette.

Searle's notion of constitutive rules is closely connected to the distinction between natural and institutional facts, as was stated in the previous chapter. In his book on speech acts, Searle describes natural facts as something that constitute our knowledge of the world, at least in the sense that the concepts which make up the knowledge are references to the physical (1969, 50). In his work on social ontology, he remarks that natural facts exist independently of human institutions (1995, 27). The existence of mountains and trees exist independently of the human institution of language and acknowledgement. Institutional facts, on the other hand, are essentially dependent on the existence of human institutions and human conduct. According to Searle,

> [t]hese "institutions" are systems of constitutive rules. Every institutional fact is underlain by a (system of) rule(s) of the form "X counts as Y in context C". (1969, 51-52)

In his work on social ontology, constitutive rule has a relevant role in his view of how institutions are created. Searle states, that:

> the form of the constitutive rule was "X counts as Y in context C"; but as I am using this locution, that only determines a set of institutional facts and institutional objects where the Y term names something more then the sheer physical features of the object named by the X term. (1995, 44-44)

This quotation from Searle illustrates his idea of the relationship between natural facts and institutional facts as the essential elements of his constitutive rule. And these two elements become particularly clear when this constitutive rule is applied in the description of the creation of artefacts. X refers to certain natural facts about the physical properties of a given object. For example, certain physical properties of an artefact that is founded on nature and the knowledge of it

are dependent of the existence of these natural facts. The set of institutional facts, determined by the constitutive rule, are described with the term Y, and the rule itself states the inter-relation between certain natural and institutional facts. The performative act of imposing some status function Y to some object X integrates natural and institutional facts as the constitutive elements of artefacts.

What is clear in Searle's theory of the construction of social reality is that he explicitly emphasises the logical priority of natural facts over institutional facts. According to Searle, the "hierarchy has to bottom out in phenomena whose existence is not a matter of human agreement" (1995, 55). This statement also outlines Searle's realism, which is opposed to the social constructivist line of thought founded on relativistic thinking. Searle claims that the assumption that all facts are institutional or socially constructed would result in a kind of infinite regression or vicious circularity of the account (1995, 56). He presents a similar argument in his brief remarks on technology. According to Searle, the history of technology is the history of the influences of existing knowledge and what he calls "organised desires" on the processes of making artefacts. According to Searle, artefacts are utilised as technical possibilities. His work includes the more or less implicit argument of the institutional nature of artefacts, although he reminds us that "when it comes to institutional facts, improvements in technology do not change the possibilities. We cannot impose electrical charge just by deciding to count something as an electrical charge." (1995, 94)

Another central issue related to the application of constitutive rules to the explanation of the creation of institutional facts is the use of performative utterances. Constitutive rule is the rule of assigning a certain status function, such as a certain X counts as Y. According to Searle, in many, although not all, cases, the creation of institutional facts involves certain declarative acts, i.e. performative utterances, declaring that a certain X counts as Y (Searle 1995, 54-55). In these declarative acts, a particular status function is assigned to some X to count as Y. In this assignment by a declarative act, the X that is founded on natural facts is given the certain institutional status Y. One example Searle provides of this declarative act is the act of pronouncing a couple husband and wife. This is not, however, a declarative act of the creation of an institution, but, rather, a declarative act of the expression of the existing constitution of the institution of marriage.

In the context of technology, performative acts are multiple and not restricted solely to utterances. A number of performative acts play at least a partially constitutive role in the process of the construction of artefacts. In addition to speech acts, these performative acts can also include certain uses and other actions. Where language use (speech acts) is more or less connected to the repetition of the speech act in acceptable contexts, the use of technical artefacts is more loosely connected to the declarative speech act (such as 'this is a mobile phone'). Therefore, it is more convenient to discuss performatives or performative constitution in the context of artefacts and not just in the restricted context of performative utterances. When Searle's constitutive rule is applied in the context of technology, the performative acts are multiple as opposed to limited solely to

performative utterances.

By applying Searle's idea of constitutive rules to the development of the ontology of artefacts, the ontology of artefacts can be extended to include three central elements: natural facts, institutional facts and performative constitution, which assigns a certain status function to the artefact by inter-relating certain natural facts with certain institutional facts. The constitutive rule is used to describe the performative sub-processes involved in the process of creating artefacts. This performative process, which is essential to the existence of artefacts, combines the natural and institutional facts that are constitutive of the artefact, giving the object in question a certain acknowledgeable status and making it both recognisable as an artefact of a certain kind and distinguishable from other artefacts. Artefacts are constitutive of two kinds of facts, natural and institutional facts. The institutional nature of artefacts is dependent on performative constitution, in which a specific institutional status in terms of institutional facts is attached to certain physical facts.

5.3 Some problems in Searle's ontology

One critically discussed aspect of Searle's social ontology is his notion of Background. According to Searle, "[i]ntentional states function only given a set of Background capacities that do not themselves consist in intentional phenomena" (1995, 129). His notion of background and background causation as the foundation of 'higher-order' phenomena such as intentionality and institutions is part of his external realism. Searle wants to avoid any kind of idealism, especially the kind that constructivist social philosophers have been accused of fostering. Searle lays the foundations of social reality in physical reality, which he refers to as Background. The causal properties of Background construct the capacities upon which social reality is founded.

David Bloor has compared his work to Searle's social ontology, and he argues that Searle's introduction of the Background renders his position on social reality inherently individualistic (Bloor 1996). Although Searle argues strongly that there do exist collective intentions that cannot be reduced to (a collection of) individual beliefs, Bloor insists that there is still room for a certain kind of individualism in his social ontology. Bloor's own intentions are to turn the picture around, for example when it comes to the origin of meaning. Bloor claims that Searle's individualism lies in the background capacities. According to Bloor, these capacities are merely individual mechanisms which enable the acknowledgement of beliefs and intentions. Bloor himself argues that meaning ought to be thought of as "having its origin in the organization of the group, and developing on to the individuals in virtue of their membership and participation in the group" (Bloor 1996, 850).

Martin Kusch adopts a similar kind of basic ontology to that to which Bloor is committed, although there are arguably a number of general differences in their

accounts (Kusch 2002, 231-248). The finitist critique of Searle's ontology by Kusch and Bloor is targeted at the idea that there are independently existing (objective) features that do or do not satisfy our conventional (institutional) conceptualisations (Bloor 1996, 850-853; Kusch 2002, 244-248). This critique is targeted directly at Searle's realism, including his introduction of the Background. In the context of technology, the finitist argument would thus claim that there do not exist any objective intrinsic features that would ultimately fit into the socially constructed conceptualisations and constructed functions of artefacts. This criticism can be aimed at the notion that institutional phenomena such as artefact statuses and their technical functions can be reduced to natural phenomena such as the material structure of these objects. What the finitists are thus accusing Searle of is that by introducing the conception of Background, he comes to take a realistic stand on the possibility of explaining social phenomena in terms of natural phenomena. The critical attitude that Searle has towards social constructivism can be read from tai seen in a passage already quoted above, which states that "when it comes to institutional facts, improvements in technology do not change the possibilities. We cannot impose electrical charge just by deciding to count something as an electrical charge." (Searle 1995, 94) What Bloor and Kusch are critical of is that his alternative realism is on the wrong path.

It is, however, questionable whether Searle actually intends to develop this kind of account of reality, although his ontological programme and particularly the concept of the Background can be seen as problematic in certain senses. While Kusch is intensively critical of Searle, Bloor engages in a more sympathetic reading of Searle's work. In another context, Eerik Lagerspetz has noted that both realist and antirealist social ontologies can be compatible with the first part of Searle's project, which develops the account of social institutions without the role of the Background (Lagerspetz 1999). There is also a similar kind of emphasis in Bloor's writing, in which he sees Searle's analysis of institutions as compatible with his account of meaning finitism (Bloor 1996, 851-852). Although Searle himself connects his idea of Background to the possibility of existing constitutive rules and institutions, the intention here is not to argue for the correctness of Searle's ontology, but to examine the possibilities to apply and enhance the idea of constitutive rules in order to develop an ontology of technology and artefacts. This is done without accepting Searle's conception of Background, and the developments here follow the suggestions made by Lagerspetz and Bloor about the applicability of Searle's analysis of institutions without the concept of Background.

Searle's realist social ontology has also been also criticised by Kroes in the context of technology and technological artefacts (Kroes 2003). The main problem that Kroes attributes to Searle's social ontology, particularly when it is applied to artefacts, is the variation in the ways in which status functions and technical (causal) functions are assigned to objects. In his work, Searle distinguishes between three different types of assignment of functions: *agentative*, *nonagentative* and *status functions*. Agentative functions are intentionally assigned to these ob-

jects through use, i.e. through various uses of artefacts. Nonagentative functions are intrinsic properties of objects and not assigned to them by any manipulative action. An example of a nonagentative function is the function of the heart as pumping blood through the body. Status functions were already discussed above, and they are functions giving an object a certain social or institutional status. According to Kroes, the problem of Searle's view lies in the fact that technical functions are agentative functions, "[f]or objects with technical functions there is a strong link between function and physical structure" (Kroes 2003, 25). According to Kroes, the main problem in Searle's ontology lies in the distinction between assigning agentative and status functions.

Kroes claims that Searle does not provide a satisfactory account of how a certain object X is an artefact, such as a screwdriver. According to Kroes "[Searle] argues that [...] a necessary condition for something to be a screwdriver [is] that it seems to be a screwdriver." (2003, 27) This reading of Searle follows from the idea that agentative functions are assigned to the object through intentional action (use), and, according to Searle's realistic ontology, the assignment of agentative functions are connected to the physical properties that make the object useful in the fulfilment of the agent's intentional actions. According to Searle, we cannot expand the physical possibilities for creating artificial entities merely by constructing functions. Agentative functions, in terms of technical functions, are strongly connected to the intrinsic properties of objects.

Kroes's criticism of Searle is exemplified by two common sense examples which seem to pose a straightforward challenge to Searle's account, at least as regards his distinction of various kinds of assigned functions. Kroes claims that Searle is unable to provide an account of any examples of malfunctioning artefacts and/or accidental uses of artefacts. For example, a certain tool might seem to be a wrench, but when trying to unlock a rusted bolt the tool breaks down. In this case, the problem that Searle's account encounters is the location in which the functional properties are situated. If the agentative functions of this object are related to its observable physical properties, then there is a serious problem between the observed and intrinsic properties of the object. The observable properties 'communicate' that the object is a fully functioning wrench, but the intrinsic properties contradict this observation. Another problematic case is when someone is using an object as a murder weapon although it does not seem to be suited to that intentional purpose. The question Kroes poses to Searle is again is related to where the functional properties of the object are situated, in the minds of agents or in the physical properties of the object.

There is thus a lesson to be learnt from Kroes' critical remarks of Searle's social ontology in the context of technology. His remarks follow the line of argumentation that there is something problematic in his realistic social ontology. The problem that Kroes points out is that there seems to be some kind of presupposition about the existence of our world that is embedded in the classification of the various types of assignment of function. Nonagentative functions presuppose facts independent of our beliefs, and agentative functions, such as technical functions, rely on the recognisable properties that are best suited to our intentions, but

they are intrinsic properties of objects. Only status functions, as was discussed in the previous chapter, have a less problematic role in Searle's social ontology. This, of course, follows from the distinction between natural and institutional facts to which Searle is committed. The question regarding the development of the ontology of artefacts based on Searle's work is whether Searle is committed to a strong kind of realism that becomes problematic when discussing the functions of artefacts, as Kroes seems to claim. This problem and its possible solutions are considered in more detail in subchapter 5.5.

One aspect of Searle's ontology that has certain advantages in the context of technological artefacts, despite his problematic conceptions of realism or various types of functions, is actually situated in the first part of his social ontology. Searle's distinction between natural and institutional facts implies a certain kind of ontological view concerning social reality and how natural objects and their intrinsic properties are connected to social reality. Although the argument that Kroes makes against Searle, particularly when considered against the backdrop of his entire ontology including the conception of Background, seems to be sound, it is questionable whether it is applicable as regards the account of artefacts and the constitutive rule presented here, which is rather sceptical of the idea of the Background. Searle, without the burden of his Background, could respond to Kroes' challenge by stating that all of these assigned functions are embedded in the constitutive rule as different kinds of facts, regardless of whether or not they are presented once and for all as the true and final facts about the true existence of the world. The central problem concerning Searle tai Searle's work is not his constitutive rule, but the fact that he is rather ambiguous about the issues for which he has received the most criticism when it comes to different kinds of functions.

The ontology of performatives developed here and founded on Searle's constitutive rules, which was initially introduced in the beginning of this chapter, can actually be presented in a way in which it is possible to avoid Kroes criticism that

> the assignment of causal agentative functions is incomplete; it discusses a necessary condition for something to be an F (with F being a functional characterization of an object), but fails to state an acceptable sufficient criterion for something to be an F. (Kroes 2003, 34)

The problems that Kroes has in mind are the malfunctioning and accidental use of artefacts that Searle fails to deal with in his ontology. If Searle's conception is refined in the direction suggested here (which is compatible with the suggestions made by Bloor and Lagerspetz), it can be made to avoid this criticism, because the classification of objects in this approach is founded on the facts about the objects. Although this might seem to be a kind of *ad hoc* solution to the problem, this refinement also includes an adjustment of the conceptualisation related to artefact functions so that it becomes an ontological perspective that seemingly avoids the accusations that is made against Searle.

As was stated in the previous chapter, the necessary condition for the existence of artefacts is institutional facts. The central idea of the constitutive rule

is that some physical properties and structures that are referred to with the term X are related to some institutional facts Y, and the Y term is a referent of some collectively accepted status that is constitutive of the artefact. Following some of the initial ideas in Dipert's classification of artefacts, it is claimed that this demand regarding the recognition of the institutional nature of artefacts distinguishes artefacts and their functions from other artificial objects. If this demand for the recognition of the institutional nature of artefacts is stretched even further, Searle's agentative functions can be included into this view of artefacts in a less problematic way. The reason for this is that the agentative functions of an artefact exist only because certain physical properties are related to some institutional statuses by the constitutive rule.

According to Kroes, the problematic feature in Searle's ontology, when discussed in connection to technical artefacts, is its ability to explain certain evident features of artefact functions. According to Kroes, the problem has is rooted in Searle's realistic ontology, which is founded on the concept of Background. The problematic features in Searle's range of functions are reflected in this notion of Background. The distinction between the observer-relative functions and the intrinsic functions of artefacts seems to be problematic in Searle's account. According to Kroes' criticism, Searle is unable to provide an account of either malfunctioning artefacts or the accidental use of artefacts. Although it was argued above that there are certain possible escape routes from these problems in Searle's ontology, especially when the idea of Background is set aside, these accusations must be considered seriously. Kroes' quite legitimate criticism also suggests that certain refinements to the idea of constitutive rule must be made in a way that it is able to provide a more precise account of the functions of artefacts.

5.4 Functions and constitutive rules

Another theory of the functions and function ascriptions of artefacts is presented by Vermaas and Houkes. Their ICE-theory of the function ascriptions of technical artefacts is an analysis of how the functions of technical artefacts connect and separate the components of the dual nature of artefacts, i.e. the intentional and structural natures of artefacts. Their idea is to present an action-theoretic account of artefacts that can contribute to the theorising use and design of technical artefacts. One of the central concepts in their theory, which intends to describe artefacts through their functions, are *use plans*, which connect the function constituting structural properties to the intentional uses of technical artefacts. Similarly to the idea of constitution, Vermaas and Houkes intend to describe the connection between the two natures of technical artefacts. (Vermaas & Houkes 2006)

The conception of use plans introduced by Vermaas and Houkes contribute to the interaction between the users and designers of artefacts. According to the authors,

designers aid users in realizing their goals by constructing a use plan to be executed, which includes manipulations of available objects and, possibly, newly designed artefacts. (2006, 7)

A use plan of some object O is a series of goal-directed actions in which the manipulations of the object O are seen as contributing to the realisation of a goal that is presented in the plan. For example, in the finale of the first act of Mozart's opera Die Zauberflöte, the bird catcher Papageno wants to help Pamina to escape from captivity and the evil tyranny of Monostatos. In order to achieve this given goal of his use plan, Papageno manipulates an object O (known as a glockenspiel) by playing it. The tune coming from the glockenspiel Papageno is playing makes Monostatos and his slaves dance uncontrollably, making it possible for Pamina to escape.

Because the ICE-function theory of Houkes and Vermaas is based on an action-theoretic account, "a technical function of an artefact can be roughly described as the role the artefact plays in a use plan for the artefact that is justified and communicated to prospective users" (2006, 8). So the proper function of an artefact, to use this term in the rather ambiguous sense of the word, is the one that is dictated by the use of the object. The criteria for something to be a correct function ascription of an artefact are created by the artefact's role in a use plan. The function becomes justified in the context of prospective users through a process of communication. Because the authors of the ICE-theory emphasise the roles of use and other intentional properties, they claim that "technical functions cannot easily be interpreted as intrinsic or essential properties of artefacts." ((2006, 8)

The ICE-function theory is, according to its authors, an abstract version of three general theories of functions: the intentionalist, causal and evolutionist theories. The intentionalist theory states that a certain capacity C is a function ascription of an artefact x in relation to use plan p if an agent a has the belief that this capacity could lead to the successful fulfilment of the goals of the use plan p when executed. The causal role is related to the justification of the beliefs in the intentionalist content, and the evolutionary content states that certain agents u have selected the artefact because of its capacity C to the use plan p and have, thus, communicated this to other agents d. In other words, a certain account A of an artefact x has a capacity C that can be executed in order to achieve a goal in a use plan p and a certain user a has beliefs about this and these beliefs can be causally justified. In addition, this account A of an artefact x with its distinguished capacity C has been selected and probably manipulated for this use plan by some agents u, and this has been communicated to other agents d. (Vermaas & Houkes 2006, 8-10)

For example, let's assume that a certain agent a is hungry and wants to cut bread to make sandwiches. The goal of a use plan p in this case is to cut bread. Here, an account A of an artefact x (a knife) is a bread knife and it has a sharp blade property C. Here, the account A distinguishes the artefact x from other uses, an example of which would be that the knife with its sharp blade would make a perfectly suitable murder weapon. In order for C to be a function ascription in relation to p, the agent must have the belief that the artefact x has

the capacity *C* and that *x*'s capacity to carry out *C* contributes to the successful attainment of a goal when manipulated in the execution of *p*. So in this case, the agent must believe that the knife has a sharp blade and that the sharp blade would be a successful means of cutting bread. In addition, this property has to be causally justifiable, i.e. the knife as a bread knife must actually cut bread. In addition, a group of distinguished engineers have developed bread slicing *p* and have selected the knife *x* because of its sharp blade property *C* as a means of carrying out this task, and by naming it a bread knife they have communicated this use plan *p* to other agents.

What is noticeable in the ICE-account of artefact functions is the presence of both the communication aspect and the embedded implicit notion of collectivity. This account also has some similarities to other accounts of artefacts discussed here, especially Dipert's account. Vermaas and Houkes state that their definition of function ascriptions is partially normative, which presupposes the existence of a social context. They also claim that the justification of the successful performance of artefacts is dependent on the testimony of other users or designers (2006, 9). In another contribution to the dual nature of artefacts programme, Marcel Scheele develops this idea of the social conditions of function ascriptions in more detail (2006). Scheele's idea is to investigate and develop an argument claiming that proper functions of artefacts cannot be understood independently of social notions.

