



Systems, Signs & Actions

An International Journal on
Information Technology, Action,
Communication and Workpractices
Vol. 10 (2017), No. 1, pp. 1–33

<http://www.sysiac.org/>

Untangling the Web of Practices: Designing Information Systems in Context

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Abstract

Practices are intertwined with each other, often in complex and unexpected ways. Therefore, the development of information systems artefacts does not only need to take into account the practices in which the artefacts are to be used, but also related practices. However, identifying and exploring these practices is a non-trivial task, which so far has not received much attention in the literature. Thus, the overall goal of the research presented in this paper is to provide a support for systematically addressing multiple, related practices in information systems design. The solution presented consists of a set of guidelines for context-aware analysis and design based on a classification of practice relationships, distinguishing between interconnected and resembling relationships. The former focus on exchanges of information as well as other resources, and they can be divided into management, asset, and input/output relationships. The latter consider practices that are similar to each other though they may reside in distinct areas or domains. The research presented is an example of design science, and the primary research methodology used is conceptual analysis. In order to preliminarily validate the result of the research, a demonstration has been carried out by applying the guidelines for analyzing an information system for schools.

Keywords: Information system artefacts, practices, practice relationships, classification of practices, design science, guidelines for analysis and design of IT systems, design context

Received: 17 March 2015; Revised: 7 April 2017; Accepted: 9 May 2017
Accepting Editor: Göran Goldkuhl

1 Introduction

Information system artefacts are studied in different fields of science, including formal sciences, behavioral sciences and social sciences. For example, a study in theoretical computer science (formal science) could determine the complexity properties of a new algorithm for traversing a social graph. A study in psychology (behavioral science) could investigate how social media influence stress levels among users. A study in business administration (social science) could examine how the adoption of ERP systems in companies affects their internal communication. Information systems artefacts, as well as other kinds of artefacts, are also studied in design science, where they are investigated as solutions to practical problems. In design science, researchers take

an intentional stance in the sense that they view an artefact as something that should support people in a practice (Hevner et al., 2004, Goldkuhl, 2012, Johannesson and Perjons, 2014, Peffers et al., 2007).

Practices do not exist in isolation but are intertwined with each other, often in complex and unexpected ways (Nicolini, 2012). People in one practice may be unaware of a related practice, e.g., a quality control practice, as well as its effects and influences on their practice, which may result in unforeseen interferences between the practices. As a consequence, the development of an artefact does not only need to take into account the practice or practices in which it is to be used, but also related practices. For example, when developing an information system for a bank, the developers need to consider not only the banking practice but also the government practice of compliance monitoring. Thereby, the bank can effectively interact with the government in the future and show its compliance with regulations. Another example is that the design of a warehouse system for products needs to take into account not only the warehouse practice but also related practices, including sales and logistics practices. Thereby, the whole supply-chain can be effectively managed. Thus, artefact development typically benefit from taking into account several related practices.

Addressing relevant practices during artefact development is not a trivial undertaking, and there is, therefore, a need for methodological support that assists practitioners and designers in this task. More precisely, they need support to 1) identify and untangle related practices; 2) understand how an artefact can affect these related practices; and, based on that, 3) unveil relevant requirements on the artefact as well as potential complementary solutions. Thereby, more effective artefacts can be developed. Moreover, when understanding how an artefact affects related practices, practitioners can better understand how they can be adapted to each other. The paper focuses on information systems artefacts but most of the results apply also to other artefacts.

To the best of our knowledge, there does not exist much work on methodological support for systematically addressing multiple, related practices in information systems design. Some relevant work has been carried out in the area of Business Process Management, e.g., by Aitken et al. (2010) and Dijkman et al. (2014), but most work has focused on top-down designed processes rather than practices. Thus, the overall goal of the research presented in this paper is to propose such a support. This goal can be made more precise by introducing three sub-goals:

- to provide support for identifying relevant practices to consider in artefact development
- to, given the relevant practices, provide support for understanding how the artefact under development can affect these practices, both intentionally and non-intentionally
- to, given the effects of the artefact on the practices, provide support for eliciting requirements that can be used to develop a more valuable artefact, to adapt the related practices, and to identify already existing, potential solutions in these practices

The rest of the paper is organized as follows. Section 2 positions the paper by introducing the concepts of practice and artefact as well as their relationships, as they have been discussed in the information systems literature. Section 3 presents the research

methodology applied. Sections 4 and 5 describe the proposed support, which takes the form of a set of guidelines for context-aware artefact design and analysis. Section 6 demonstrates the guidelines by applying them on an information system for schools. Section 7 summarizes the paper and suggests directions for further work.