In his paper, Scheele introduces two concepts, the proper use and proper function of artefacts, which describe the dependence of function ascriptions on the existing social conditions. According to Scheele, "an agent may use an artefact in accordance to its proper function, that is, what the artefact is meant for" (2006, 25). This is something describable as the proper use of an artefact, i.e. the artefact is used in accordance with its proper functions. The conditions for the proper functions and uses of artefacts are partially dependent on social considerations, although these social conditions are necessary but not always sufficient. The considerations of proper artefact use refer, according to Scheele, in part, to the physical features of artefacts, which are not socially constructed (2006, 26). This all is, of course, in line with the general idea of the dual nature of artefacts, and Scheele reminds the reader to be careful when considering how the proper use is couched in a social context.

Scheele takes Searle's social ontology as an example of a theory in which functions are treated as overly dependent on social constitution. According to Scheele, "[f]unction ascription is grounded in (collective) intentions, because this can take place only within a set of prior assignments of value" (2006, 26). In other words, the proper functions of artefacts are constituted by collective intentions. This kind of interpretation is, however, awkward if it is compared to Kroes' more detailed discussion of Searle's account of functions. Actually, Scheele's interpretation that all functions in Searle's account are generally regarded as observer-related properties highlights an existing tension in Searle's work. According to Kroes, Searle's problem is that by basing his social ontology on the concept of

physical background, he views certain intention-dependent features of artefact functions as intrinsic properties that ought to be more observer-relative. This claim is the exact opposite of Scheele's argument, although both are loyal to their source of criticism. Searle himself claims that all functions are observer-relative and that there is a distinction between agentative and non-agentative functions.

Although it is questionable whether Scheele is entirely correct in his accusation that Searle's philosophy includes a kind of social constructivism, his emphasis on the relevance of the physical is accurate. A similar idea was also present in other accounts of the dual nature programme. For example, the two-way underdetermination thesis about artefacts suggested by Houkes and Meijers (2006) states that reasoning that proceeds from structure to function, which is determined by physical properties, is impossible and vice versa. Socially constructed proper functions of artefacts cannot impose material structures on themselves, nor can a certain material structure impose certain definite proper functions on itself. In addition, the condition of realisability states that realising an artefact function can be carried out from two directions, from intentionality to structure and from structure to the intentional uses. But because intentionality and social context have a significant effect on the realisability of proper functions and the uses of artefacts, the collective intentions involved in the use of artefacts ought to be taken into account.

Although it is not properly or extensively developed, the central idea emphasised by Scheele in his paper is that social context plays an essential role in the recognition of the proper functions and uses of artefacts. It should be noted, following Scheele's line of thought, that the functions and uses of an artefact cannot be explained merely by appealing to social notions. But this issue is also relevant when considered from the opposite perspective. The physical cannot explain functions independently, and social notions are required in order to explain the existence of proper functions and uses. For example, in the demonstration discussed above in the context of ICT-theory, the account A of an artefact and its property C as a function are realised (only) in some social context. In addition, the use plan p as a communicated fact is a subject of shared beliefs, which is one of the central features of collective intentions. (Functions, use plans and the creation of artefacts are discussed in more detail in Chapter 7.)

5.5 The enhancement of constitutive rules

The general idea in Searle's conception of constitutive rules is that these rules forge connections between natural and institutional facts, in which X refers to non-institutional entities and Y refers to institutional structures. In the context of artefacts, the referent of the term X is based on a combination of natural facts which give the object its physical properties and functions, at least in the case of non-agentative functions. Kroes argued that Searle's account of constitutive rules has one central defect in that it is unable to provide an explanation of the

technical functions of artefacts. The approach taken here states that certain physical features of artefacts, features that Kroes refers to with the notion of technical functions, can only be recognised as physical properties of technical functions in the context of existing institutional facts. The role of institution is an essential component of artefacts, and the natural facts of an artefact (such as the properties which Searle describes as agentative functions) exist only in relation to it. Here, the idea of the context dependent realisability of functions comes close to what L. R. Baker refers to with her conception of circumstances. Circumstances provide the context for the existence of the constitution relation in her ontology of artefacts.

In this account, it is claimed that the existence of certain institutional facts enables us to recognise objects as certain artefacts and to observe the physical properties that function in certain ways in order to fulfil the various uses of the artefact. The existence of institutional facts enables us to know what kind of functions certain artefacts are designed to carry out and what they can be used for. The technical functions and other agentative functions are dependent on the status function attached to objects. According to Searle, constitutive rule X counts as Y in context C, describes performative acts as assigning a certain status function to X to count as Y. This notion of the constitutive rule should be expanded so that the assignment of status functions is simultaneously the assignment of technical functions, because it would be awkward to consider the technical functions of artefacts without recognising that the artefact has a certain acknowledged status.

One aspect of Searle's work that is discussed by Scheele but not Kroes is that Searle himself claims that all functions are observer-relative. As such, he also speaks about functions as being assigned or imposed. As was argued in the previous chapter, at least in the first part of his ontology, Searle's ontological idea is quite similar to the one presented here. Therefore, Searle's notion of the existence of different kinds of functions can be understood as related to the discussions surrounding the types of facts we impose on objects. This kind of reading of Searle's work, which was also favoured by Bloor, differs from Kroes' reading. Kroes includes the second part of Searle's ontology, the background, in his own reading, and claims that technical functions are intrinsic features of artefacts in the sense that they communicate their functionality by being the kinds of objects they are. Scheele, on the other hand, emphasised the social construction side of Searle's ontology. The perspective taken in the ontology of artefacts developed here is that various functions are embedded in the facts that we have about objects. In the process of constructing artefacts, these functions are performatively created and essentially connected to the institutional facts which are constitutive of the artefact. Although the emphasis here is mainly on the social construction aspect of technical artefacts and their functions, one should keep in mind that the view developed here is sympathetic to the attribution of a constitutive role to the physical properties of artefacts.

In his critical account of Searle's constitutive rules, Hindriks has remarked that when discussing constitutive rules, institutions play three types of roles: be-

havioural, normative and conceptual (Hindriks 2005, 117). The conceptual roles of institutions are connected to the means of reference, i.e. to how we refer to objects, events and properties. This conceptual role is connected to the ways in which existing classifications are constructed and maintained. The normative role is connected to the functions that entities have. The behavioural role of the constitutive rule has an important role in the description of our actions. According to Hindriks, institutions facilitate many of our actions[1]. This distinction between the three different roles of constitutive rules also lies behind Hindriks' modification of Searle's constitutive rules. Hindriks has proposed an alternative conception of constitutive rules, which he refers to as the XYZ-conception of constitutive rules. He argues that Searle's conception is underdeveloped in some respects, and his account intends to repair the defects in Searle's account. In his account, X refers to non-institutional entities and Y refers to the institutional statuses related to X. Z refers to the behavioural dimension of institutions. For example, certain pieces of paper (X) count as money (Y), and money (Y) is a means of exchange (Z). (2005, 117-140)

One of the potential benefits of Hindriks' conception of constitutive rules for the ontology of artefacts is its conceptual sophistication. His institutional Y-terms refer to institutional statuses, which is quite similar to what Searle has in mind. In Hindriks' version, the conception of institutional statuses can be used to describe both the various (observer-relative) statuses imposed on artefacts and the different functions, as opposed to the mere status functions, that are imposed on artefacts. As was argued above, certain agentative functions that were considered by Kroes to be intrinsic properties of artefacts ought to be described instead as being part of the institutional status of artefacts. In Hindrks' conception, the Y-term seems to enable the inclusion of a wider scope of functions under it.

It was stated in the previous chapter that the existence of artefacts is dependent on constitutive institutional facts (i.e. the existence of an institution). Therefore, it is also natural to argue that the uses and functions of artefacts are dependent on both these institutional facts and, to be more precise, the institutional status of the artefact. Facts about the uses and functions of artefacts are constitutive of the artefact, and, according to the characterisation of artefacts, these properties of an artefact are dependent on institutional facts. These properties are the facts which make up the functions that are essentially connected to the institutional facts of the artefact. These properties can be found, for example, in the meanings of the terms that we use to refer to artefacts. By naming an object as a certain artefact, the process of naming, which distinguishes it from other kinds of artefacts, is in some way or another dependent on the physical properties, constructed or acknowledged functions and possible uses of the artefact. And as such, any reference to an artefact is also a reference to certain facts that we have about the it.

One way of more closely demonstrating the application of the ideas that Hindriks suggests be included in the ontology of artefacts is to apply his notion

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[1] A similar line of thought can also be found in the work of Mary Douglas, see, for example, (1986)

of the conceptual role of institutions. As has already been discussed previously in this work, Barry Barnes developed an idea in his famous paper in which the types of conceptual references can be categorised into two kinds of references: the kind that relies merely on observational pattern matching and the kind in which no pattern matching occurs (Barnes 1983). Barnes described the terms used in these types of references tai categories of reference as 'N'-terms and 'S'-terms respectively. After introducing his analysis of the two idealised types of reference, Barnes argues that linguistic acts of reference can be self-referential, or speech about speech, and references that are not merely self-referential. What is argued here previously is that when referring to artefacts, the meaning of terms is greatly dependent on self-reference. This is also the case when it comes to the technical functions of artefacts. Although the target of reference is on the physical properties of the artefact, the meaning of these properties is related to its use, which in turn is dependent on its institutional status.

According to Barnes, most of our linguistic reference is self-referential, and this is also the case with artefacts. The reference to artefacts, and especially to their functions and properties, has a self-referential component. What we acknowledge or recognise in an artefacts is closely linked to their socially defined uses and purposes. The references to something as a mobile phones is closely connected to its properties, such as its capacity to send different kinds of messages or its ability to connect to the Internet and provide the user access to his or her e-mail while, for example, on vacation. But in contrast to the more constructivist thinkers, Barnes wants to emphasise the fact that at least some of our concept applications and references are not (merely) self-referential, but refer instead to phenomena that are more than just pure social constructions (Barnes 1983, 538-541).

According to Hindriks' conception of constitutive rules, the performative constitution of the creation of an institution is also the creation of ways of referring to objects. The institution is thus also constitutive of the meanings of the terms we use to refer to artefacts. Similarly, making reference to the specific functions and properties that are relative to the use of the artefact is constitutive of the institution. Functions are part of the institutional status of the artefact according to the ontology developed here. Whereas performative constitution is thought to be an essential part of the ontology of artefacts, the physical facts of artefacts, such as their technical functions, are dependent on their constitution and institutional statuses. The acknowledgement of certain features of an artefact, particularly those which are either useful or specifically designed to carry out a certain action, is simultaneously the acknowledgement of its institutional status or the performative constitution of its having a certain status as an artefact.

Following ideas developed by Searle and Hindriks, the concept of performative constitution as being an essential part of the ontology of artefacts consists of three inter-related aspects: non-institutional facts, institutional statuses and the behavioural dimension that is related to these institutional statuses. The institutional statuses, including imposed functions, are manifested in three different

spheres: (i.) In the manipulated physical existence of an artefact; (ii.) In social structures such as language and (mutual) beliefs; (iii.) In the behavioural dimension or in actions. Performative constitution, which mediates between natural facts and institutional facts, integrates physical properties with social structures and action. The process of constructing artefacts includes performative constitution, which connects certain natural and physical properties (as we know them) to certain functions and action by assigning an institutional status to the artefact.

In his work, Searle argues for in favour of the logical priority of brute facts over natural facts. As a consequence of this, his ontology of social reality bears the burden of having to legitimise this logical order. This is also one of the factors behind Kroes' critical attitude towards Searle's work, and the meaning finitists are also critical of this part of Searle's ontology. The ontology suggested here does not follow Searle's line of thinking as regards the logical priority of brute facts, at least not in the sense presented in the context of his conception of Background. The ontology suggested here is more in line with Marx's suggestion of an holistic view, and it is claimed that natural facts, institutional facts and performative constitution are all essential features of artefacts, none of which have priority over the others, as Searle argues. By not adopting this idea of logical priority, the ontological account incorporates the two criteria for ontology of artefacts provided by Houkes and Meijers, i.e. two-way underdetermination and the realisability condition. When applied to constitutive rules, the constitution directive described by the constitutive rule can go either *from uses and functions to structure* or *from structure to functions and uses*. Particularly when describing the necessary conditions of the creation of artefacts, constitutive rule the constitutive rule ought to be thought of as a two way street. The behavioural dimension can be seen as a relevant aspect of the assignment of functions to physical properties similarly to the way in which the assignment of certain functions to physical entities can be relevant to the behavioural dimension related to artefacts (i.e. the creation of new forms of action).

Because the emphasis in the ontology of artefacts is strongly on the institutional nature and institutional status of the artefact, there are some additional necessary features that have not been discussed here. It was argued that, in the context of artefacts, the constitutive rule is a rule related to the attachment of certain institutional statuses and the behavioural dimension relative to them to artefacts. It has been argued by several authors of social ontology that the existence of institutions is dependent on collective acceptance (See f. ex. Searle 1995; Tuomela 2002; Hindriks 2005). Institutions can exist only if a relevant social collective accepts it as an institution and acts in accordance to their beliefs. According to Hindriks, institutional statuses are connected to certain behavioural dimensions. As such, institutions, i.e. those facts that are collectively accepted as institutions, have relevance for action. As was already stated by Searle, constitutive rules create and thus constitute behaviour, although the behaviour that they constitute is, of course, dependent on the existence of institutions.

Both the collective acceptance and nature of institutions are discussed more thoroughly in the next chapter. It can be noted here, however, that the idea of

constitutive rules as descriptive of the features that are relevant to the creation of artefacts is related to both the physical properties of artefacts and the action (use) related to them. Constitutive rules combine non-institutional facts with institutional statuses, and the institutional statuses have a behavioural dimension. On the other hand, the behaviour or use of artefacts is dependent on their institutional statuses. It is dependent on the kind of institutional statuses that are imposed on certain non-institutional phenomena stated in terms of natural facts. According to this analysis, accidentally used and/or malfunctioning artefacts are neither artefacts or relative behaviour that could challenge the characterisation of artefacts, although accidental use can enhance the institution or create new institutional forms of action.

According to Scheele, proper functions and uses can be distinguished from accidental uses and malfunctions by making reference to social notions (2006, 25-32). A similar idea was presented in the previous chapter by applying the initial idea of the classification of different kinds of artificial things developed by R. Dipert. Because the physical properties of artefacts cannot determine their functions, although they are partially constitutive of them, the tribunal for proper uses and functions must be founded on social notions. Already in the previous chapter, the criterion of social notions was stretched to include institutional facts. The existence and realisability of proper artefact functions and uses require the existence of an institution. This distinguishes the proper functions and uses from accidental uses and malfunctions. In this chapter, this idea was explicated with an enhanced version of constitutive rules that relates functions more closely to uses.

One central idea that Houkes and Vermaas proposed in their work was that of use plans, which are central to both the creation and use of artefacts. Artefact functions are relative to the specific use plan that is created by designers and manufacturers to be intentionally carried out by the users. The idea of the use plan is to tie together certain goals and functions as means of attaining a specific goal. It is thus use plans that have the role of bringing together certain (manipulated) physical properties as functions of an artefact with the institutional status of being a means of carrying out a certain goal attaining action, namely the use of the artefact. The existence of this relation, which is described by a constitutive rule and embedded in use plans, is dependent on the fact that people designated as users collectively engage in the action described in the use plan. Even without the intended uses assigned to the artefact by its designers and manufacturers, the constitution relation expressed in a constitutive rule cannot exist without the collective action of users.

As such, the existence of artefacts with features such as proper uses and proper functions (if these kinds of proper properties can even exist) cannot be explained solely by referring to the existence of constitutive rules. Although the dual nature of artefacts and the constitution relation between these 'two natures' are essential for understanding the ontological status of artefacts, they alone are not sufficient accounts of the ontology of artefacts. The existence of this kind

of constitution relation, including institutional facts, is dependent on collective action. Here we are, of course, faced with the question of the primacy of institution vs. actions, and it is argued here that the approach ought to be an activity approach beginning from action and not from institutions and rules. The stance taken here is that actions define and create rules, institutions and actions, such as artefact manufacturing, and the uses give objects their status. A more detailed account of these issues is provided in the next chapter.

The effect of this activity approach on the idea of constitutive rules is that these rules should be seen as a description or a theorisation of the necessary phenomena related to a specific goal attaining intentional action. Technical artefacts are manipulated physical objects with institutional statuses and functions, and these objects serve as a means of carrying out a certain goal attaining action (exemplified, for example, in a use plan). So the ontological artefact condition (OAC) formulated in the last chapter can now be extended to include some action A:

> An object O is an artefact if:
> (i.) There are natural facts X that state certain intentionally modified (or deliberately left alone) properties of O for the enhanced achievement of a goal G.
> (ii.) There are institutional facts Y that state the means for achieving a goal G.
> (iii.) There is action Z (labelled as use), which is intentionally directed towards achieving tai the achievement of a goal G and to which Y is a means for achieving the goal G. (iv.) There is a constitutive rule that states that such natural facts X count as Y and that Y is a means for Z in the certain context C, and that this rule is a formulation of the use plan attached to the object O.

The purpose of this refined ontological artefact condition (OAC*) is to emphasise the idea that action, whether manufacturing- or use-oriented (and in most cases these come together, as is argued in Chapter 7), is the primary source of the existence of artefacts. Artefacts are relative to uses and uses are goal attaining actions. The manufacture and designing of artefacts are also dependent on use as a goal attaining action, so the functions of artefacts are always relative to use. Therefore, functions as manipulated properties of an artefact constitute the institutional status of artefacts through their being a means for some goal directed action. Constitutive rules describe a constitution relation, and the constitution relation discussed here differs from L. R. Baker's account in various respects. There are also some similarities, and the emphasis on issues related to use or action in general highlights them in more detail. In her view, Baker argued that the constitution relation is dependent, among other things, on circumstances. Similarly, here, the constitution relation expressed by constitutive rule exists in a certain context. Other at least partial components of the circumstances or context in which the constitution relation exists are the use, manipulation and intentionality involved in these actions. Because one criticism against Baker's conception of

constitution made here was that it is ambiguous as regards the content of circumstances, the context of social phenomena and action is explicated in greater detail in the next chapter.

5.6   Conclusions

The discussion in this chapter has been about elaborating and enhancing the idea of constitutive rules. Constitutive rules are the conceptual glue between the physical and social properties of technical artefacts, and one central argument in this chapter has been that any account of constitution should be based on a more thorough explanation of the behavioural dimension. Artefacts are nothing without uses, just as (other) institutions cannot exist without collective or cooperative action in accordance with the institution. This is the central normative aspect of artefacts and institutions in general. Enhanced with the ideas of normativity and use, constitutive rules come to make more explicit reference also to functions and functionality. The institutional status of artefacts is something that combines a certain functionality as a means of fulfilling certain (goal attaining) uses. So the constitution relation is not just an explication of how some non-institutional and institutional facts come together, but also of how a certain functionality (based on non-institutional facts) extends to include the uses of artefacts.

Because of the strong appeal to institutions as an essential feature of artefacts, their use is not arbitrary or individual. The behavioural dimension of the constitutive rule is action in the collective sense. Accidental or individual ways of using certain artefacts are not 'proper uses' of them, and this idea once again reflects the normative aspect of artefacts. These novel or accidental uses should not be underestimated, however, because they can be the source of both new ways of using artefacts and of creating or enhancing institutional structures. The uses of artefacts change from time to time, and this sociotechnical phenomenon has been one target of investigation in the social studies of technology. For example, the original use of skis was as a means of getting from one place to another, and only later has skiing become a recreational and competitive sport. In the case of bicycles, the history of the artefact is the other way round (See Bijker 1995b, 37).

One implication of the emphasis on the normative aspect of artefact use and the institutional statuses of artefacts is that the functions of artefacts appear to be socially constructed. It is true that the functions of artefacts have a strong relation to social notions and that the institutional statuses of artefacts are partially comprised of the functionality that the artefact is used for. However, we should keep in mind that the functionality of each and every artefact is partially comprised of its physical properties, and one of the purposes of this ontological investigation was to avoid one-sided approaches to technology. The majority of the issues related to the functionality of artefacts should be described with a natural kind of terminology and as natural facts. The physical processes that make up an artefact can include subprocesses that have their own functions in respect to the process

as a whole. Ingvar Johansson has described these functions as constituent functions, and while they can actually make up an artefact, they are not identical to functional artefacts, which, according to Johnsson, have cultural-subjective functions (Johansson 2006).

The benefit of the Searlean view is, as was argued above, that different kinds of facts, such as different kinds of functionalities, are dependent on the subjects who observe, construct and share them. The distinction between different kinds of facts is also a distinction between the types of entities to which they refer. In the case of artefacts, constitutive rule is a conceptual tool that is used to express how facts about physical properties and material structures (manipulated or deliberately left alone) construct the kind of functionality that relates to institutional status and the related uses of the object. The ontological argument here is that artefacts are comprised of two different kinds of facts and that natural facts can exist independently of human involvement. The institutional facts about the artefact status and collective use are dependent on human involvement. The appeal to fact-based ontology and emphasis on constitution relations allows one to avoid falling into the trap of essentialism about material properties. There is no need to make claims about any truly intrinsic properties in an essential sense. The 'intrinsic' properties or functions are natural facts that are integrated into the total functionality of the artefact through a constitution relation.

The kind of constitution relations and constitutive rules presented here also have practical implications and possible practical applications for innovations. According to Kroes (2006), one central question in engineering is how to reason from structure to functions and vice versa. Constitutive rules bring structure and Johansson's constituent functions to the overall functionality of artefacts as regards their use. The conception of use plans can help us to be more specific about this relation. Use plans explicate the practicality and purpose of artefacts by explicating the goal of the action associated with them. The functionality of the artefact is a means of carrying out this goal attaining action, and the manipulated physical properties ought to be embedded into this functionality. It can be claimed that constitutive rules which make more explicit reference to use represent one necessary condition of the success of innovations. The created and manipulated physical properties have to be such that they generate a functionality for the object in a way that it can be used as a means of carrying out goal attaining action (explicated in the use plan). Of course, the use relation expressed by the constitutive rule is only half the story as regards this function. In order to be successful, innovations also have to create a specific use , i.e. the social behaviour needed to apply the functionality as a means of carrying out goal attaining action (in certain ways). Innovations do not merely create objects with a certain functionality, but they also create practices, as is argued in the next chapter. The claims of this chapter can be summarised as follows:

- Following Searle, fact-based ontology can avoid references to truly intrinsic properties and other essential claims of material existence.

- The problems and underdevelopments of Searle's constitutive rule should

be enhanced with a conception that is conceptually richer and makes direct reference to actions (artefact use). The proposed alternative follows the ideas developed by Hindriks in his XYZ-conception of constitutive rules.

- This enhanced constitution relation should also be seen as a relation between functions and uses.

6 INTENTIONAL USES AND INSTITUTIONAL STATUSES

Intentional use and institutional statuses are issues that have been emphasised extensively in the previous parts of this work. This chapter provides a more thorough account of artefact use and the related social-collective phenomena. The central issues discussed here are normativity in social action, including artefact use, the nature of intentional action, and the explanation of collective action. The main argument here is that by making certain refinements to the traditional accounts of intentionality and intentional action, they become applicable also to collective action. It is also suggested that the explanation of the institutional statuses of artefacts and other related social phenomena should begin from actions, not from 'social objects'. In order to promote this idea, the theoretical notion of *conventional practices* is introduced in this chapter.

6.1 Normativity and artefact use

The processes of creating artefacts, such as mobile phones or heart rate monitors, are not just the combination of certain existing theoretical and technical ideas (and knowledge) and certain technical devices. Technological innovations, i.e. the creation of artefacts, are performative acts of declaring that certain types of properties combined together in a certain way are artefacts designed or suitable for certain uses. Artefacts have a certain kind of physical structure and other physical and functional properties which make them recognisable as and distinguishable from other artefacts (for those who participate in that form of life). These properties and functions also create certain kinds of rules, habits and practices in communities of users, and as such technology is partially socially constructed.

Technical innovations are also social innovations, and innovations create new forms of life, i.e. new kinds of social practices. The social construction of artefacts should be understood as a performative act of assigning certain func-

tional and institutional statuses to an artefact. This social construction as a performative constitution has its foundations in the natural world, and an artefacts' physical properties create limitations and possibilities with regard to their potential novel functions and uses. The social construction aspect of this performative act is the creation or application of certain institutional facts which become constitutive of the artefact. The dual nature of artefacts, discussed in previous chapters, is something that technological production comes to promote, whether explicitly or implicitly. The creation of artefacts involves a certain kind of teleology in the explanation or at least the embedded thinking of the functional properties of the artefact (See Hamlin 1992). When an artefact is designed and created, certain functions of use and purpose are also created. The design and manipulation processes are goal achieving actions, and the creation of functions for artefacts is a produced means of achieving certain ends through their use. These means of carrying out goal achieving actions, described as use plans by Vermaas and Houkes, are the basis for the collective use of artefacts.

The issues discussed in this chapter are related to the institutional aspects of the use and production of technology and technological artefacts. The main issues discussed here are collective action and social rules. In writings on artefacts and innovations, the relevance of action to the ontological status of artefacts has been promoted in various ways. The reference to functions as one of relevant general feature of artefacts refers to the properties that are necessarily relative to use, whether actual or potential. As has been stated above, functions are a conceptual drawbridge between physical properties and intentional uses. In their ICE-theory, Vermaas and Houkes (2006) proposed the idea that use plans are one of the central elements in the explanation of the function ascriptions of artefacts. In use plans, the properties of an artefact are thought of as functions that can be used as a means of achieving a goal explicated in the use plan. This kind of means-ends analysis of actions, including action goals, is, of course, familiar from the intentional analysis of actions. In his account of the dual nature of technical artefacts, Peter Kroes (2002) argued that one central element of any theory of technical artefacts is the context of intentional human action. The physical properties of an artefact are connected to use through the functions of artefacts.

In his contribution to the dual nature of artefacts programme, Marcel Scheele (2006) proposed that the understanding of artefact functions must necessarily include a reference to social notions. The explanations of proper use and proper functions, which are distinguished from both the accidental uses of artefacts and malfunctioning artefacts, must make an appeal to social notions. Proper uses and proper functions have a social status that is, in part, constitutive of artefacts. This idea of the social aspect of artefacts is also discussed by Maarten Franssen in terms of the normativity of artefacts (2006). The normativity of artefacts relates to the so-called proper functions of artefacts, and, for example, the value judgements of the goodness or suitability of an artefact are related to its uses and functions. A drill is good if it functions well and can be used according to the purposes for which it is designed. But as in every normative judgement, the judgement is dependent on some institutionalised fact against which the case in

question is valued. In the case of artefacts, a judgement regarding the goodness of an object is, of course, partially dependent on the causal properties of the object in question, although it is also dependent on a specific convention about the proper uses and functions of such objects. A drill can be judged as good or bad only against the background of the conventions about the uses attached to drills and the properties the artefact should possess in order for it to function according to the uses for which it was designed.

This notion of the social aspect of artefacts was described in more detail in the previous chapter in the context of the application of constitutive rules. The question of the criteria for the proper uses and functions of artefacts was answered by claiming that institutional statuses are distinguishable feature of artefacts. The institutional statuses of artefacts connect properties to uses by citing certain physical properties as proper functions crucial to the proper uses of the artefact. This was emphasised by the idea of performative constitution related to the creation of artefacts. In the process of creating and manufacturing artefacts, certain properties are given an institutional status indicating that these properties are functions of some use, and this use can be described as goal attaining intentional action. This connection of these features was described in the previous chapter with the enhanced conception of constitutive rule, in which in a certain context C the non-institutional facts X representative of certain properties are connected to certain institutional statuses (name, functions, etc.) Y and the institutional statuses Y are relative to some behavioural dimension Z (Hindriks 2005).

Because the necessary role of social notions is emphasised and the ontology developed here relies on the notion of institutional facts and institutional statuses, these features have an effect on the further development and further understanding of the ontological status of artefacts. This idea of the existence of certain necessary social features of the theory of artefacts also appears, whether implicitly or explicitly, in other theories. For example, the condition of the realisablility of artefacts suggested by Houkes and Meijers is dependent on social notions because artefact functions manifest themselves in a social context. Because the social context plays such a significant role in the existence of artefacts, the intentions related to artefacts cannot be reduced merely to individual intentions and the action of using artefacts cannot merely be individual action as the manifestation of individual intentions. The explanation of the creation, existence and maintenance of artefacts is dependent on further social notions which have the capacity to take into account collective action and shared intentions.

The concepts of rule following and (shared) intentions are usually mentioned in discussions of collective action and/or cooperation. The theories of collective action, especially in social theories, state that collective action is rule governed, i.e. the action is done in accordance with some social rule. These rules guide and regulate social action and make collective action possible[1]. In order

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[1]   For problems surrounding the explanations of cooperation and collective action in social theory, see (Barnes 1995, 10-36).

for something to be a social rule it must exist and be acknowledged by the members of the society. According to paradigm view of collective intentionality, this is dependent on the mutual beliefs among the individuals within the social community. In other words, the fact that something is a social rule is dependent on the collective acceptance of the ithe individual members of the social collective.

In contemporary social ontology and the theories of joint and collective action, the collective acceptance of some social rule governing action is analysed as being dependent on the intentions of the individuals. In Donald Davidson's account of intentional action, an account that has greatly influenced contemporary discussions, intention is defined as beliefs and the relating pro attitudes. In his account, action is dependent on the beliefs about a rule and the pro attitude toward acting in accordance with the rule. If we want to apply this analysis to social collectives, the action in question becomes collective action and not individual action, and these intentions and beliefs as the contents of intentionality have to construct a pool of similar kinds of intentions (at least they have to be similar in terms of the relevant aspects of the beliefs). Some authors have even suggested that in collective action, the individuals in a collective form genuine We-intentions (Searle 1995, 23-26) or the collective itself has an intention of its own (Gilbert 1990). In a sense the collective forms an individual intentional subject.

There are, though, two interrelated problems in the explanations of collective action. One is the problem of how individuals with individual intentions form a collective or a shared intention. The other is the problematic status of rules in the explanation of social action. They are both discussed in this chapter, because the ontology developed thus far in the previous chapters relies on the notion of constitutive rules. The existence of such rules is dependent on collective acceptance, and, as such, we must pay at least some attention to the discussion of the question of shared intentions here. The purpose of this discussion is to provide an account of the basic social notions related to the institutional statuses of technical artefacts and the collective use of artefacts. The benefits which rule dependent accounts have is that collective action can be explained by referring to rules. What is shown in the following is that certain kinds of rule-based accounts of collective action have vicious problems.

The main argument in this chapter is that artefact statuses and functions are social conventions which follow from the fact that the means of using artefacts are social practices (and therefore based on the conception of conventional practices). The creation of novel artefacts is also the creation of practices in a culture in which artefacts have a certain status in accordance with the practices of purposeful action. Because artefact use is intentional in a collective or cooperative way, the argument begins from the question: "what is intentional action?". It is shown that the types of social action involved in artefact use are related to the intentional content in action. This content is related to the description of action, and the analysis of it can benefit from the application of the issues discussed previously in this work (for example, the dual nature of artefacts and constitutive rules).

6.2 Functions and use as conventions

The institutional aspect of artefacts relates to the process of creating an institution and rendering an artefact and its functions recognisable as what they are by giving it an institutional status. According to Searle, the creation of new institutions can be explained with the conception of constitutive rules. The fundamental idea in constitutive rules is that certain non-institutional properties are given an institutional status. This constructed institutional status of an artefact must be accepted in the community of users. In order to insure the future existence of the institution in question, it has to become a shared convention that expresses the idea that certain kinds of things and properties, having their foundation in the natural world, actually constitute such and such artefacts. According to the shared convention, these objects, designated as certain specific artefacts, possess properties and functions that are suitable for certain kinds of action.

When the initial institution is created, the conventions or institutional statuses of artefacts become common knowledge in the community, i.e. mutually shared beliefs of the individuals in the community. These mutual beliefs are related to the facts that constitute the artefact and the beliefs in the functions of these artefacts and their potential uses. These mutual beliefs about uses and statuses are decisive in connecting certain physical properties to the uses and intentions of actors. Without existing beliefs of uses, functions and properties, it would be virtually impossible to even imagine the existence of artefacts in any form. An initial criteria for collective use is that these beliefs are shared among members of the community, or at least among the members of a relevant group of users.

In every case of the creation of institutions, and therefore also in every case of the creation of artefacts, the process includes the processes of both accreditation and authorisation. Some physical entity is assigned an artefact status if (and only if) its institutional status, which is based on the functions related to its intentional uses, becomes accepted. Pieces of metal only become money when tier monetary status has been mutually accepted by a community. The fact that certain kinds of pieces of metal function as money is, of course, only a convention, but the continued existence of such a convention is dependent on both the continuity of the mutual belief that these pieces count as money and the collective use of these pieces as money.

This criterion of mutually shared beliefs is also relevant to the maintenance of institutions and, in the case of technology, the continued existence of artefacts. When an artefact has successfully achieved an institutional status, a mutually believed status, the continued existence of the artefact and the institution then becomes dependent on the mutual beliefs of the individuals of the community about the status of such and such artefacts. The existence of artefacts is dependent on these mutual beliefs, which in turn are manifested in the collective action which takes place according to the beliefs of the people in the community. For example, a sharp triangle shaped stone in a primitive society continues to function as an axe only if a belief that such an entity can be used for splitting logs is shared

in the society and the members of the society continue using it for that purpose. Primarily, of course, the initialisation and existence of such collective action and shared beliefs depends on the processes of accreditation and authorisation. The members of the primitive society have to have accepted a triangle shaped stone as a suitable tool for splitting fire logs and engaged in the manufacturing of or actively searched for such stones.

It can be said, then, that the criterion for the existence of artefacts in a social community is dependent on the collective acceptance of the institutional statuses assigned to artefacts, and the existence of an artefact can be said to be dependent on the collective actions and shared knowledge of the community[2]. A certain artefact cannot exists or become part of the collective common knowledge until the people in the community collectively accept it and acknowledge it as an artefact. The existence of artefacts is also dependent on collective intentional action, the mediation between the functions of an artefact and its intended uses. In a community engaging in collective action, the individual actors must have a mutually shared beliefs of rules and other social (or institutional) facts, which are the features of collective intentionality that are necessary for collective action (Searle 1995, 23-26).

In order to explain how people engage in collective action and how action is dependent on existing institutions, Eerik Lagerspetz (1995, 2001) has developed the conception of conventional fact to explain the nature of institutions. The goal of conventional fact is to overcome certain problems which are inherent to the theories of social action. One of them is the logical problem of rule regress in accounts that are founded on the idea of social rules as the explanation of cooperative action. The idea of conventional facts is based on shared beliefs between members of a community. The actors in a community must have similar shared beliefs in social action, although this alone is not a sufficient condition of collective action. The actors must also have so-called second order beliefs, which are beliefs about others' beliefs, or the belief that other actors share similar beliefs about the form and objectives of the action. In his analysis, something is a conventional fact if (and only if) there is a mutual belief within the relevant population of the community and this conventional fact is at least a partial reason for performing a meaningful action (Lagerspetz 2001, 80).

Although the discussion of artefacts as conventions or institutions can imply a feeling of existing static structures, institutions intend to change from time to time. When the institution of an artefact is introduced to the community by the designers and manufacturers of the technology, the institution embarks on its individual lifespan in the community. Mary Douglas has described this changing or enhancing process of institutions by saying that institutions remember and forget (Douglas 1986, 69-90). The institution of an artefact is shaped by its designers and manufacturers by introducing new features that change or enhance the meaning of the term used to refer to the artefact. New functions also change the ways of

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2   Of collective action, see (Barnes 1995, 10-127)

performing meaningful action relative to the artefact. Institutions are also shaped by the community by the attachment of both different statuses and different rules of application to it. In the case of a mobile phone, the ability to send multimedia messages has changed the application of the term, and we might take the fact that mobile phones can be used to send multimedia messages for granted in our daily practices. In addition, rules of use, like the one stating that mobile phone should be switched off at the opera and concerts, have enhanced and developed the institution of mobile phones.

As was argued in the previous chapter, the process of creating an artefact also includes, as a defining factor, the creation of an institution, which makes the artefact what it is. This establishment of an institutional status was explained with the idea of constitutive rule. The idea to which Searle's and Hindriks' concept of constitutive rules refers is that the acceptance and accreditation processes involved in the creation of artefacts produce rule-constituted action and conventional practices. The rule or a norm of artefact use itself is expressed by the constitutive rule. In other words, the institutional status of the artefact first becomes common knowledge within the community and then becomes the mutual belief of the individuals in the community when a relevant group of the participants of a community begin to act according to their mutual beliefs. Once this institution of an artefact is established in the community, individuals begin to act in accordance with the constitutive rule. In a society, people also act intentionally to change or enhance the rules of the institution (for example by making changes to environmental legislation), creating new types of social practices related to the artefact. What the institution is, i.e. its static and changing content, is something that is maintained by the mutual beliefs of the individuals of the community and dependent on their collective action.

6.3 Intentionality and action

The main features of the conventional nature of artefact use were discussed in the previous section. It was argued that the institutional status of an artefact is a conventional fact and that this conventional fact is constitutive of collective action. The existence of conventional facts that explain collective action were said to be dependent on shared mutual beliefs. In this section, collective action is discussed in more detail. There has been an intense amount of emphasis on the discussion of collective action and collective intentionality in the recent literature on social ontology (See, for example, Bratman 1999; Tuomela 1995; Velleman 1997). The collective acceptance of institutions involves co-operative action and shared intentions. The existence of institutions is dependent on collective intentionality, which can be further analysed as comprised of shared attitudes, as Tuomela (2002, 17-39) has shown, or of beliefs and related attitudes. The basic idea behind the explanation of collective intentionality, which is a necessary foundation for cooperative action (in the we-mode, which is not merely distributed individ-

ual action), is that individual authors engaging in cooperative action must have shared beliefs as well as beliefs about the fact that other participants also have similar kinds of beliefs (i.e. individuals need to have beliefs and second order beliefs about beliefs). For example in Lagerspetz's notion of conventional facts, some action A, such as men gathering for a village meeting under the exact same tree on every Tuesday at noon is a conventional fact if and only if a relevant portion of the village community believes that A and that other members also believe that A.