2 Practices and Artefacts

2.1 The Concept of Practice

The notion of practice has been hugely influential in modern social science through works such as those by Bourdieu and Nice (1977) and Giddens (1986). An overview of philosophical and sociological approaches to the role of practice and practices in human activity is given in Schatzki et al. (2005). Moreover, Nicolini (2012) provides an introduction to a number of theories and approaches of practices, including contemporary ones, such as the work of Engeström (2005), and Schatzki (2005).

There exists as yet no widely accepted canon of practice theory, and instead, the notion of practice can be seen as a guiding lens in a family of approaches for analyzing social, technical and organizational phenomena (Nicolini, 2012). Feldman and Orlikowski (2011) identify three ways of studying practices: empirical, theoretical and philosophical. In the empirical approach, researchers investigate empirically how human agency produces organizational outcome, thereby emphasizing the importance of practices, but without explicitly grounding their works on practice theories. The theoretical approach studies how theoretical relationships can explain how practices are produced from everyday performance, and also how they are reproduced and changed within different contexts and over time. The philosophical approach presumes that the fundamental phenomenon in social reality is constituted by practices, as expressed by Schatzki et al. (2005, p.2): “The social is a field of embodied, materially interwoven practices centrally organized around shared practical understanding”. In these three different approaches to studying practices, researchers interpret the notion of practice in different ways, but there are still a number of common themes. Adler and Pouliot (2011) suggest five key characteristics of a practice: 1) practice is performance, i.e., the process of doing something, 2) practice tends to be patterned, i.e., actions are repeated over time and space, 3) practice is more or less competent in the meaning that it can be done correctly or incorrectly in a socially recognizable way, 4) practice rests on background knowledge, and 5) practice weaves together the discursive and the material world, i.e., without written and spoken communication people cannot make a difference between behavior and practice, and the practice is mediated by material artefacts. To this last characteristic can also be added the critical role of the human body, since a practice is often viewed as “routine bodily activities made possible by active contribution of an array of material resources” (Nicolini, 2012, p.4).

How to weave together social, discursive and material worlds has been investigated in a number of research streams related to practice theory, including socio-technical systems, Actor-Network Theory, and sociomateriality (Cecez-Kecmanovic et al., 2014). The notions and approach introduced in this paper are independent of the ontological commitments in any of these research streams. In particular, we do not need to commit to the dense philosophical assumptions made in some variants of sociomateriality, e.g., about the inseparability of the social and the material (Leonardi, 2013). Still, acknowledging the importance of the material in sociomateri-

ality could suggest valuable extensions of our approach, which is so far centered on purely social aspects, especially goals, norms and power as discussed below.

Practices can be more or less structured or formalized. Some practices take place within organizations, e.g., the production of vehicles in factories or the management of customer complaints in call centers. Other practices occur in informal settings, for example, kids playing soccer in a backyard or people celebrating Christmas. There are also practices in which people can engage as individuals, e.g., brushing their hair or tying their shoelaces. This paper is focused on organizational practices, i.e., practices within an organization that have the goal of producing value for customers, which may be external or internal to the organization.

2.2 Practice and Process

The notion of practice is often compared and contrasted to that of process. As discussed by Brown and Duguid (2000), a practice is typically improvised, able to respond to changing environments, and driven by tacit knowledge. Practices emerge bottom-up from the activities of agents and reflect their knowledge and experience as these have developed over time. In contrast, Brown and Duguid (2000) argue that processes organize and orchestrate routine work in a predictable environment, relying on explicit knowledge as expressed in task descriptions and handbooks. In their view, processes are designed top-down by management and imposed on employees with or without their consent. While processes enable management to establish an efficient work organization that ensures reliable and consistent results, they can also hamper creativity and flexibility. There is also a risk that a newly introduced process can break down existing work practices, thereby disrupting the working of an organization. Practices, on the other hand, provide fertile ground for invention and adaptability, but they are challenging to manage and can easily become inefficient. According to Brown and Duguid (2000), managers need to balance between processes and practices to provide structure and efficiency and at the same time foster innovation and creativity. In order to do that, practices need to be identified, understood and disseminated. Achieving this balance, however, could be a challenging task since there is a gap between the way work is described in work descriptions and the way employees actually work within a practice.