As is clear from this example, there is hardly any escape from individuals, their beliefs and intentions, although there have been some accounts in discussions on collective intentionality in which intentionality has also been attributed to collectives and collectives as a single body (Gilbert 2000). Most of the work done on intentionality prior to the 1980's is about individual intentionality, and collective action and collective intentionality are approached here through some of the most familiar authors of intentional action, Anscombe, Davidson and Searle, who are some of the main founding figures of the philosophy of intentional action in contemporary analytic philosophy. Davidson's conception can be seen as the most influential conception of intentionality in the contemporary discussion of intentionality. There are certain advantages to Anscombe's view in terms of the analysis of collective action, which is the motivation behind the comparison of their views. It will be argued that Anscombe's view of intentional action is a conception that can offer both a more convenient description of the phenomena and a description of intentional action necessary for the collective acceptance of artefacts.

In Anscombe's view, action can be seen as intentional in two ways, as an intention to act or acting intentionally. The intention to act and intention in acting are two different cases to which the concept of intention is related. (1957, 1-5) She remarks that the intention to act should be distinguished from issues such as prediction, because intending to do something is more that just predicting one's own actions. Intention is more strongly bound to action, and as a concept it is grammatically closer to commitment or promise than prediction. The other way of looking at intentionality, i.e. as acting intentionally, refers to action that can be seen as goal oriented or directed towards the attainment of a certain goal. It is also more related to the description of action than the intention to act, although, of course, these issues are also interrelated.

Anscombe characterises actions that can be described as intentional by stating that intentional actions are actions to which the question 'Why?' is applied (this is applicable to both senses of intentionality) (1957, 9 & 1981, 75). What is referred to as intentional action is thus something to which the question 'why?' can be relevantly both applied and answered. How we arrive at the answer to this question is, Anscombe argues, by recognising the mental cause of the action. What she refers to with the conception mental cause is what can be seen as causing voluntary action. These causes motivate the agent to act and can be external to the agent, such as a knock at the door, or they can be something known without observation. (Anscombe 1981, 76-77) What Anscombe claims by mentioning

two possible ways for these causes to exist is that an intentional agent can be her own motivating factor for action and that intentional action is (foundationally) voluntary. The agent can engage in mental acts that are not responses to external stimulus and that are mental causes for her actions.

Another distinction Anscombe makes about intentional action is that motives and desires should be distinguished from intentionality. The concept of intention relates strongly to action, and taking intentional action entails a certain commitment to perform the action. Motives and desires, on the other hand, are grammatically vague conceptions in relation to action and cannot be seen as a mental cause for the action (although they can be related in some way to the action). For example, one can have a desire to go hiking in the Alps without ever actually doing it. Or someone can have a motive for murder without ever committing it. (Anscombe 1957, 18) For Anscombe, mental cause is that an act is intentiallay carried out. The intention consists of the goals the action is intended to achieve and the beliefs related to how they can be achieved (1957, 57-67). Intentional action is therefore structured by these two features, and Anscombe claims that the description of intentional action is a description from means to ends, i.e. the relation of certain means to certain ends.

Anscombe's conception of intentionality is, to put it simply, a description of action by describing means and ends as the 'motivating' mental cause. It should be noted, though, that mental cause is not something that necessarily ties together certain means to certain ends (see below discussion of individuation of events). This is also a feature that distinguishes her conception of intentionality from Davidson's similar concept. Although there are many similarities, Davidson's analysis of intentionality differs from Anscombe's in its claim that the intentionality of action consists of the causal analysis of the reasons for action. Davidson's conception can also be seen as a part of the rationalist tradition in which action is explained as rational behaviour. In this sense, Davidson's ideas of intentionality come close to those presented by Daniel Dennett (See Dennett 1971; Hertzberg 1994, 154).

Davidson's conception of intentional action is based on the claim that the explanation of human action ought to be causal. In his paper (1980a), Davidson argues that there is a primary reason for action, consisting of pro attitudes and related beliefs about the action (which Anscombe refers to as the mental cause). In another paper on the explanation of action, he refers to causality in the weak sense of the term, as opposed to the stronger sense of causal explanation, such as that presented in the deductive-nomological explanation of human action (1980e, 262). Davidson is not, then, committed to the idea that there are general universal laws that explain action by making statements which describe the necessary and general causal relations which generate action. His conception of causality is somehow different (See von Wright 1971).

In addition to causality, there is another theme of the explanation of action that is central to Davidson's view of intentionality. Davidson seems to suggest that any explanation of intentional action must make an appeal to the reasons

behind the agent's actions (1980e, 261-263). Davidson develops his conception of intentionality as a rational tool in the explanation of action, and the explanation of actions means providing a rational explanation for why an agent did what he or she did. According to Davidson, this explanation is made by identifying the pro attitudes and related beliefs as the cause for the action. (1980a, 4) The primary reason is the cause of the action, and the understanding of these primary reasons can be used in the rationalisation of the action (1980b, 84-85).

Although it is argued that there are a number of similarities between Davidson's and Anscombe's conceptions of intentionality, the causality in explaining intentional action is something about which they disagree of. Anscombe explicitly argues that what she calls mental cause is far from the Humean account of the explanation of human behaviour, and she sees causation as playing quite an insignificant part in the explanation of intentionality (Anscombe 1957, 16-18). Davidson himself would likely say that Anscombe's conception is inherently neo-Wittgensteinian and that his own conception goes against the grain, as it is quite similar to Hempel's view (because of rationality and causality) (1980e, 261). It is also true that in Davidson's conception of intentionality, the explanation of action is distinguished from what is referred to as the "Humean conception," if the Humean conception is interpreted as an appeal to an explanation of human action that is in line with the human sciences . The peculiarity of Davidson's conception of causal explanation is that it is limited to singular causal statements. The causal explanation of an agent's action is a singular statement connecting the primary reasons behind his or her action (1980a, 8-19). Davidson himself comments on this weak sense of causality by saying that "if A causes B, there must be descriptions of A and B which show that A and B fall under a law" (1980e, 262).

This idea of causality in Davidson's conception of intentionality generates yet another distinction between Davidson and Anscombe, as has been argued here (Annas 1976). The issue in question is the individuation of events, and it can be seen as problematic for Davidson's view (See Davidson 1980c). The question of the individuation of events is about tracking down the reasons for actions. If an action can be individuated, then it has only one proper description, including the description of the reasons behind it. Because Davidson holds that the causal explanation of intentional action is the proper explanation of action, it inclines Davidson to be committed to the fact that there must be one and only one proper explanation of actions. This is also why he has focussed on the discussion of the criteria for recognising identical and distinct action (1980c, 163). Davidson, then, is committed to saying that for a certain action A there is only one primary reason p that is the cause of the action (Annas 1976, 253; Davidson 1980d).

Anscombe, on the other hand, is critical of the Aristotelian notion of the final end in action, i.e. the idea that for a certain action A there is a final end e to which the action aims. Therefore, it is possible to say that Anscombe is also critical of the idea that there is only one proper description of an action. This, then, raises the question of whether there can be multiple descriptions of a single action (See Mele 2000). Anscombe presents a detailed discussion of various descriptions of

the same action, and Annas (1976) claims that this is a point at which her account differs from Davidson's. Anscombe, unlike Davidson, accepts that intentional action can have multiple descriptions (Annas 1976, 252-253). For Anscombe, descriptions of intentional actions are descriptions of means to the descriptions of ends, and these descriptions are not restricted to one particular means to ends description. It seems that Anscombe is in favour of the non-causal explanation of action and supports the idea that descriptions of intentional action can be multiple, i.e. the same action can have different descriptions. Searle's account of intentionality is introduced below, because it has certain advantages over both Anscombe's and Davidson's views of intentional action.

In his conception of intentionality, Searle makes a close connection between intentional states and speech acts, and he says that "[i]ntentional states represent objects and states of affairs in exactly the same sense that speech acts represent objects and state of affairs" (1979, 75). In his work, Searle describes few connections between intentional states and speech acts, which suggests that he supports a certain conception of intentionality. Searle claims that in his view of intentionality, intentional states represent content in a kind of psychological mode, and intentional states represent objects and states of affairs in a similar manner to speech acts. It can be said that the representative content of the Searlean conception of intentionality is based on whole propositions. (Searle 1979, 75-80; 1983, 5-13) Searle's conception of intentionality can be seen as a combination of the issues found in Anscombe's and Davidson's views, although Searle's work has created some novel conceptions of the tradition of intentionality. At least in the endeavour to develop an account of intentional action, it is beneficial to combine certain ideas from Anscombe, Davidson and Searle. The three main concepts of Searle's theory of intentionality are: *Intentional content*, *direction of fit* and *conditions of satisfaction*. Searle's introduction of these terms is motivated by his analysis of the belief - desire model of intentionality (such as Davidson's account with its beliefs and related pro attitudes), which he finds unsatisfactory (Searle 1983, 29-36).

A synthesis of Davidson's, Anscombe's and Searle's views can be applied in order to provide a more thorough conceptualisation of intentional action, which is also applicable in the explanation of the intentionality in collective action. Following Searle's criticism of the belief - desire model, it is suggested that the basic idea of the Davidsonian causal explanatory model be replaced with Anscombe's descriptive view. The reasons for this are that Anscombe's view has certain benefits in terms of its explanatory power when applied to collective intentionality and action, as is argued below. Again, following Searle, it can be said that Anscombe's view is also underdeveloped in certain respects. Searle states that intentional states represent intentional content in a certain psychological mode, which means that the Davidsonian psychological concepts cannot be excluded from a conception of intentionality despite the fact that they are neither necessary nor sufficient conditions of the conceptualisation of intentional action. These psychological concepts ought to be included in what Searle refers to as intentional content. Intentional content is the general feature of intentionality that has a certain direction of fit and conditions of satisfaction. For example, the intentional

action of taking a sip of cognac has an intentional content consisting of goals (getting a mouthful of cognac) and relating means (drinking from a glass filled with that drink) in a certain psychological mode (belief that the drink is actually cognac and an attitude of wanting to have a drink). According to Searle, the direction of fit is from world to mind, i.e. the world fulfils the beliefs about the means of the goal-attaining action (the glass is not glued to the table, the drink is not something else etc.). The conditions of satisfaction are thus that such an event, i.e. taking a sip of cognac, actually occurs.

6.4   Rule-governed and rule-constituted action

Because of the institutional nature of artefacts, their existence is dependent on the collective acceptance and engagement of individuals in collective action. This collective action can be said to be intentional, because collective acceptance is dependent on shared intentions, i.e. mutual beliefs of means and ends. Collective action is seen as rule-constituted action in which the application of the constitutive rule dictum is a description of a certain specific rule. On the other hand, the idea of describing social action in terms of mere rules was shown above to be problematic and an alternative conception of conventional fact was introduced. In addition, a conception of intentional action was discussed by comparing Anscombe's, Davidson's and Searle's views. According to Anscombe, actions that can be called intentional are cases to which the question 'Why?' is applied. Anscombe also claimed that intentional action is closely related to the description of action, i.e. to a description from means to ends.

By adopting Anscombe's notion of the relevance of the description of intentional action, a classification of certain kinds of rule-based collective actions is carried out here that emphasises the idea that the description of action is also a description of rules, or that the description of action is related to rules. The different types of collective action are classified here by applying two terms, *rule-governed* and *rule-constituted* action. Both of these types of collective action are describable by conventional facts, but the difference between them lies in the content of the intentions. This distinction resembles the dichotomy between tacit and explicit rules. The distinction between these types of action is also related to the question 'where does explanation come to an end?' The idea here is to describe two paradigm types of collective action that can answer the problematic question of how we should describe the social action existing in the logical problem of rule regress.

Here, the relation between these two types of collective action is discussed through one central inotion of intentional action developed by Anscombe. In her book on intentionality, Anscombe remarks that "the term 'intentional' has a reference to a *form* of description of events" (1957, 84). One problematic issue in the recent literature on collective intentionality has been how it is possible to explain truly collective action (and honest we-attitudes) that begins from individ-

ual beliefs and individual intentions (See, for example, Bratman 1999, 109-129). In other words, how is it possible to arrive at we-intentions from a collection of individual I-intentions? Because this intensely discussed issue cannot be covered in detail here, it is merely suggested that Anscombe's conception of intentionality can offer a contribution to these discussions. [3] This suggestion is demonstrated here briefly by developing Anscombe's ideas of intentionality in the context of collective acceptance and the conception of conventional facts.

The explanatory problem in the individualistic accounts of collective intentionality that are shared by a number of authors of collective action is the idea that the explanation should begin from individual beliefs which take the form of I-intend. The puzzling theoretical question in these accounts is how to go from a collection of I-intend modes to We-intentions (See, for example, Bratman 1999, 142-160). One way of explaining this is by referring to beliefs and beliefs about beliefs, such as in Lagerspetz's conception of a conventional fact. One way to question the necessity of this kind of individualistic approach is to look at the intentional content of collective action. In individualistic accounts the explanation of genuine we-mode intentions have to start from the analysis of beliefs including I as a referring referential term. It is only I that have the belief that we share an intention to do X together.

The suggested alternative approach, which can be derived from Anscombe's conception of intentionality and enhanced with some Searlean ingredients, has the potential to gain more direct access to the content of collective intentionality. The idea put forth here is that intentionality makes reference to a form of description which in turn can be applied to the creation of an alternative account of collective action and intentionality. Although Anscombe mainly discusses individual actions, her conception of intentional action is also applicable to the discussion of collective action. The basic idea in applying Anscombe's approach is to apply a similar kind of conceptualisation to both individual and collective action and to argue that the difference between these two types of action lies in the content of their description.

Following Anscombe's ideas, the mode of explanation is similar in both individual and collective intentionality, but the content type of the description is different. First of all, the content type can be distinguished into I-type descriptions and We-type descriptions. In addition, the We-type descriptions, referring to collective action, can be divided into two types of descriptions that are descriptions of rule-constituted and rule-governed action. The distinction between I-types and We-types is merely based on the type of target of description, although the type of mental cause can also be different in I-types and We-types. For example, I-type action can include an exclusively personal mental cause and We-type action a social phenomenon as an internalised mental cause. In the case of I-types, the intended goal of action is personal, as are the necessary means for achieving

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[3]   It can be argued that many of the authors of collective intentionality have a conception of intentional action, which is more closely related to the davidsonian account. (See f. ex. Bratman 1987 & 1999; Tuomela 1995 & (2002); Velleman 1997).

the goal. In We-types, goals and/or means also refer to a social collective.

Before going any further in this analysis, it should be noted that the concept of rule-constituted action should be distinguished from the problematic explanations of social action that are based on rules (discussed above). In addition, here, rule-constituted action refers to action that is carried out primarily in accordance with constitutive rules, or, to use terminology introduced above, in accordance with constitutive conventional facts. The interests are thus not in explaining action that is carried out in accordance with regulative rules. Although there can be regulative rules related to the use of artefacts, these rules do not play an explanatory role in the fundamental features of artefacts. An action that is relative to some regulative rule is not constitutive of the rule itself. The relation between an action and a rule is arbitrary in the case of regulative rules. In the case of constitutive rules, the relation between a rule and an action cannot be said to be arbitrary.

Both rule-constituted and rule-governed action are types of collective action that are relevant to the collective acceptance of artefacts. The difference between these two types of action is comparable to the idea of a relevant group in collective acceptance (See, for example, Lagerspetz 2001). In the analysis of social action, the actions of relevant groups can be said to be actions that relate to constitutive rules. This can also be demonstrated by two examples of rule following from Wittgenstein's philosophy. Pleasants (1999) has argued that there are two characteristics in Wittgenstein's philosophy that are relevant to the theory of social action. The first is the idea that the action itself is the expression or application of the rule. The second is that one can manage to act or master a language without acknowledging the explications of the related rules. So, the characteristic of rule-constituted action is the acknowledgement of the constituting rule, whereas rule-governed action is not dependent on the acknowledgement of the rule.

There are many everyday examples of these types of action. The most typical example of rule-governed action is the use of language by native speakers. Typically, native speakers do not begin by learning the rules of grammar and then apply these rules in the constructing of sentences in accordance with these rules. They might not even have any idea that such rules exist, although they continuously put together correct sentences. They know these rules by heart. Rule-constituted action, on the other hand, is dependent on the acknowledgement of these rules. For example, many people learning a foreign language (for example in school) come to know the rules of grammar that enable them to form correct sentences. Of course they also have to learn the semantic and pragmatic rules that distinguish correct sentence formations from incorrect ones (relative to the context of sentence, language-game or use) in order to acquire decent skills in the language in question.

The importance of this distinction in explaining collective action is that although there are many cases and examples of rule-constituted action, the collective action of some group is at least partially formed by rule-governed action. It can be said that the totality of collective action is formed by the rule-constituted actions of a relevant group and in addition to the rule-governed action of other

members of the collective. The rule-constituted actions of a relevant group are essential to collective acceptance, but it cannot be the sole basis of the analysis of the totality of collective action. In the case of technology, the initial acceptance of new artefacts is dependent on the collective actions of some relevant group. These actions also create the possibility for the existence of rule-governed action. The constitutive rule is the description of the rules of rule-constituted action, and, in the case of rule-governed action, the action itself is the description. A good example of the differences between rule-constituted and rule-governed action is fashion. Fashion designers create constitutive rules and celebrities acknowledge them and follow them (rule-constituted action). In addition, teenage girls and boys typically dress in a certain way because "everybody" else is doing it (rule-governed action).

Anscombe claimed that intentional action is dependent on the description of action. In the case of rule-constituted action, the description can be expressed with the constitutive rule. For example Hindriks' XYZ-conception of constitutive rules connects some non-institutional entity X to some institutional statuses Y and to behavioural dimension Z that is relative to Y. In the case of rule-constituted action, the form of explanation or logical order of description runs from left to right: X -> Y -> Z (+ C). A certain entity is assigned certain institutional statuses that relate to some action. For example in the case of fashion, some piece of clothing is given the institutional status of being fashionable, and this status is relative to the action of wearing the clothing in a certain social context. This is also the way in which certain types of novel action are created, such as manners of speech or sending SMS-messages. In the case of rule-governed action, the description is the other way round. In rule-governed action, the description begins from the action itself, and the action is related to some institutional statuses of some non-institutional entity.