In contrast to Brown and Duguid (2000), there has been approaches that are focusing on the similarities between processes and practices, for example, Goldkuhl and Röstlinger (2006) and their workpractice theory, which is a framework that can be used for conceptualizing contexts to information systems. Although they see differences between workpractices and business processes, such as the concepts of norms and judgements common in workpractice approaches but not in process-oriented approaches, their aim is to make the notion of workpractices and processes more compatible and transparent to each other.

2.3 Goals, Norms and Power

In the tension between practice and process, Schmidt (2014) identifies two distinguishing features of practices, normativity and contingency, and he defines practice as normatively regulated contingent activity. Practices are always governed by norms, often in the form of rules, principles or guidelines. Therefore, it is always meaningful to ask whether someone has acted well or competently within a practice, which is also in line with the third characteristics of Adler and Pouliot (2011), stating that a practice

can be done correctly or incorrectly in a socially recognizable way. Furthermore, practices differ from processes by including a more substantial amount of contingency, meaning that agents in a practice more frequently need to handle variations, deviations and contingencies. The agents cannot rely on predefined recipes for handling every situation but often need to exercise their own judgment for managing unexpected events.

For an organizational practice, there can be a tension between its goals and norms. On the one hand, the practice has the goal of producing value for a customer, and on the other hand, its activities will be regulated and influenced by the norms of the practice as well as the society in general. Goals and norms may be well aligned, but they may also come into conflict, and it is therefore useful to distinguish between instrumental and normative aspects of an organizational practice. An instrumental aspect concerns the fulfilment of organizational goals, while a normative aspect concerns the conformance with norms. For example, an instrumental aspect of a sales practice in a company could be the amount of products or services sold, as this is related to the sales goals of the company. A normative aspect of the sales practice could be the extent to which salespeople prioritize the interests of the customers before those of the company, which relates to general societal norms. In order to manage goal fulfilment as well as norm conformance within an organizational practice, agents become organized through and use power relationships. Power is here viewed as an agent's ability to influence another agent to think or act differently than that it would otherwise have done, as suggested by (Frost, 1987). For example, a sales manager could have the power to reward high-performing salespeople. Summarizing, instrumental aspects of an organizational practice concern its goals and how well means are able to fulfil goals, while normative aspects are about the norms and values that influence the behavior of agents in the practice. Power aspects, finally, concern the form, basis and distribution of power among the agents of the practice.

2.4 The Role of Artefacts in Practice

Artefacts can be defined as objects made by, or identified by, humans with the intention that they be used to address practical problems, as suggested by Vermaas et al. (2011). But there is also a need for interpretation, i.e., the user of an object, or even a community of users, has to view and interpret it as an artefact (Thomasson 2014). Some artefacts are physical objects, such as furniture, computers, and hip replacements. Other artefacts take the form of drawings or blueprints, e.g., an engineering design for an aircraft, and they can be materialized in the form of physical objects. Methods and guidelines can also be artefacts, for example, a method for designing computer games. Many social objects, including laws and regulations, can also be seen as artefacts, as argued by Vermaas et al. (2011) who even view entire socio-technical systems as artefacts. There are also IT artefacts, which by Hevner et al. (2004) are defined as “constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems)”. Common to all of these artefacts, whether they are tangible or intangible, is that they support people when they encounter problems in some practice. Here, the notion of problem is taken in a wide sense also including challenges or opportunities.

The importance of artefacts in practices are emphasized in the fifth characteristics of practices of Adler and Pouliot (2011), stating that practices are mediated by

artefacts, and by Nicoloni (2012), stating that there are no practices without artefacts (and human bodies). Artefacts have been extensively studied by researchers in practice theory, in particular information system artefacts.

According to Feldman and Orlikowski (2011), it is not the technological artefact per se that is valuable and meaningful for organizations. Instead, it is the technology-in-practice that is producing value and meaning for an organization. A technology-in-practice is an enacted structure of technology use, and consists of rules and resources that are constituted and reconstituted through human agents' interaction with the technology. These enacted structures will shape the agents' further interaction with the technology, which in turn, may or may not reproduce these structures, or constitute new structures. As a result, the operations and outcomes of technology are never fixed, instead they are emergent, situated and dynamic in a situational organizational setting. Therefore, the use and configuration of technology need to be studied over time, i.e., in a temporal trajectory.

Artefacts can establish connections between different practices across space and time. That is, artefacts can be created in one practice but can then be used in another. As exemplified by Nicolini (2012, p.4): "The desk used by the students, the equipment used by the teacher, and even the fact that the room is likely to be clean are also results of other activities which become the resources for the practice at hand". Similarly, an artefact can shape or be shaped by several practices, and a designer might, therefore, need to consider these practices as well when designing an artefact for a certain practice. As stated by Rohde et al. (2009): "Design is conceived itself as a social practice which is directed towards developing other social practices by designing artefacts and stimulating their appropriation in organizational settings. Such a focus requires a simultaneous analysis of social activities, artefacts' functionalities, design processes and organizational change". This conception is in line with the approach proposed in this paper, suggesting that the design of artefacts needs to consider their effects on, as well as requirements from, other related practices.

2.5 Design of Artefacts in Practices

Artefacts for organizational use can be developed in many different ways. These can be categorized into three design approaches (or ideal types in Weber's (1978) meaning) based on the comparison and contrastation between practice and process, as discussed by Brown and Duguid (2000). The three design approaches specified are practice-driven design, process-driven design and a combined practice- and process-driven design.

The first approach is the practice-driven design - which is a bottom-up design approach, based on an organization's practices, culture and specific circumstances (Ciborra, 1992). For example, Ciborra (1992) stresses the need of contingency thinking in artefact design. The key to such thinking is the use of tinkering and serendipity during the design and use of artefacts. The importance of applying a bottom-up approach is also stressed by proponents of so called sociomaterial practices, viewing the social and material as intertwined (i.e., "constitutively entangled") (Orlikowski, 2007).

The second approach is the process-driven design, which is a top-down design approach, where new processes and supporting artefacts are introduced without considering existing practices but rather aiming to replace them. An example of such an approach is business process engineering (BPR), which encourages an organization to

fundamentally rethink and restructure its way of working by radically redesigning its business processes so that they support the overall goals of the organization (Hammer, 1990). Other examples of this approach are some implementations of business process management (BPM) that are focusing on process efficiency supported by a workflow system (Chang, 2006). (However, some approaches to BPM, e.g., adaptive case management (Swenson and Palmer, 2010), adopt more of a bottom-up approach, thereby combining practice- and process-driven design.) A third example is top-down implementations of ERP systems, where the practices need to more or less totally adapt to the way of working of the ERP systems (Chang, 2006).

The third approach is the combined practice- and process-driven design, which combines the top-down and bottom-up approaches, where existing practices are respected and preserved when new processes are introduced, as suggested by Brown and Duguid (2000). An example of such an approach could be the use of enterprise modelling to describe the way of working in a practice (i.e., models of business processes and practices) as well as concepts used in the practice (i.e., models of concepts and their relationships). The resulting models from the enterprise modelling could then inform the design of technological artefacts. However, when introducing the designed artefacts in an organization, using such an approach, the artefacts still need to be appropriated in the local setting in space and time, resulting in new or adapted local practices and artefacts. According to Rohde et al. (2009), technological artefacts always “contain empty slots that have to be filled in use through recontextualization, i.e., by interpreting and applying their functions appropriately to given situations”.

The approach proposed in this paper supports all three design approaches, although our main focus is on the combined practice- and process-driven design. For this kind of design, the guidelines presented could be used for both the development of artefacts and for the analysis of already developed implemented artefacts. For the other two approaches, the practice-driven and the process-driven design, the guidelines could mainly be used for the analysis of already implemented artefacts, but they could then be used as a base for redesigning artefacts and/or adapting practices based on this analysis.