In the case of rule-governed action, engagement in collective action follows from the acknowledgement that a certain kind of action Z is carried out in a certain context C and, thus, some entity X has certain institutional statuses Y, following from the action Z. Commonly, the engagement in collective action is simply carried out by recognising that some action is done tai takes place in a certain context, and this kind or type of action is then adopted as a part of the correct or accepted form of behaving. This idea can be demonstrated by returning to the example of fashion. There exist certain designers and a relevant group of "recognised" authorities on fashion (certain people such as celebrities, fashion magazines etc.). These parties create the artefacts and accept them, for example, as the new spring trends. Some consumers are also part of the constitutive relevant group, although many consumers are more conscious of what their friends wear than of the constitution of the relevant group, and usually (as fashion followers) come to mimic the actions of others. The typical examples of rule-governed action are cultural rituals, habits and customs. They are usually performed because they are performed in a given culture. Typically, there is no other explanation given for the action than the circular self-referring reason.

This distinction between rule-governed and rule-constituted action is reminiscent of the taxonomy of actions presented by Collins and Kusch (1998). They distinguish between mimeomorphic action and polymorphic action. In short, the difference between these two forms of action is that mimeomorphic action is the kind of action in which the form or pattern of action is always similar. According to the authors, mimeomorphic actions are "actions that we either seek to or are content to carry out in pretty much the same way, in terms of behaviour, on different occasions" (Collins & Kusch 1998, 31). Polimorphic actions are all other actions. Polimorphic actions are actions in which the same action can be carried out by (infinite amount of) different behaviours.

The difference between the idea of rules and action developed above and Collins' and Kusch's account is that the account here intends to provide an institutional account of the types of actions in Collins' and Kusch's account. The account here intends to provide an account of how these types of collective action or *conventional practices* come about in the first place. For example, the birth of a new technology is a paradigm example of how these kinds of conventional practices come into existence. The process begins with the identification of some problem that needs to be solved, which is the goal in the intentional action. In the initial phases, there can be multiple means for attaining this goal, and here we are clearly talking about polymorphic action. But during the development process of a new technology, a kind of technological closure occurs and a certain type of technology then becomes the paradigm means of the goal attaining action. When the relevant groups come to accept this and start acting accordingly, the action becomes rule-constituted action. When the lager collective of technology users become members of this created conventional practice, the rule-governed action in question can be mimeomoprhic action or polymorphic action depending on the ways in which the technology is used. Below, the idea of conventional practices as a repository of rule-governed and rule-constituted actions is discussed in more detail.

6.5 Conventional practices and explications

The reason for discussing different aspects of rules and the conception of intentionality here is to provide a description of collective acceptance and action, which is relevant to the understanding of the institutional aspect of the ontology of artefacts. In was argued in the previous chapters that artefacts have a dual nature and that the creation of an artefact involves social construction in terms of the assignment of certain institutional statuses to non-institutional entities. In order to provide a sound conceptualisation of the institutional nature of artefacts, a revision in the conceptualisation of collective action is also suggested here, based on Anscombe's conception of intentionality, conventional facts, and rule-governed and rule-constituted action. It is argued that the conception of a rule in Searle's and Hindriks' terms differs significantly from the conception of

rules in the works supported by the social theorists (such as Giddens). As a so-lution to the problems related to the explanations of rules, including social rules (and constitutive rules), the notion of conventional practices is introduced here.

In his latter philosophy, Wittgenstein remarks that obeying a rule is a cus-tom, use or institution (1995, §199). In another passage, Wittgenstein writes that actions carried out in accordance with rules are founded on a convention (1995, §355). In another above-quoted passage from Wittgenstein's work, it was stated that explanations must come to an end at some point. The main problem regard-ing the logical regress of rules are those cases in which explanations do not come to an end. The explanation of social action based on the conception of rules is al-ways dependent on further rules. Eerik Lagerspetz's conception of conventional fact has been suggested as an answer to the problem of the logical regress of rules. Wittgenstein has engaged in a similar discussion of rules as being conventions. According to Bloor, Wittgenstein uses the concepts rule, custom, convention and institution without providing any explanation of their meaning and evidently in a way in which the meanings are quite similar (Bloor 1997, 27-42).

Searle and Hindriks use the term constitutive rule to describe the institu-tional phenomena that are connected to some non-institutional entity. Although it is referred to as a rule, it should not be understood as a rule in the sense that it is dependent on other rules. According to Anscombe, intentionality is a ref-erence to some form of description. Because the institutional statuses of some non-institutional entity are inseparably connected to action and intentionality, the constitutive rule should not be treated as a rule at all, but as a form of de-scription of possible rules or conventions.[4] The constitutive rule should be seen as a form of description of some institutional phenomena. These phenomena are referred to by Lagerspetz with the conception of conventional fact, and they are connected to certain non-institutional entities and the related intentional action.

The reasons for disregarding the problematic rule nature of constitutive rules are that the phenomena to which it refers are conventional in nature and the existence of these conventions is not (necessarily) dependent on the existence of further rules. The existence of artefacts is partially comprised of rule-governed action, which is not dependent on the explication of the rule. Also, in the case of rule-governed action, the constitutive rule cannot be an explanation of collec-tive action as a whole, but is only applicable to a certain part of the collective engaging in collective action (as a constitutive rule). The constitutive rule can be a description of the mental cause (to use Anscombe's terminology) of collective intentional action, but it is not the primary condition for the existence of collective action in the case of rule-governed action. The mental cause can also be merely the description of a certain action (in a certain context). It can be a description of the action, but it is not the explicit constitutive rule that causes them to engage in action.

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[4]   Consider also Wittgenstein's comment: "Following according to the rule is FUNDAMEN-TAL to our language-game. It characterizes what we call descriptions." (1996, IV:28)

The distinction between rule-constituted and rule-governed action is also related to another problematic distinction between rules, namely the distinction between tacit and explicit rules. According to those authors who defend the tacit rule view, social action is partially constituted by comprised of tacit (implicit) rules that are not explicit and not even totally explicable. According to Pleasants, the false assumption that these authors make is that they presume the existence of further rules that are beyond the explicit knowledge of the authors. For example, in the cases referred here as belonging to the category of the conception of rule-governed action, the assumption is that there must be rules behind the actions that are constitutive of the action, although the actor herself is not aware of them. Pleasants' evidence against this kind of reasoning is based on Wittgenstein's ideas that "explanations come to an end somewhere" and that the ability to follow a rule is to do it (the application is the rule). (Pleasants 1999; Wittgestein 1995, §1, §89-102, §217) Wittgenstein himself strongly argues against the idea that there is something like the essence of language beneath the surface, and that whatever it is, it is hidden from us (1995, §89-102).

According to the tacit view, it would be tempting to claim that rule-governed action is tacit rule following and rule-constituted action is explicit rule following. This would then imply that these actions are fundamentally different types of action. If this were the case, however, wouldn't it be awkward to claim that, for example, people using mobile phones to intentionally do A, would actually consist of two different types of seemingly similar action. Where one person explicitly follows the rules by making a dinner reservation with her cellular phone, another person might only be tacitly aware of how to do so. Furthermore, if these actions are indeed different, they are not explicable or describable as similar. But it cannot be the case here that they are different types of action. Rather, they are merely different tokens of the same type. The difference is not in the form or even the content of the description. The difference is in the way of engaging in the action at hand and the roles in the social collective.

It was suggested above that collective action is dependent on collective acceptance and shared intentions. Following Anscombe, it was suggested that her conception of intentionality, which states that intentionality is a reference to a form of description, ought to be applied in in the explanation of collective action. Based on Anscombe's idea, it was suggested that constitutive rules should be understood as a form of the description of collective intentional action and not as a rule in the classical social theoretical sense. Here, a comparison to Lagerspetz's conception of conventional fact was also made. It was shown that Wittgenstein's inotion of rules as conventions shares certain similarities with the idea of conventional facts. It was also claimed that collective action consists of two kinds of action (two tokens of the same type of action), rule-governed and rule-constituted action, in which the concept of rule should be understood as a convention in the sense that no further explanation is needed.

The existence of artefacts is dependent on the institutional statuses that are assigned to a certain non-institutional entity. The existence of institutions is dependent on two kinds of collective action, rule-governed and rule-constituted ac-

tion. Rule-constituted action is especially essential in the creation of artefacts and the initial acceptance of their institutional statuses. Rule-constituted action, thus, cannot be the sole description of the collective action relative to artefacts. The totality of collective action must also include rule-governed action, which can be described quite similarly to rule-constituted action, although there are some differences as regards how the action is taken. Collective intentionality also makes reference to a form of description that is the form of constitutive rule.

In the dictum of constitutive rule, X refers to the natural facts that explicate the physical structure and properties of an artefact. Y refers to the institutional status of an artefact. Z relates to the behavioural dimension, or, in other words, to its action and use. C is the description of the context in which the description of these constitutive features is presented. The institutional status of an artefact is, of course, relative to the existence of an institution. It has also been noted that institutions are dependent on collective action (as a manifestation of acceptance). This collective action is connected to both the functions of the artefact and its behavioural dimension. It is essentially connected to the intentional use of the artefact. The context is the cultural or social context (of institutions and uses) in which the actual description, following the form of description, is applicable.

The main idea that is promoted here is that any thorough and consistent understanding of technological development must include an understanding of the social aspects of artefacts and an account of its physical properties. Our knowledge of technology is not just based on theories or taught in books and lectures in the field of the natural and technological sciences, nor is it merely socially constructed knowledge. For Marx, productive activity was what unites man with nature. By developing the fundamental idea of the Marxian ontology and the dual nature of artefacts, the production of technology is seen as a means of uniting natural facts with institutional facts. The discussion of natural facts as facts that exist independently of human constitution is a step towards a realistic interpretation of technology, in contrast to the approach taken by the construction view. The understanding of these institutional structures and the mechanisms of creating institutions in technological development can have an influence on what we perceive as technological development, and the institutional aspect is indeed an essential feature of the ontology of artefacts.

The suggestions made here also include a change in perspective when providing accounts of institutions and institution-related collective action. Although there has been extensive discussion of rules in this chapter, rules should be understood as conceptual characterisations and references to the normative basis of action. The perspective of explaining collective action and relating institutional phenomena ought to begin not from rules but from action. It is actions that define institutions and give statuses to objects. Actions are what define the institutional status of artefacts. The notion of conventional practices intends to capture this idea in the activity approach to collective-social phenomena in general and artefacts in particular. The social construction of artefacts is mainly the result of conventional practices that can be analysed in terms of the kind of intentional action

described above. These practices are conventions about how a certain goal is attained by certain technological means. The intentional content of the action that takes place in these practices can include the notion of rules in general and constitutive rules in particular as the analysed description of the normativity in the action. In the following chapter, I will discuss how these conventional practices are created in the course of the production of novel artefacts.

6.6 Conclusions

Watching a child play, one can easily get an idea of the conventional nature of artefact use that the notion of conventional practices is intended to capture. For a child, almost any object is a potential toy, and these objects are usually given assigned functions and statuses that differ greatly from their intended use. Their functions and statuses might even test our imaginative capacities. Children also use constitutive rules and performative acts of declaration when claiming tai declaring that, for example, a pine cone (with certain modifications) functions as a cow in the context of a play farm. It becomes a conventional fact that pine cones are cows and using them in accordance with their statuses can become a conventional practice. There are no further rules that explain the rule that pine cones are cows in the context of a play farm.

One central issue behind the idea of conventional practices as the theoretical notion of the use of artefacts is the intentionality and intentional action discussed above. One of the key notions in Searle's account of intentionality was intentional content, which extends the traditional belief-desire model of intentionality. It was argued that this idea of intentional content should be combined with Anscombe's idea stating that there is a strong connection between intention and the description of action. The reason for emphasising this idea was that in many cases of artefact use, there is simply no other "explanation" for the way artefacts are used. Artefacts are used in such and such a way because they are used in such and such a way.

Now that this analysis of intentional collective action as artefact use has been presented tai is complete, it is possible for us to consider the implications that it might have for technological development. Although these uses are conventional practices, they include certain preconditions regarding how these conventions can and have been created. The notion of use plans stresses the teleology embedded in artefacts and artefact use. Artefacts are used as a means of achieving some goal, and this goal setting and attaining has influences on how artefacts are created. There are also causal preconditions and effects related to functionality which are manifested through the physical properties and material structure of the artefact. These underlying preconditions of the conventional practices also have an effect on how the future uses of artefacts can change, although they do not determine these potential future uses.

One way that technologies develop is that new uses for existing artefacts emerge. Although the artefact itself does not change, new practices of use emerge. In these cases, the concept of relevant social groups, introduced by SCOT and briefly discussed above, is a useful conception. The use of an artefact in a new way includes the emergence of a new relevant group[5]. Typically, the members of relevant groups who use existing technologies in new ways also innovate themselves. The innovation theorist Eric von Hippel refers to individuals who create new uses and practices for artefacts as "lead users" (See von Hippel 2005). The relevant social groups are also important to the design and manufacturing driven development of technology, not just to the user driven development or sociological analysis of technological development. The creation of new artefacts requires the creation of a new kind of practice (or at least the enhancement of an existing one). In order for the creation of new innovations to succeed, the technology must to be accepted by a relevant group of users. And finding tai locating market niches for products requires the location of relevant social groups, and in this sense the conceptualisation developed here can enhance the conceptualisation of the relevant phenomena in the more practical and market driven enterprises of technology development.

The central issues in this chapter have been the collective involvement upon which artefact identity is dependent. The main arguments of the account developed here, which relies on the notion of conventional practices, can be summarised as follows:

- The collective intentionality in artefact use can be more consistently described when the psychological notions of intentionality include the social nature of many of our actions. This can be done by applying Searle's notion of intentional content and combining it with Anscombe's idea of the form of the description of actions.

- The conventional character of many social actions, including the practices of artefact use, can be characterised by two paradigm cases of social action, rule-governed and rule-constituted actions.

- Conventional practice is introduced as a theoretical term that captures the collective intentional action of artefact use.

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[5]   Here, the use of relevant social groups is limited to the possible user groups, and others, such as legislators or environmental groups, are bypassed for practical reasons.

7 THE CREATION OF ARTEFACTS

In this chapter, the creation of artefacts is discussed from the point of view of technical design. The main topic in this chapter is the promotion of a view of design that is referred to as "practice-based". The central idea of practice-based design is that the main target of the design action is the creation of social practices through designing technical artefacts. The purpose here is to apply and elaborate on the discussions in the previous chapters. This chapter begins by discussing both design action as intentional action and the practical reasoning involved in design. The practice-based design account is then further developed by applying some of the ideas in Michael Bratman's planning theory of intentionality to the notion of the use plans of artefacts. This fine-tuned version of use plans is applied in order to highlight the criteria for the creation of novel artefacts and, more specifically, to demonstrate why these practices are at the core of design action. After discussing these criteria, the discussion moves on to the question of how these criteria are involved in the reasoning behind the creation of artefacts. The notion of a conceptual framework is then introduced through the discussion of reasoning and design. The chapter ends with the argument that the ontology of artefacts developed here provides a conceptual framework for the design of artefacts.

7.1 Intentions, reasoning, and boundaries

Various authors in the dual nature of artefacts project have promoted the relevance of intentionality to the theory of artefacts (See, for example, Houkes & Vermaas 2004; Kroes 2003). Some authors have put particular emphasis on its relevance to the design and manipulation of novel artefacts. According to the ICT-function theory put forth by Vermaas and Houkes, "designing can be characterized as constructing a use plan and possibly describing a type of artefact" (Vermaas & Houkes 2006, 7). In use plans, a certain goal has been set and artefacts are either used or intended to be used in order to achieve it. In design, the

aim is the production of technical devices with appropriate functions that can be applied in use plans. When considering artefact design and manufacturing, the theoretical approaches to artefacts must take into account two different aspects of intentionality. One is the collective intentionality involved in the use of artefacts and the other is the intentionality of the design and manufacturing processes. Although they represent two entirely different realms of intentionality, they both share the same use plan, which relates properties as functions to use of the artefact according to its functions.

The intentional content that is shared by designers and/or manufacturers and users is the content that is embedded in the use plan. At least this content is something that ought to be similar, if the manufacturers and designers are to succeed at producing a purposeful functioning artefact for the fulfilment of a specifically defined use. There are, of course, a number of ways in which these intentional contents can be matched in the actual processes of design. In the social studies of technology, concepts such as *relevant social groups* have been introduced to explain how certain technologies (among others) become applied in the fulfilment of certain uses. There has, however, been a significant amount of criticism towards this view, and it has been claimed that this theorisation ignores the immediate interactions between users and designers and that it ought to be rephrased so that it takes into account the joint doing of users and designers (Hyysalo 2004, 70). One concept that has appeared in the social studies of technology and intends to capture this user-designer relation is Steve Woolgar's idea of *configuring the user*, a concept that Hyysalo has recently extended (Hyysalo 2004, 215-227).

In order to understand relationship between users and designers, which is, of course, essential to the (successful) creation of novel artefacts, we must examine how these two intentions coincide, i.e. the designers' versus the users' intentions regarding the use of the artefact. This can be done in part by providing a typology of the ways in which this user-designer interaction can be realised. For a more substantial account, however, one must look into both the social ontology of these relations and their underlying possibilities and boundaries. One issue discussed here is the intentionality that is explicated in the practical reasoning leading from the possible needs to a use plan. This reasoning is discussed here from the designer's point of view, and one of the central issues concerning both reasoning and the user-designer relation are the potential boundaries, i.e. how these boundaries are determined and the types of issues which limit and guide the reasoning. Boundaries should understood here as the practical criteria for limiting the possible outcomes of reasoning, i.e. the possible use plans of an artefact.

One way of referring to the possibilities and boundaries of technology is with the concept of Technological Frame introduced by Bijker. According to him, this Technological Frame describes the central elements of a certain technology, including its goals, key problems and problem-solving strategies, exemplars, user's practice and various forms of current knowledge. (Bijker 1995, 252; Hyysalo 2004, 67-72) This can be seen as the technological counterpart of T. S.

Kuhn's (1996) notion of the paradigm or disciplinary matrix of the natural sciences, at least in the sense that it intends to describe the common practices and problems of a certain distinguishable aspect of technology. As an alternative theoretical notion describing the context of technology, Hyysalo has suggested practice bound imagery as a theoretical term to be applied to technology studies. His idea is to include the actor network approach to the theoretical description and boundaries of certain technologies. (Technological Frame and practice bound imagery are discussed in greater detail below in relation to the creation of new artefacts.)

One of the central issues of this work has been the claim that technological development involves social construction and that this social construction in design can be understood as a performative act assigning a certain institutional status to an artefact. This performative act of creating or using artefacts is the creation or application of certain institutional facts, which are constitutive of the artefact. These issues follow the ontological view of the dual nature of artefacts, and it has been argued that an essential feature of technological entities is that the explanation of them involves a certain kind of goal directedness and that this feature has implications for the design of technology. If we take the fact that technology is socially constructed for granted, following from the interpretative flexibility of scientific findings, we are still required to provide an account of the boundaries of the interpretative flexibility and social construction. The boundaries of social construction and interpretative flexibility can be partially explained by the social or deontic powers conferred by the statuses of artefacts (See Searle 1995, 100-101). These deontic properties embedded in the status of artefacts create both positive and negative powers, such as the right or obligation to use an artefact in a certain way[1]. But these powers are only relative to certain physical properties enabling the very possibility of their creation. In this sense, brute or natural facts have a logical priority in the explanation of the possibilities and boundaries of the creation of technological artefacts.