3 Research Methodology

The research methodology used in this paper is design science (Hevner et al., 2004, Peffers et al., 2007, Johannesson and Perjons, 2014). The design science research carried out is mainly based on conceptual analysis, which focuses on breaking down concepts into their constituent parts in order to gain a better understanding of an issue, in our case the concept of practices in context. Based on this analysis, we propose an artefact consisting of a set of guidelines for context-aware analysis and design. The guidelines are demonstrated by using them for analyzing an information system for schools, SchoolSoft, used by many pre-schools, elementary schools and upper secondary schools in Sweden. SchoolSoft was chosen as a test case, because it has a broad applicability and therefore influences several stakeholders and practices. Furthermore, the school domain is complex and includes several interrelated practices, professional and governmental as well as informal ones.

There exists several methods and method frameworks for design science (Hevner et al., 2004, Peffers et al., 2007, Sein et al., 2011), each proposing activities, guidelines and principles for carrying out design science research. We have used a variant

of the method framework by Peffers et al. (2007) as proposed by Johannesson and Perjons (2014), as it makes explicit and visualizes the use of research methods for empirical grounding as well as a knowledge base for theoretical grounding, see Figure 1.

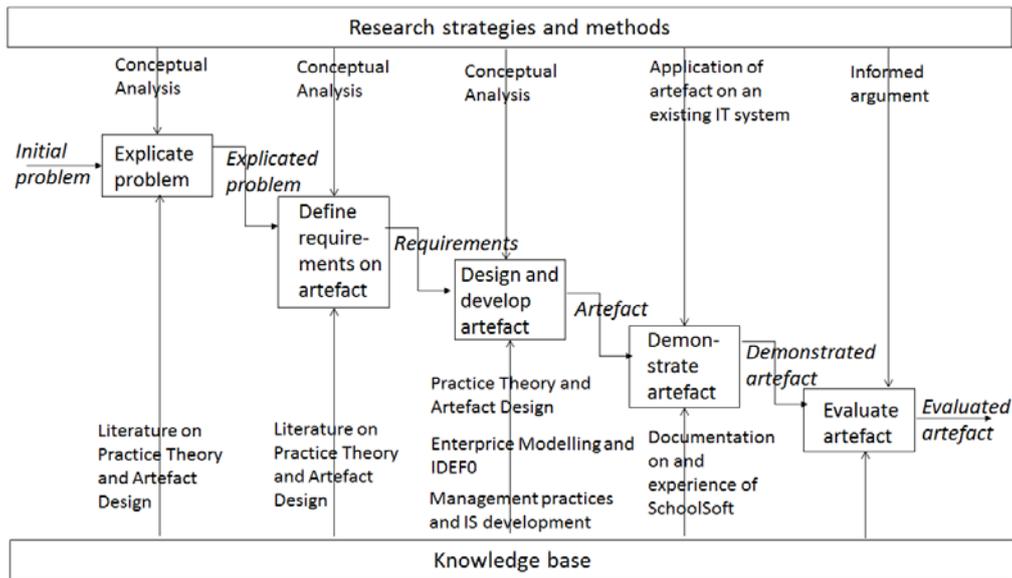


Figure 1: The design science research method used in this paper, based on the framework by Johannesson and Perjons (2014).

The design science research carried out has focused on design and development and to a lesser extent on demonstration and evaluation. Problem explication and requirements definition have been based on literature studies and personal experience.

Explicate problem. The first activity in the design science method is to precisely formulate and justify a practical problem. The problem specified in this research is that practitioners lack methodological support for taking into account relevant practices for artefact development, in particular information systems artefacts. Nicolini (2012) confirmed that artefacts are important for establishing connections between different practices across space and time. Information systems today are moving from supporting separate functions into integrating multiple systems and organizations, thereby forming the backbone of current information infrastructures. This development means that information systems to an ever increasing degree influence and are influenced by multiple practices.

Outline artefact and define requirements. The second activity addresses what type of artefact the solution is supposed to be, and defining the requirements on the solution. The requirements can be seen as a transformation of the problem into demands on the proposed artefact. The artefact developed in this study consists of a set of guidelines for context-aware analysis and design based on a classification of practice relationships. Two requirements are in focus for the developed artefact: it should be *efficient* and support *reflection and sense-making*:

- *Efficiency*: Designers should be able to use the artefact in a time and resource efficient way.
- *Reflection and sense-making*: The artefact should encourage reflection and sense-making. Artefact design and use in complex environments will often result in several challenges related to organizational culture, resistance to organizational change from groups of employees, organizational and individual learning, but also in non-intended effects. Reflection and sense-making can help designers to better understand and address these issues.