When considering the design and manufacturing of technology from an intentional perspective, it can be said that the intentional content embedded in the use plan of an artefact is bound first and foremost by the possibilities and restrictions of its natural phenomena and properties. The restrictions that are the result of these properties are related to the social phenomena and the form and structure of action itself. This intentionality of design action is discussed here in the context of means-ends analysis and practical syllogism. It will also be shown that intentionality is a central feature of design action, because design action is best seen as an action that is targeted towards the achievement of a goal specified by the social, functional and physical properties of the artefact.

The declaration of the initial institution in the creation of new artefacts by the performative act, which states that some physical functions and properties count as the created artefact, results in the appearance of a boundary condition

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[1] One example is the use of nuclear power plants, which can be used for the production of both electricity and the raw materials needing in order to build a nuclear weapon.

which the declaration must fulfil if it is to become an institution. As was stated in the previous chapter, every innovation has to go through the processes of accreditation and authorisation. Design processes are not carried out in isolation by the designer, but always in relation to a certain environment. The initial ideas and products of innovation require the acceptance of different social groups, such as fellow designers, managers, customers, consumers, governments etc. In a design organisation, the initial idea for solving a design problem usually has to gain acceptance within the design group before it is further developed (King & Anderson 2002, 80-165). Product design has to meet the demands of customers and process design has to adhere to various principles, for example those set out in environmental protection legislation.

The issues of accreditation and authorisation have been extensively discussed in recent literature on scientific discoveries. Brannigan notes that "events are discoveries not in virtue of how they appear in mind, but how they are defined in and by a cultural criterion" (Brannigan 1981, 90). Schaffer remarks, that "work that is not credited is not a discovery" (Schaffer 1996, 14). Analogically speaking, these claims are of most relevant to the discussions of innovations and technological developments. Every innovation and introduction of a new artefact is dependent on the process of accreditation carried out by the community of users, or, at the very least, the acceptance of the community of designers. The relevance of these issues is not limited to the theorist of technological development. It is also crucial that the people who are responsible for the actual design and technological development of artefacts possess an understanding of these issues. For example, emphasis on the priority of the customer in marketing jargon can be seen as an initial reflection of the importance of the necessary conditions that the existent culture sets for a specific design. The product has to be accepted by the customer according to his or her standards.

In the accreditation process, on the other hand, the incorporation of a new artefact into the existing social structure of a culture and the prior existing institutional structure of a society can be seen as the preliminary condition for the potential acceptance of an innovation (for example such conditions as the laws, habits of consumers and moral attitudes of the community). Even after the artefact has gone through the accreditation process, it is not just that certain types of physical objects are accepted into the social reality of the community while others are not. If we think of the creation of the institution of mobile phones, the technological development process has led to the introduction of certain initial rules, possibilities for creating habits and behaviour patterns in addition to the introduction of a classification mechanism for certain types of artefacts[2].

The accepted institutional status of an artefact becomes an institution for classifying certain physical things and functions as something that facilitates the recognition of certain objects as certain artefacts. In other words, the accreditation process institutionalises the use of certain terms which are descriptive of the artefact.

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[2]   For classification and social reality, see (Barnes 1982; Barnes, Bloor & Henry 1996, 46-80)

For example, the use of the term mobile phone is based on a set of rules (conventions) about what a mobile phone is and what is not. The created institution of an artefact is also an introduction of certain initial rules of use and behaviour. It is primarily the physical properties of the artefact that restrict and enable certain patterns of action. Mobile phones have enabled communication that is not limited to any specific place or time. If we think of the marketing campaigns for certain consumer goods, it becomes clear that the advertising of a product includes strong references to a certain kind of behaviour, and the purchasing of the product in question implies the acceptance of the artefact and the specific behaviour included in its institution. We can claim that the creation of an artefact is, in addition to the creation of a physical object, the creation of the rules of a new form of life.

The theory of design should emphasise the institutional aspect of design in order to facilitate a broader understanding of design in general. Although this is not a statement of criticism against the relevance of the current investigations in the field of what Terence Love (2000) has described as Design Theory or Problem Analysis (see below), it is argued that there is an aspect of design, the social aspect, that is relevant to both the investigation of design and technological development. In discussing design theoretically, it should be acknowledged that there are certain purposes attached to the artefact in the context of its design and the entire design process (design action) as a whole. Certain structures in both the design and the artefact seem to have certain effects on designers and the consuming society, and in all cases the design is evaluated by both the design community and the users. All of these aspects are constituted by institutional structures, whether related to the users or the designers, and it is these institutional structures that constitute our knowledge of what things exists and how we understand them and act in accordance to their functions.

7.2 Intentionality and artefact design

In his paper on the philosophy of design, Terrence Love has examined some contemporary attitudes towards the theorisation of technical design (Love 2000, 295-301). According to Love, the vast majority of theoretical accounts of design have been centred on the natural facts involved in designing artefacts. Terrence Love labels this kind of approach to design, in which the focus of interest is limited to the object of design, as the design theory approach. In the design theory approach, the "theory of design" is based on the empirical knowledge of physical phenomena and includes, as limits, the knowledge of the applicability of the laws of the natural sciences to what is to be created in the design processes. (Love 2000, 293-294) Because artefact design is carried out mainly by humans, human design processes have also been topics of theoretical interest amongst psychologists, cognitive scientists and social scientists (mainly in the context of organisation theory and more recently in the field of research referred to as the design science). The

human approach, which deals to a large extent with the personal cognitive capacities and social facts of design organisation, is aimed more at what is referred to as "problem analysis," i.e. the ways decisions are made and the environments of decision making are defined (design methodologies, design environment, best practice strategies, organisational structure, knowledge management etc.) (Love 2000, 294; Simon 1981, 132-140).

The problem Love highlights in these theoretical approaches to technical design is that the human approach and the design theory approach have remained separate areas of research. Following Love's suggestion, the approach to creating and designing technical artefacts presented here intends to overcome the dichotomy between the above mentioned approaches to engineering design. The approach presented here is founded on the issues discussed in the previous chapters on the ontology of artefacts and discussed here in this chapter from the perspective of the inferences and reasoning involved in engineering design. By looking into reasoning and inference in engineering design practice, it is possible to clarify how these two approaches can be integrated. The inferences and reasoning in design connect uses and functions to physical properties. For example, the uses of a knife, for example as a bread knife, have relevance to the physical properties of the blade. This approach has similarities, for example, to Kroes' recent writing on engineering design, in which the main problem he discusses is the question of "what kinds of inference patterns are involved in reasoning from statements about functions to statements about physical structure and vice versa?" (Kroes 2006, 140)

The starting point in this analysis is the fact that artefact construction and design can be analysed as an intentional goal attaining action, although some authors have suggested other approaches (Gero & Kannengiesser 2004; Rosemann & Gero 1998). n her account of intentionality, G. E. M. Anscombe characterises intentional action by stating that descriptions of intentional action are descriptions of means to the descriptions of ends (1957). This kind of means to ends analysis of design action is not entirely new to the (methodology of) the engineering sciences either. For example, in his book, The Sciences of the Artificial, H.A. Simon refers to this analysis as an alternative to the description of the logic of design (1981, 141-142). For one reason or another, the concept of intentionality, which could potentially be an interesting means of investigating the history of technology studies itself, has not received much attention in technology studies until quite recently. On the other hand, intentionality, especially in terms of collective intentionality (or shared intentions), has been one of the recent issues of investigation in the philosophy of collective action and cooperation (Bratman 1999; Tuomela 2002). In their paper on design, Houkes et al have extended the importance of collective intentionality to the understanding of design (2002).

One other intentionality-based issue related to the reasoning in engineering design is practical reasoning, because artefacts are objects of practical use. In his central contribution to the philosophy of the human sciences, G. H. von Wright connects Anscombe's means to ends analysis of intentional action to the Aris-

totelian practical reasoning described as a practical syllogism as a method for understanding human action. The description of human action introduced by von Wright is intended to serve as a method for understanding the reasons why a specific action has been carried out. In general, intentional action is means to an end, and in order to understand it one must know what ends the action is aiming at reaching and by what means. In von Wright's model, intentional action is reconstructed as practical reasoning by referring to means and ends, and this practical reasoning can be described in a practical syllogism. If person p aims to achieve a certain goal G and has the belief B that it can be achieved by doing A, then p begins to do A. This practical reasoning can be expressed as a syllogism in this way:

> p intends to bring about G
> p considers that he cannot bring about G unless he does A.
> Therefore p sets himself to do A. (von Wright 1971, 96; von Wright 1963)

By suggesting the practical syllogism as a methodological device for understanding action and the practical reasoning involved in it (See Kusch 2003, 328), von Wright intends to describe the necessary and sufficient conditions for intentional action[3]. For some person p to do intentionally A, person p must have certain goals and relating beliefs how these goals are to be achieved. In order for p to bring about G, she must consider A to be a necessary and sufficient means of bringing about G. These necessary and sufficient conditions can be thought of as conditions that include the logical demand for the kind of practical reasoning that is described in a syllogism. If the conclusion in the practical inference is true, i.e. that person p sets to doing A, the premises in the syllogism ought to be true. The person reasoning from means to ends must think that these means are a necessary and sufficient means of bringing about G. Because humans do sometimes fail in the achievement of their goals, the minimal condition is that p needs to be convinced that doing A will bring about G. (von Wright 1971, 98-110)

The logical demands that are stated in the practical syllogism are not, however, conditions that are carried out in every course of action carried out by man. Even our common sense experiences go against this idea, because we sometimes fail to achieve the goals we set and we do not actually engage in conscious practical reasoning for every action that we carry out. Martin Kusch (2003) has recently remarked that the practical syllogism as a description of practical reasoning is primarily a post actu model for understanding why something was done, i.e. a description of the reasons for the action which is carried out. However, in some of the recent literature, Bratman and Brandom, for example, have argued that practical reasoning is also relevant in terms of making plans and carrying out rational

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[3] It has been claimed by several authors that von Wright's analysis of the criteria of the necessary and sufficient conditions fails. In design, practical reasoning and the practical syllogism can be applied as descriptions of ideal reasoning and relevant issues in reasoning in design.

action and is thus not merely a post actu method for understanding actions (Bratman 1987; Brandom 1994 & 1998). Houkes et al argue, by referring to Bratman, that making plans by using practical reasoning is an essential part of meaningful (and rational) design action (2002, 304). When considering the logical deduction involved in the syllogism, the deductive reconstruction of reasoning in intentional action should be considered an ideal case which can also show the flaws in the reasoning related to design action. The syllogism of practical reasoning can also be thought of as a logical and conceptual tool for plan making.

In connection to practical reasoning, intentional design action should be seen, at least ideally, as meaningful action including explicit goal setting and the explication of the possible ways of achieving the set goals (See Kroes 2006, 147-148). At first glance, this might appear to be nothing more than a mere trivial description of the existing practices of engineering design and artefact manufacturing. The design teams have their goals, and their education and socialisation into the design organisation provides them with the means to complete the given task of achieving the goal (i.e. creating the technical artefact). But upon closer inspection of these concepts in design (goals, beliefs), it becomes clear that the means and ends, both in practice and in theory, lack explicit reference to the understanding of what technological design is (See Kroes 2006). In the case of technological artefacts, this feature is evident in the design theory approach, in which the assignment of functions is aimed merely at the identification of the physical properties of artefacts, lacking any explicit references to, for example, social phenomena. According to the dual nature view of artefacts, the attachment of functional properties to the created artefact involves something more then the mere manipulation of its physical properties.

The social context of users is something that has an effect on artefact functions through the use related to the artefact properties and by the needs that have an effect on the artefact design. The existing social structures of the designers also have effect on the means of creating the artefact. In artefact creation, the understanding of the existing needs to which the use plan is related is also bound by social culture in which the designer and design activity exist. In practice, artefact design can be bound by the habits and conventions of the design organisation, which, in the worst case scenario, can diminish the creativity of the designers or lead to the functional failure of the artefact. As such, the social context and social phenomena that are relevant to artefact creation include two similar spheres of intentionality and collective intentionality. The social contexts that affect artefact creation are the *context of users and uses* and the *context of designers and manufacturers.*

The relevance of the cultural aspect for intentional action and the influence of an existing society on intentional action are also discussed by von Wright in his model of action, although von Wright himself does not make explicit reference to the social-collective phenomena of intentional action. What von Wright refers to as "normative pressure," i.e. the way people respond to existing norms and practices, is relevant to the intentional action the of the people. The way people

typically conform to norms, rules and practices, is by avoiding punishment or being reminded of their mistakes. This kind of behaviour is something that people inevitably engage in intentionally. The setting of goals and their beliefs of the necessary and sufficient means for achieving them are guided by their acknowledgement of rules and norms. (von Wright 1971, 145-151) Although von Wright's discussion focuses mainly on the intentional actions of single individuals, he does connect them to social institutions and collective action, and these issues are discussed quite extensively in the contemporary discourse on intentionality (See, for example, Bratman 1999, 109-129, Tuomela 2002, 78-121).

In designing new artefacts, the role of a society and its practices are central to intentional design action and the use plan. Design action is guided by goals that have their origin in the existing or predicted needs of customers. The means of carrying out the design action, i.e. the means of achieving the set goals, are learned through education and practice, as well as through socialisation into the design community. The setting of goals and selection of the means of achieving them occurs mainly on the basis of the existing needs and in accordance with to the existing practices and norms. Vermaas and Houkes (2006) suggested a conception of use plans as a conceptual tool for describing the function ascription in the design and manufacturing of technical artefacts. In a design plan, certain properties of an artefact are thought of as functions that are means for achieving a specifically defined goal of the use plan. By applying this concept, the goals of the intentional actions of designers and users become manifested in the function ascriptions of artefacts. The designers create functions as means for users to achieve a goal described in a use plan.

7.3   Uses, practices and figurations

In his planning theory of intention, Michael Bratman has extended the idea of practical reasoning to the plans and planning of intentional action. For Bratman, practical reasoning (and its syllogistic description) is not only a post actu description of intentional action but also the reasoning behind the plans of future action. This idea is something that is adopted in the idea of use plans. The difference between the technical design and individual planning of action is that the planning agent is primarily the designer or design community as opposed to the user. Of course, how the artefact is used is dependent on plans and execution of the user, but the content of the intentionality in the action of use is at least partially similar to the that of the designers. At least this ought to be the case if the artefact is successfully used in accordance with the intended purpose created by the designers.

An idea that John Searle emphasised in his account of constitutive rules was that performative acts as declarations of states of affairs are one of the central feature of the creation of new institutional facts (1995, 34). When it comes to technical artefacts, the states of affairs stated by a constitutive rule are such that some non-

institutional facts X have the institutional status Y of being a certain artefact. The goal of the enhancement of the constitutive rule suggested in Chapter 5 was to promote the relevance of collective action and its interrelation to the institutional status of the artefact. This is in line with Searle's claim of the primacy of social acts over social objects. Collective actions create and maintain social institutions, such as the institutional statuses of artefacts.

The designing and manufacturing of novel artefacts is guided by the marketing of the use plan to the users. As was argued in the previous chapter, the existence and maintenance of institutions, including technical artefacts, is dependent on the collective acceptance and involvement of the users. The theoretical term *conventional practices* was used to describe the feature of artefacts according to which their existence is dependent on the practices of use, which are conventional in nature. In this sense, the designing and manufacturing of novel artefacts are both social and technical innovations. The creation of novel artefacts is simultaneously the creation of a new social practice through the uses and functions of the artefact.

One puzzling question in the theories of innovation and the social studies of technology has been how these novel practices become adopted by the users and thus part of the social structure of the user culture. The idea of relevant social groups was discussed briefly in the context of the social construction of facts research programme (see Chapter 3). The main idea in the social construction of artefacts view is that technological closure, in which a certain technology becomes chosen as the paradigm solution to an underlying problem of technological development, is influenced by the power of certain relevant social groups over others to influence the outcome of the closure. (Pinch & Bijker 1984) This initial theoretical description by Pinch and Bijker has been further enhanced by Bijker's conception of Technological Frame. Technological Frame intends to serve as a more sophisticated theoretical conception which captures the essential features of technological development. (Bijker 1995, 252; Hyysalo 2004, 67-72)

An alternative theoretical conception in terms of practice bound imagery has been offered by Hyysalo. Practice bound imagery emerges from actor-network theory and it intends to be more sensitive to the relation between users and designers in the initial phases of novel technology (Hyysalo 2004, 65-102)). Hyysalo also elaborates the concept of figuration initially introduced to the social studies of technology by Woolgar. In his work Hyysalo distinguishes different kinds of figurations, which are ways that functions and uses of an artefact are created and initialized into the user community. With his different conceptions of figuration, Hyysalo intends to describe the ways use plan is created, marketed and initialized through designer - user interaction. (Hyysalo 2004, 203-232)

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to the social studies of technology by Woolgar. In his work, Hyysalo distinguishes different kinds of figurations which represent the ways in which the functions and uses of an artefact are created and initialised into the user community. With his different conceptions of figuration, Hyysalo intends to describe the ways in which use plans are created, marketed and initialised through designer - user interaction. (Hyysalo 2004, 203-232)

Hyysalo distinguishes between three types of figurations of technology: pre-figuration, re-figuration and co-figuration. The pre-figuration of the use of technology is carried out by designers and is a representation of the use of the technology that is either being designed or to be designed (Hyysalo 2004, 217-221). The sources of the reasoning behind the uses in the case study conducted by Hyysalo were found to be explicit investigations and designer's assumptions. In the initial phases of technological design in which pre-figuration typically occurs, the design begins from functional descriptions, and, according to Kroes, the reasoning in engineering design proceeds from functions to structure (138-139). It can be said that initial functions of designed artefacts are pre-figurations of their uses. The interesting question both here and in general regarding the designing of artefacts is related to the sources, motivations and boundaries of the reasoning behind the pre-figuration of technology.

The re-figuration of the use of technological artefacts refers to the figurations that revise the uses of the artefact's use plan. According to Hyysalo, "[t]he re-figuration of technology means intertwining it with its utilizers' work and everyday life." (2004, 221) This idea of re-figuring technology bears a strong resemblance to the idea proposed here in the previous chapter about the potential of users to change and enhance the patterns of use and the institutional status of artefacts. Pre-figuration refers more to the idea of performative acts in terms of the creation of artefacts, in which certain non-institutional facts are given a certain institutional status relative to their use, and and are re-figured so that they enhance and maintain the existing institutional statuses and related patterns of usage.

Co-figuring technology use is the third conception of technology figurations, and it refers to the processes of the interaction between the users and designers of technology. According to Hyysalo,

> [e]ven though most design and use of technology takes place in separate place and time, there are occasions when designers and users work together in improving the technology. (2004, 225)

A similar notion of co-figuration is emphasised by Vermaas and Houkes in their use plan account. Although their idea that designers communicate use plans to users is more in line with pre-figuration, they remark that "[t]ransferring the artefact only would be largely worthless to users" (Vermaas & Houkes 2006, 7). What they seemingly wish to conclude is that communicating use plans should be, at least partially, understood as co-figuring the use of technology.

According to Bratman one central feature of plans is means-ends coherence (1987, 31). This is something that is also applicable to both design action and the means-ends content of the intentions of use plans. Following from this criterion, it can be said that the elements of the practical reasoning of use plans must be coherent, meaning that the relation between means and ends is such that the functions and properties of an artefact are the means of achieving the goal[4]. Another demand that Bratman requires of plans are that they include consistency constraints . The consistency to which Bratman refers is internal consistency. This idea follows from his view of plans as partially integrated with other plans and more general plans etc. His idea of consistency thus refers to the idea that there are no competing plans or beliefs that could violate the execution of these plans.

In the context of the use plans of artefacts, this consistency constraint can be expanded to cover the beliefs, practices and institutions of the collective of artefact users. By expanding this demand from the internal perspective of an individual agent to the external view of social collectives, it can be used as a criterion for both successful use plans and the use of pre-, re- and co-figuring technology. The criteria for designers to create a successful and executable use plan, which is seemingly a necessary criterion for successful innovations producing novel artefacts, is that the created use plan has to be consistent with the existing practices and mutually shared beliefs (at least in the relevant social groups) of the users. The intended practice of using the technology created in the creation process of novel artefacts has to be acceptable and executable by the members of the intended target user group, and, of course, there also has to be a need to adhere to the use plan. There has to be a reason for attempting to attain the goal of the use plan by applying the offered technological means.

7.4 Imageries, technological frames, and practices in design

Returning now to both the reasoning in the creation processes of artefacts and the question of the boundaries of reasoning, the issue can be discussed more thoroughly by referring back to the subjects discussed in the previous sections of this chapter. As a characterisation of the content of use plans, both the means-end analysis as a description of the intentional action and the practical syllogism as a framework for practical reasoning were introduced. Following the ideas initially put forth by Bratman, it was suggested that means-ends coherence and consistency constraints are criteria for use plans in relation to the external social context of practices and institutions. This appeal to the external context of the social is implied, for example, by the issues of the accreditation and acceptance of new technology above.

The initial theoretical framework of the social construction of facts and artefacts analysed the socio-historical development processes of technology through

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[4] On coherence between physical and functional properties, see also (Kroes 2006) and on problems of Kroes' idea of coherence see (Dipert 2006).

four central concepts: artefacts, problems, solutions and relevant social groups. These concepts are used to explain the social reality of the development process with its problems and offered solutions. The maturation of the development process is referred to as technological closure, i.e. the selection of one technology amongst many as the paradigm example, and it is described as a result of the problem - solution development influenced by relevant social groups. The impact of the relevant social groups is central to the development and selection of the artefact and eventually to what is referred to as technological closure. (Pinch & Bijker 1984, 410-419)

In his later works, Bijker has proposed the concept of Technological Frame to further characterise the elements of this kind of social reality of the technological development process. Recently, the idea of Technological Frame has been criticised for undermining the central role of users and user-designer interaction during the process of technological creation. Hyysalo has suggested practice bound imagery, which is based on the idea of actor-networks, as an alternative theoretical concept.[5] The central idea of both practice bound imagery and technological frame is to capture the framework of the knowledge, techniques, practices and problem-solution pairs of a certain technological development. This theoretical description of the central actions and social structures is then used to explain the whys and ways of certain technological developments.

One reason to discuss imagery in the context of technology is to attempt to make sense of how new ideas (in terms of functions and physical inventions) come about in technology. Here, imagery refers to what is imaginable or conceivable in technology, i.e. to the kind of uses and related functions that can be created from certain physical properties. In this kind of context, the theoretical concepts of technological frame and practice bound imagery refer to the framework, background and boundaries in which this imagery takes place. A similar kind of underlying question is discussed by Kroes in terms of how engineering design can create reasoning that integrates the technical functions and physical-structural descriptions of artefacts. Kroes' answer is to extend the logical notion of coherence used by Thagard to the relationship between physical and functional descriptions (Kroes 2006). The ontology of artefacts developed here has suggested that this relation between physical properties and functions (relative to use) is primarily a constitution relation combining natural facts to institutional facts.

In his discussion of Kroes' work, Randall Dipert remarks, among other things, that the question Kroes poses about the existence of a gap between physical and functional descriptions has clear similarities to the question of the hypothesis generation in science (Dipert 2006, 155-156). As is the case in science, there is no logic of discovery[6] in engineering in the sense that there would be sound deductive methods of inference from observation to theories, or, in the case of technology, from physical properties to functions (Dipert 2006, 155). In his paper,

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5   Compare the use of imagery also to Bloor's (1991) idea of social imagery
6   On the logic of discovery, see (Hanson 1958, 70-92 & Magnani 2001)

Dipert suggests that the coherence between physical and functional descriptions, at least in the sense of Kroes' extension of Thagard's idea, is inspired by the idea of abduction. The notion of how physical and functional descriptions come to cohere involves a kind of non-deductive reasoning which is sometimes referred to as abductive reasoning.

This notion of abductive reasoning includes two interesting aspects which are discussed here in more detail. One of them is abduction as a type of creative reasoning that can also be applied to the reasoning in engineering design. The other is the analogy between hypothesis and functions, which makes abductive reasoning as hypothesis generation applicable also to the context of technology. Where the first issue is related more to the forms and types of reasoning, the latter relates more to its content. Although there has been some dispute as to whether abduction is a plausible form of inference and what can be considered as abductive reasoning, it is evident that both the hypothesis generation in science and the function generation in technology involve a kind of reasoning that includes novelty. The following discussions of abductive reasoning provide conceptual tools for understanding the general mechanisms of creative reasoning involved in function generation in engineering and reasoning in design in general.

In the context of scientific discoveries, it has recently been argued that reasoning for suggesting a scientific hypothesis is limited through the conceptual possibilities of describing the phenomena to be explained (Pohjola 2006). This idea is similar to the theoretical ideas of practice bound imageries and technological frames that intend to describe the framework of reasoning in technology. One relevant thing about the creative inferences in the processes of creating artefacts is that the products of inferences can be thought of as kinds of hypotheses, and an artefact is seen as a successful innovation only when its functions are in use. Functions, all of which are created by the manipulation of physical properties, are only manifested in the practice of the use of the artefact. what needs to be answered it what are the limiting mechanisms for reasoning in technology. I.e. what are the structuring mechanisms creating technological frames or practice bound imageries that provide the context in which the new function ascriptions are made.

According to the philosopher Charles Sanders Peirce, abductive inferences are the third form of inference, in addition to deduction and induction. In his early writings Peirce referred to this as the reasoning hypothesis (Peirce 1932, 2.623), which can actually be descriptive of the reasoning itself. The end result of abductive reasoning is a hypothesis, a suggested explanation of some surprising observed fact. Peirce's classical formulation of abductive inference as expressed in syllogistic form is this:

> The surprising fact C is observed;
> But if A were true, C would be a matter of course,
> Hence, there is reason to suspect that A is true. (Peirce 1960, 5.189)

One typical objection to this Peircean schema is that the suggested hypothesis A already appears in the premise of the syllogism, so the schema cannot explain

the discovery of A in the first place (See Niiniluoto 1999, 439-440). The modification to the syllogism suggested by Niiniluoto is the replacement of the individual hypothesis A with the hypothesis of kind K in this way:

> The surprising fact C is observed;
> There is reason to suspect that some hypothesis of kind K explains C,
> Hence, there is reason to suspect that some hypothesis of kind K is true. (Niiniluoto 1999, 440)

Niiniluoto's syllogism is an enhanced version of Peirce's including a modification stating the K-ness property of the hypothesis. The idea of K-ness implies that there are certain general types of hypotheses that could explain the phenomena. The K-ness criterion states the idea that the suggested explanation of some surprising fact can only be of a certain kind. This idea of criteria (and the relevance of context) for suggestible hypotheses and artefact functions can be further illustrated through some examples from the discussions of inference to the best explanation (IBE), because discussions in IBE have inherent similarities to the reasoning that proceeds from properties to functions, as is the case in the theory of technical artefacts.

In literature, the inference to the best explanation is seen as a contextual principle which is strongly dependent on the existing background knowledge for its application (Douven 1999, 426). For example, Gilbert Harman discusses an example in which a person sees someone jerking her hand away from a hot stove after having touched it. Although we do not have direct access to others' feelings of pain, we still conclude that she is feeling pain on the basis of her behaviour. (Harman 1965, 93) The inference from behaviour to pain, i.e. the hypothesis that her behaviour is a result of the fact that she is in pain, is essentially connected to the context of the observation (not an issue explicitly discussed by Harman). It can be said that the existing context of observation and reasoning draws the boundary conditions for the possible explanations, because the external observer cannot have access to the action causing feeling, i.e. her personal feeling of pain. The explanations are thus relative to the representative observation of the fact to be explained.

These conditions for the hypotheses and function ascriptions of technical artefacts can be further enhanced by some ideas based on Ludwig Wittgenstein's views on hypothesis. In 1930, in a discussion with Waismann and Schlick, Wittgenstein makes a claim about the nature of hypotheses. He distinguishes between propositions and statements on the one hand and hypotheses on the other. The statements and propositions are descriptions of states of affairs that can either be true or false, which is, of course, a very common way of thinking about statements or propositions. On the other hand, hypotheses are not descriptions in the same sense as propositions. According to Waismann, Wittgenstein has said that a "hypothesis is not a statement, but a law for constructing statements." (Waisman 1979, 99) In Wittgenstein's manuscripts inform the early 1930's, there is one

passage in which he claims that a hypothesis is a logical structure to which the rules of representation adhere (Wittgenstein 1975). According to Noë, the distinction Wittgenstein makes between hypotheses and statements is that hypotheses and statements have a different kind of formal (or grammatical) relation to reality (Noë 1994, 14 & 34).

What can be said about hypotheses and function ascriptions is that they are not descriptions of phenomena in the same sense as propositions or statements. Hypotheses are descriptions of the possibilities of certain phenomena to become propositions or statements. This idea is analogously applicable to functions in technology. Functions are the possibilities of phenomena which can only become actualised by the use of artefacts. This idea of the possibility of phenomena and its descriptions are related to what Wittgenstein describes as grammar and grammatical investigation (Wittgenstein 1995, ∮ 90). Grammatical investigation is not, in the context of hypotheses, targeted at the phenomena themselves but at the forms of expression that are used to describe them. The hypothesis suggestion is about the possible ways of conceptualising phenomena, or ways of presenting descriptions. What Wittgenstein is referring to with his terms grammar and grammatical is not just the syntactical rules of language structure, but also the rules of the meaningful use of language (Fregean semantics and the context of language use).

Hypotheses are possible explanations that can later be proven right or wrong. This idea has been expressed by various authors who have written on creative discoveries and hypotheses by distinguishing between the contexts of suggesting and justifying hypotheses. For Wittgenstein, the possibility of phenomena refers to the idea that there are certain rules of description or representation that we apply in the process of suggesting hypotheses. These rules are related to the logical form or structure of possible descriptions on the one hand, and are about something that goes beyond form and structure (the concept of language-games and the use of language) on the other. Wittgenstein claims that the target is on the possibility of phenomena and that hypotheses operate according to the rules of description. Also, when confronted with a fact that requires explanation, there are only certain limited kinds of propositions that could explain it.

What is emphasised here is that hypotheses can be seen as suggestions that are similar to the designing functions of artefacts, at least in the sense that they are both hypothetical and have yet to face any empirical experiments that would determine their success. The process of suggesting, extending the possible explanation of and testing a hypothesis is also somewhat similar to the process of technological development. The three aspects of figuring discussed above, pre-, re- and co-figuring, can be seen as aspects of the initial suggestion, enhancement and modification of a function that resemble the scientific process of how a hypothesis can become part of a scientific theory. Just as in science an initial theory must endure various enhancements and adjustments before it can become a paradigm of science, artefact functions and the related physical properties go through various changes and modifications during the development stages.

There are, however, certain differences between hypothesis suggestion in

science and in engineering design. If we accept the premise that there is always a use plan at the core of any design action, then the function ascription of an artefact also necessarily relates the physical phenomena to the social phenomena, such as institutions, habits and practices. So, the hypothetical suggestion that such and such physical phenomena are functions of an artefact relates only to the means of a use plan. For artefacts, the context of justification is not only the empirical fact that such and such physical phenomena are some function of an artefact, but also that such and such physical phenomena are used as function providing means for attaining a certain goal (of the use plan). As has been argued in the previous chapters, even if some object does have certain properties that can be used as a function of some use, the artefact ceases to exist if it is not used, i.e. if it does not have an institutional status.

What this discussion of hypothesis generation intends to offer to reasoning in design and the creation of artefacts is an insight into and method for understanding the selection of possible alternatives in the creation process of artefacts. The function ascriptions of artefacts are limited in various senses. An artefact's physical properties restrict its possibilities and the social structures and practices restrict the possibilities of function ascriptions. This was the idea embedded in the concepts of technological frame and practice bound imagery. There does exist a specific framework in which reasoning in engineering design takes place. The discussion about hypotheses and abductive reasoning as hypothesis suggestion deals with the conceptual aspect of this framework. As was argued, these ideas can be also be applied analogously to function ascriptions and reasoning in artefact design.

For Kroes, the initial question of reasoning in engineering design was "what kinds of inference patterns are involved in reasoning from statements about functions to statements about physical structure and vice versa?" (2006, 140) Here, reasoning in engineering design was approached from the perspective of intentional action and the framework of practical reasoning was adopted to be descriptive of the intentional content related to the use plan of artefacts. The notion of use plans and their means-ends structure of practical reasoning was enhanced with some of the ideas from Bratman's planning theory of intentions. These ideas were means-ends coherence and consistency constraints. The question of consistency was approached through abductive reasoning and the possibilities of phenomena and functions, and it was argued that fulfilment of Bratman's two criteria can be achieved only by connecting functions to the social context of use.

The conceptions of technological frame and practice bound imageries are used to capture the context of technological innovations. In the context of abductive reasoning, the idea of a conceptual framework was introduced through Wittgenstein's view of hypotheses and the possibilities of phenomena. It is suggested here that by applying use plans, practical reasoning and the conceptualisation of artefacts through constitutive rules, a conceptual framework for creating artefacts can be developed. Through this conceptualisation, the idea of the practice-based design of technical artefacts is proposed as both an application of

the ontology of artefacts developed here and an answer to the question proposed by Kroes in his paper.

7.5   Design and the ontology of artefacts

The emphasis here on the relevance of practices promotes the idea that relevant knowledge for technical development by technical design should include an understanding of the social aspects of artefacts in addition to their physical (or natural) properties. And the knowledge that is relevant for design is not limited to the scientific theory formulated and presented in books and lectures. Rather, it must also include a more or less thorough understanding of the effects of design on the surrounding culture. If one wants to formulate a theory of design (as a theory of technological development), one should take into account the fact that there are institutional structures which play a central role in and have a significant impact on the design process. The functional failures of artefacts are not merely the result of the miscalculations of an engineer. Functional failures are also failures in understanding the community of users, its cultural existence, needs and values. Design in general is a social process which takes place within an organisation that interacts with its external environment.

It has been argued in a number of recent writings on social ontology, collective intentionality and cooperation that any collective action, which is necessary in order for something to become a social institution, must be comprised of the shared mutual beliefs of individuals (Lagerspetz 2001; Tuomela 2002, 22-39). Bratman says that shared intentions are the basis for coordinative action (1999, 113) and that social institutions can be seen as obliging structures for coordinative action (Tuomela 2001). As has been argued previously in this work, the existence of artefacts is dependent on the collective acceptance of these shared beliefs through participation in practices by individuals. The "proper" or acknowledged functions and uses are dependent on their institutional status, and it is a feature that distinguishes artefacts from other kinds of artificial entities. There are two main aspects of the importance of the collective account of intentionality for the theory of design: the context of the design organisation and the environment of the culture of artefact users.

In the context of the design organisation, collective intentionality theorises the shared mutual aims of the design action in the organisation and the means of achieving them. The plans related to collective intentionality, developed especially by Bratman (1999), ought to have a particularly strong emphasis on the context of design organisation. The analysis of collective intentionality emphasises that if design organisation intends to have a shared intention for the design actions, then it has to involve planning, communicating and accepting. For a design organisation to have a collective intentionality, it has to develop mutual beliefs of the tasks, goals and means constituting the action.

In the context of the culture or environment of users, the question about col-

lective intentionality is strongly related to the acceptance of an initial institution constituting the artefact. As was previously discussed, the acceptance involves collective acceptance in the culture of users through shared cooperative action. The existence of an institution is dependent on the collective action of relevant groups of users that maintain and later enhance the social structure of the institution. The theory of design, as a theory of performative and productive action that creates artefacts having effects on the social structure of a culture, ought to explain the fundamental mechanisms related to how artefacts as social constructions have their social status in a culture.

As was argued above, the intentional contents of designers and users are integrated in the use plan of an artefact. The purpose of artefact design is to create a technical object that has certain (manipulated) properties that function as means for some specified goal attaining action. This goal attaining action of the use plan is what the users ought to collectively perform by using the artefact as a means of achieving this goal. This collective engagement in using the artefact (in a certain way) is a necessary condition for the artefact to gain institutional status. Because institutional status was one of the central criteria for something to be an artefact, the creation of artefacts, and thus successful innovations, are dependent on the fact that a design manages to create a practice of use by developing an artefact and attaching an institutional status that is relative to its function to it.

The main issue of the approach here has been the reasoning involved in the creation of artefacts and reasoning that proceeds from the physical to the functions and vice versa. It was argued that the two different theoretical aspects of technical design can be integrated through reasoning in the design process and that this integration should be the result of the consistency and coherence of use plans. Following form the fact that the existence of artefacts is dependent on institutional status, practices of use are primary phenomena in the description of artefacts. Practices as actions create and maintain institutions and come to constitute artefacts. As such, in order to fulfil the criteria, use plans have to make explicit reference to use in general and use as social phenomena in particular. In the previous chapter a theoretical concept of conventional practices was introduced in order to capture this phenomena, and an account of practice-based design which follows this conceptualisation is suggested here.

One idea that was touched upon during the discussion of abductive reasoning, more specifically in the discussion of hypotheses and technical functions as outcomes of reasoning, was the idea of the conceptual framework of reasoning. The framework in question cannot, however, be arbitrary in the sense that it has to provide grammar to the possible descriptions or conceptualisations of artefacts (in a general manner). Therefore, the conceptual framework has to be able to capture what is necessary and essential in both the reasoning and its outcome. At least some of these aspects have been discussed and presented here in the context of technical artefacts. The ontological investigation into the fundamentals of various phenomena intends to provide a more thorough understanding of the basic features of the object under examination, and, thus, also to provide conceptual-

isations to be used when referring to them. This has also been the main goal in this work. What the ontological investigation carried out in this work can offer to the creation of artefacts is an explication of the relations between the features of technical artefacts and the conditions in which they can exist by describing the fundamental phenomena. Similarly, it can function as a conceptual framework for design, including practical reasoning and use plans as design-oriented features of the ontology.

It has been argued that the creation of practices of use is essential to the creation of novel artefacts. Therefore, it is suggested that design ought to begin from these practices, or that the design action should intentionally aim at producing such practices. This can be thought of as the doctrine of practice-based design. The intentional content of practices is embedded in the use plans of artefacts. Searle's condition of the satisfaction of this intentional content is action itself. This condition can be enhanced with the two criteria from Bratman's planning theory of intentionality. The use plan must have means-ends coherence and the use plan must be consistent. These two criteria or rationale for design action imply that the functions explicated in the use plan must be consistent with the ends of action and that the action, too, is consistent, i.e. executable in the social context of users. Following from the ontology developed here, it can be said that the design action has to be able to performatively create a constitution relation between certain natural and institutional facts in a way in which the object and its physical properties comes to have the institutional status of being an artefact that has certain functions that can be used as a means for some attained goal.

8   CONCLUDING REMARKS

This work has attempted to provide a sophisticated ontological description of technical artefacts, including the social ontology of artefacts. This ontology intends to promote certain central issues about the fundamental nature of technical artefacts. One of them is the centrality of use as a social practice. Without the cooperative use of an artefact, the created object of technological development becomes obsolete and forgotten and ultimately ceases to exist. Another central issue is the centrality of social phenomena for the existence and recognition of artefact statuses and functions.

Although the ontology has promoted the idea of social construction, the centrality of social phenomena cannot exist without the causal roles of physical phenomena. Therefore, a certain logical priority of natural facts exists in the conceptualisation of artefacts. It is only certain physical properties that provide a basis for reasoning that ultimately ends with the assignment of certain functions and uses to an artefact. The socially-constructed components of artefacts are based on physical phenomena. As has been argued here, conceptualisations of technology studies such as interpretative flexibility, multi-directional models and technology deconstructions are also bound by properties located in the natural world, and this ontological claim can also have methodological implications in the social studies of technology.

The interrelation of causal roles and physical properties with institutional statuses and intentional uses is one of the puzzling questions of recent philosophical accounts of technical artefacts. This issue is also relevant in the context of technical design, because design is a creative process in which physical-causal phenomena are connected to certain uses and practices. The proposal for their interrelation in this ontology was based on constitutive rules, but it was enhanced in a way in which this constitution relation is always relative to use as a social-collective practice.

The intention in summarising the issues discussed in the ontology and relating them to artefact design and creation is to imply that there are areas in which this work can communicate with other theoretical and methodological practices in the area of technological development . One line of communication

is, of course, technology studies. Another means of communication could be the theoretical approaches to innovations. Ontology as a philosophical discipline is intended to explicate the fundamental features of phenomena. As such, it is easy to see the relevance of this work also to more practically-oriented approaches to technology and technological artefacts.

For example, the implications of this work for the design practices of technological and engineering design are quite similar to the issues discussed recently, for example, in relation to user-centred design (See, for example, Norman 1998). In these accounts the design process is not technology driven but user and user need driven. Design begins from users and the design process is an interactive process between the designer and the user. The contribution that this view can make to design practices and methodologies is the introduction of the social aspect of technology. In relation to the more cognitive-oriented approach of user-centred design, this work suggests a practice-based design in which social practices are explicitly taken into account in the design process.

Future developments of this research could take a number of different forms and create a wide range of possibilities. The first is, of course, the future consideration and enhancement of the ontology developed here. In addition to refining the details of this work, it could have interesting cross-disciplinary applications. One of them is the enlargement of this basic ontology and the idea of the creation of artefacts in the context of the theory of innovations. As a term, innovation has a wider scope of meaning than artefact, and innovations are related more to the creation processes and success of technology. This development would require more emphasis with regard to, for example, the role and content of relevant social groups and the phases of innovation processes.

Because philosophy is not an empirical science and the statements that philosophy makes cannot be corroborated through empirical testing, the perspectives and objectives of philosophical work also differ in certain respects from empirical sciences. One central tool of philosophical analysis is conceptual investigation and construction. Through conceptual analysis and elaboration, philosophy can bring new insights to and help clarify phenomena. The purpose of this work is to do precisely that for the study of technological artefacts. In addition, it aims to contribute to the recent successful developments related to these issues. By recognising the central role of social life and the practices of use in relation to artefacts, we can put ourselves in the more sophisticated position of being able to evaluate phenomena belonging to the phenomena which fall under the heading of technical artefacts.

Another issue related to innovations in general and reasoning in innovations in particular is the topic of model-based reasoning and its application to technology. This was briefly referenced in Chapter 7 in relation to abductive reasoning and the means-end coherence of a use plan. The main question of model-based reasoning is: "Can there be (general) models of reasoning?" And in the context of technology, we must ask: "Can there be general models of reasoning about func-

tions and use plans?"[1] One way of attempting to answer this question could be that the ontology developed here could function as conceptual model, or at least the foundation for a conceptual model, of the model-based reasoning in technology.

Another issue that was not discussed here in detail is the application of the notions of social ontology to the design organisation itself. The discussion in the previous chapter was mainly on how these social-collective phenomena affect design action and reasoning as the intentional content of design action. As the authors of the social construction of artefacts have shown, different relevant social groups exist within a design organisation or the collective that produces technology. Another unanswered question is how these two social collectives, users and designers, can be methodologically integrated beyond the concept of use plan discussed in this work.

One way of seeing the extension of this issue and the ontology of artefacts developed here is by considering the possible implications of these issues in organisational innovation and marketing strategies. In the conclusion to Chapter 6, the concept of lead users was discussed. According to the inventor of the term, Eric von Hippel, lead users are people who are relevant to the manufacturers who create new innovations. If this appeal to special individuals can be extended to groups, the analysis of such groups through use plans and other concepts can be used to enhance the marketing and commercialisation of new products.

The claims that technology is partially socially constructed and that creation of new technology also creates new kinds of practices also have potential implications for technology policy and the evaluation of the ethical aspects of technology development. Since the emergence of the field of the social studies of technology, ethical and political questions have become one of the central topics of discussion in technology studies. The previous appeal to the freedom of science, in which technology was seen as a product of scientific findings, has been replaced with a view on how science and technology mesh in the practices and interests of various social groups. This has silenced those who have claimed that the ethical aspects of technology should be discussed only in the realm of use, not in the context of science or manufacturing.

If technology production is also the production of practices (i.e. social innovations), then an enhanced conceptualisation of this aspect of technology production can and should be increasingly taken into account. The issue of produced practices can be viewed from two aspects. From the productive aspect, the interests are related to the kinds of practices the new technology needs to create. A good example of the undermining of this fact is the introduction of WAP technology to mobile phones (in Finland) at the turn of the millennium. The developments were exclusively technology driven. The technology, with its potential applications, including video streams, weather reports, mobile e-mail, etc., were promoted with a big fuss and the promise of fast data transfer with 3rd generation

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[1]   On the notion of model-based reasoning, see f. ex. (Magnani & Nersessian 2002). On previous work done on the subject, see (Pohjola 2006).

mobile technology (which actually didn't enter the Finnish market until 2006). In all the technology hype, the manufacturers neglected to establish whether the users actually wanted the services the technology was intended to provide, and the end result was that WAP technology never realised the level of success its manufacturers had intended.From the normative or ethical perspective, the possible practices can be discussed and considered in terms of the kinds of practices and uses the technology should or should not permit.

The discussions and developments in this work can also make a contribution to technology policy. In late 2005, some Finnish policy-makers expressed concern that Finland is falling behind in the global markets partially because of its innovation policy[2]. Although the level of Finnish innovations is high, Finland has been unable to develop them into successful applications and the level of the commercial application of technological innovations is lower than in its rival countries. One reason for this is the structure of innovation and technology funding, in which the emphasis has been on the work related to development and production as opposed to product application. This might turn out to be the result of a misunderstanding regarding what innovations are, because they have been confused with technical inventions which are merely the basis of innovations. In providing an ontological analysis of technology, the basic features and concepts of technological artefacts and innovations can be made more clearly specified.

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[2]   See f.ex. Sitra's (The Finnish National Fund for Research and Development) annual report from year 2005

YHTEENVETO (FINNISH SUMMARY)

Teknologiset innovaatiot ovat keskeinen osa meidän arkipäiväistä elämää. Innovaatioista on muodostunut myös yksi keskeinen kansallisen ja globaalin kilpailukyvyn väline. Innovaatioilla on keskeinen asema teknologiapolitiikassa, joka ohjaa yliopistojen, tutkimuslaitosten ja yritysten valtionrahoitusta. Vaikka teknologia on niin keskeinen osa meidän arkipäivää, ei ole kuitenkaan tavatonta, että teknologiaan liittyvät käsitykset ja termit ovat epäselviä. Esimerkiksi julkisissa keskusteluissa tekniset keksinnöt (invention) ja innovaatiot tapaavat mennä sekaisin.

Käsillä olevan työn tarkoituksena on selventää teknologiaan ja teknologian tuotoksiin liittyviä käsitteitä. Työssä filosofisen analyysin kohteena ovat tekniset artefaktit ja analyysin tehtävänä on selvittää artefaktien perimmäinen olemus. Tämä filosofinen analyysi tarjoaa käsitteellisen kuvauksen teknisistä artefakteista ja niihin liittyvistä ilmiöistä. Analyysin tehtävänä on vastata mm. kysymyksiin 'kuinka teknisillä artefakteilla on oma identiteetti joka mahdollistaa sen tunnistamisen ja erottaa sen muista?', 'mitkä ovat keskeiset vaikuttavat seikat sille, että artefakteilla on tietty identiteetti ja status?' ja 'millä tavalla artefaktin fyysiset tai materiaaliset ominaisuudet liittyvät sen funktioihin ja siihen mihin sitä käytetään?'.

Työn keskeinen argumentti on, että tekniset artefaktit ovat sekä fysikaalisia että sosiaalisia systeemejä. Artefakteja ei määritä pelkästään sen fysikaaliset ominaisuudet vaan keskeisesti myös sen käyttö. Artefaktien käyttöä tarkastellaan tässä työssä eritoten sosiaalisena ilmiönä, koska artefaktit ovat kulttuurisia objekteja ja käyttö tapahtuu sosiaalisessa kontekstissa. Tästä seuraa myös se, että uuden teknologian tuottamista tulee ajatella laajemmin kuin vain fysikaalisten laitteiden ja prosessien tuottamisena. Teknologian tuottaminen on keskeisesti myös uusien kulttuuristen toimintatapojen tuottamista ja teknologiset innovaatiot ovat osaltaan myös sosiaalisia innovaatioita.

Työ lähtee liikkeelle perinteisestä kysymyksestä artefaktien filosofiassa, joka koskee artefaktien identiteettiä. Antiikin Kreikasta juontavan ongelman mukaan teknisten välineiden identiteetin määrittäminen sen materiaalisten ominaisuuksien perusteella on ongelmallista. Esimerkiksi kysymykseen missä määrin jonkin välineen ominaisuuksia voidaan muuttaa, jotta kyseistä objektia voidaan edelleen kutsua samaksi välineeksi on ongelmallista. Ratkaisuksi tähän ongelmaan Lynne Rudder Baker on ehdottanut konstituutiosuhteen käsitettä, jonka mukaan tietty materiaalinen objekti konstituoi artefaktin tiettyjen olosuhteiden vallitessa. Esimerkiksi tietyissä olosuhteissa alasin on sepän työkalu ja joissain toisissa olosuhteissa sama objekti voi toimia verkonpainona.

Vaikka yllä mainittu Bakerin konstituutiosuhde on askel oikeaan suuntaan, siinä on tiettyjä ongelmia. Yksi keskeinen ongelma on Bakerin kovin yleinen ja avoimeksi jäävä käsite olosuhteet (circumstances). Baker ei ole kovin yksityiskohtainen sen suhteen mikä määrittää ja muodostaa nämä olosuhteet, jossa jokin konstituutiosuhde vallitsee. Yksi mahdollinen tapa jolla olosuhteiden käsitettä

on mahdollista tarkentaa, on tarkastella kulttuurista tai sosiaalista kontekstia jossa konstituutiosuhde vallitsee. Kontekstin näkökulmasta tarkasteltuna kysymykseksi nousee, mitkä ovat ne keskeiset seikat jotka muodostavat tai määrittävät sen sosiaalisen kontekstin, jossa konstituutiosuhde tietyn materiaalisen objektin ja sen artefaktin statuksen välillä vallitsee.

Sosiaalisen kontekstin vaikutusta teknologiseen kehitykseen on tarkasteltu viimeaikoina teknologian sosiaaliseen puoleen painottuneessa tieteen ja teknologian tutkimuksessa. Käsillä olevassa työssä tarkastellaan erityisesti yhden tällaisen tutkimusohjelman kontribuutiota. Trevor Pinchin ja Wiebe Bijkerin alun perin muotoilemassa teknisten artefaktien sosiaalisen konstruktion tutkimusohjelmassa keskeinen ajatus on tarkastella teknologiaa sosiaalisena konstruktiona. Tutkimusohjelman keskeinen tarkastelunkohde on se, kuinka sosiaaliset tekijät ja sosiaaliset ryhmät vaikuttavat teknologian kehitykseen. Vaikka kyseinen tutkimusohjelma on kehittänyt merkittäviä menetelmällisiä ja teoreettisia välineitä teknologian tutkimukseen, sen perusajatuksissa on ontologisesta näkökulmasta tiettyjä rajoituksia. Eritoten rajoittuminen pelkästään sosiaalisiin ilmiöihin luo tiettyjä rajoituksia ihmisestä riippumattomien fysikaalisten ilmiöiden tarkasteluun, jotka kuitenkin ovat keskeinen rajoittava tekijä sille, minkälaisia (sosiaalisia) konstruktioita teknologiat voivat olla.

Työn positiivinen ontologinen kontribuutio on artefaktien ontologia, joka perustuu kolmeen keskeiseen osaan: artefaktien kaksinaiseen luonteeseen, konstituutioon ja artefaktien käyttöön. Artefaktien kaksinaisen luonteen perusteella teknologiset artefaktit ovat kahden maailman kansalaisia tai niillä on kaksinainen luonne. Yhtäältä ne ovat fysikaalisia objekteja, rakenteineen ja ominaisuuksineen. Toisaalta ne liittyvät toiminnan ja käytön maailmaan, jossa niitä käytetään tarkoituksenmukaisesti. Tässä työssä tämä kaksinainen luonne kuvataan muista teoreettisista rakennelmista poiketen John Searlen filosofiaa seuraten luonnollisten ja institutionaalisten tosiseikkojen avulla. Tämän tön mukaan artefakteja konstituoi sekä luonnolliset että institutionaaliset tosiseikat. Tämä tarkoittaa sitä, että artefaktit ovat fysikaalisia entiteettejä ja niillä on asema todellisuuden sosiaalisissa rakenteissa. Pelkästään artefaktien tunnistaminen ja käyttö edellyttää, että sillä on sosiaalinen status kulttuurissa. Lisäksi artefaktit liittyvät käytäntöihin, jotka ovat puhtaasti sosiaalisia konstruktioita.

Näiden kahden luonteen keskeistä yhteyttä tässä työssä tarkastellaan yllä mainitun konstituutiosuhteen kautta. Tässä työssä konstituution ajatus eroaa kuitenkin Bakerin konstituutiosta ja se perustuu Searlen esittämään ajatukseen konstitutiivisesta säännöstä. John Searlen konstitutiivista sääntöä X counts as Y in context C on mahdollista käyttää havainnollistamaan artefaktien kaksinaista luonnetta. Searlen mukaan konstitutiivinen sääntö kuvaa performatiivisen aktin jossa jollekin entiteetille X annetaan jokin statusfunktio Y, tietyssä yhteydessä C. Erityisesti Searle käyttää konstitutiivista sääntöä kuvaamaan sosiaalisten instituutioiden syntymistä. Artefaktien yhteydessä manipuloidulle fysikaaliselle entiteetille X siis annetaan statusfunktio Y, joka on samalla tietty institutionaalinen status, joka tälle entiteetille luodaan. Searlen ajatusta instituutioista seuraten

voidaan sanoa, että artefaktien tuottamisessa on kaksi erottamattomasti yhteen liittyvää puolta: fysikaalisen objektin manipulointi ja institutionaalisen statuksen luominen objektille.

Ontologian kolmas keskeinen osa on artefaktien käyttö sosiaalisena ilmiönä. Artefaktien institutionaalisesta statuksesta seuraten työssä argumentoidaan, että artefaktien käyttö voidaan nähdä sosiaalisina käytäntöinä. Koska artefaktit ovat kulttuurisia objekteja, niiden käyttämiseen osallistuminen on osallistumista sosiaalisiin käytäntäihin. Tässä työssä näiden käytäntöjen sisältö kuvataan käytön (toiminnan) intentionaalisuudesta lähtien. Artefakteilla on tietty (luotu, rakennettu) funktio ja tämä funktio toimii keinona tietyn päämäärän saavuttamiseen. Ollakseen kollektiivista toimintaa, jota artefaktien institutionaalinen status edellyttää, tämä keinojen ja päämäärien kuvaus toiminnan tai käytön intentionaalisuuden sisältönä pitää olla jaettua.

Artefaktien ontologia joka tässä työssä esitetään, ei ole pelkästään objektien tai entiteettien ontologiaa vaan osin myös sosiaalisen ontologiaa. Työn yksi keskeinen argumentti on, että artefaktien olemassaolo tarvitsee kollektiivista toimintaa, koska yksi keskeinen kriteeri joka erottaa artefaktit muista keinotekoisista entiteeteistä, on sen institutionaalinen status. Artefaktit eivät kuitenkaan ole pelkästään sosiaalisia konstruktioita, vaan niiden ominaisuudet ja funktiot ovat vahvasti kiinnittyneitä fysikaaliseen todellisuuteen. Tämän vuoksi artefaktien ontologian täytyy kuvata myös konstituutiosuhde joka yhdistää fysikaaliset ominaisuudet funktioihin ja sosiaalisesti määräytyneisiin käyttöihin ja käytäntöihin.

Työn viimeinen osa on omistettu teknologian tuottamisen tarkasteluun ja sille minkälainen kontribuutio esitetyllä ontologialla voi olla tuottamisen teoreettisiin ja käytännöllisiin seikkoihin. Seuraukset joita tämän analyysin tuloksilla voi olla teknologian tuottamisen ja suunnittelemisen käytäntöihin liittyvät sosiaalisten tai kulttuuristen ilmiöiden ja fysikaalisten ominaisuuksien yhdistämiseen. Esimerkiksi teknologisten innovaatioiden onnistumiselle ja menestymiselle kriteereitä luovat fysikaalisten seikkojen lisäksi sosiaaliset seikat. Kehittämällä uusia menetelmiä, joilla suunnittelussa voidaan ottaa huomioon tuotettavan teknologian sosiaalinen puoli, innovaatioiden onnistumisen mahdollisuuksia voidaan edistää. Koska uusien innovaatioiden käyttöönotto vaatii käyttäjien hyväksymisen ja omaksumisen, innovaatioiden tulee olla sellaisia, että ne istuvat olemassa oleviin tai mahdollisiin tarpeisiin. Lisäksi ne eivät saa olla ongelmallisia suhteessa olemassa oleviin käytäntöihin ja uskomuksiin. Uudesta teknologiasta ei tule menestyksekäs innovaatio, vaikka se olisi teknisesti kuinka hyvä tahansa, jos sitä ei kukaan halua käyttää.

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