Design and develop artefact. The third activity deals with designing and developing the artefact that will solve the explicated problem and satisfy the defined requirements. The artefact was developed using example-oriented conceptual analysis based on literature as well as experiences from fieldwork in healthcare (Henkel et al., 2011), document management (Alwazae et al., 2015) and education (Bider et al., 2015). Examples from these domains were studied in order to inform the design of the guidelines; new examples were introduced and investigated as long as they helped to identify new guidelines. The work was informed by theories from enterprise modelling, especially the use of the IDEF0 functional modelling technique, as well as practice theory focusing on technology artefacts within practices.

Demonstrate artefact. The fourth activity is to use the developed artefact in an illustrative or real-life case, sometimes called a “proof of concept”, thereby proving the feasibility of the artefact. The artefact was demonstrated by applying it on an existing IT system for schools that supports several practices. The demonstration was carried out only by researchers without the involvement of school staff or students.

Evaluate artefact. The fifth and last activity deals with making an evaluation of the developed artefact to determine whether the artefact does fulfill the requirements and can solve the explicated problem. The evaluation method used in this research is a so called informed argument, presented in Hevner et al. (2004). It is a lightweight evaluation where the researchers who developed an artefact discuss its benefits and drawbacks, and by reasoning show that it does fulfil the defined requirements.

4 A Model of Practice Relationships

In the modern world, organizational practices have multiplied as a result of specialization and professionalization. As a consequence, artefact design for practices can benefit from considering not only the practice (or practices) for which an artefact is designed but also related practices in the environment. However, identifying these practices is a non-trivial problem as well as determining in what ways they are related. As a step towards supporting the identification of relationships among practices, a set of classifications are presented, which are based on the functional modelling technique in IDEF0.

In this paper, the IDEF0 modelling technique (FIPS, 1993) is used as a theoretical ground for categorizing, representing and analyzing different types of relationships among practices. Although IDEF0 has primarily been used for modelling functions and processes, we believe that it is adequate also for organizational practices and their relationships. The reason for this is that organizational practices are similar

to processes, in the sense that they include goal-oriented activities aiming at producing value for organizations and their external and internal customers. Furthermore, IDEF0 abstracts from workflow-oriented notions such as control flow and message passing, thereby residing on a level of abstraction that is appropriate for describing organizational practices. IDEF0 also provides notions for describing relationships between functions, which in this paper have been used for the classification of different kinds of practice relationships.

The IDEF0 technique, see Figure 2, describes a system (e.g., an organization or an IT system) as consisting of a number of functions (e.g., processes, activities, operations or practices), graphically represented as boxes. The IDEF0 technique also models relationships among functions through a set of channels conveying data or objects. These channels are represented as arrows between boxes. In this paper, four types of channels from the IDEF0 technique are used: input (associated with the left side of a box), output (associated with the right side of a box), control (associated with the top side of a box) and mechanism (associated with the bottom side of a box). Input are resources that are consumed or transformed to output by a function. For example, in a bicycle production function, steel, rubber and leather are input for producing bicycles, which are the output of the function. Controls are instruments in the form of rules and guidance that are governing and guiding the transformation of input to output, such as blueprints (e.g., over the bicycle) and routine descriptions (e.g., how to produce the bicycle). Mechanisms consist of the assets that are used for carrying out the transformation from input to output, such as employees, machines and IT systems. In contrast to input resources, assets are not consumed or transformed by the function but remain essentially unchanged. Note that assets sometimes embody controls as well, e.g., rules can be implemented and enforced by an information system.

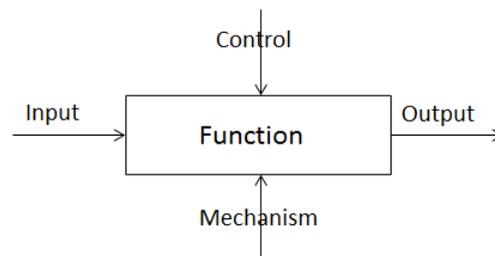


Figure 2: IDEF0 modelling technique - major constructs.

The IDEF0 modelling technique can effectively support the analysis of relationships between organizational practices as it is able to represent their key features. First, IDEF0 diagrams can explicitly represent the input to be transformed in an organizational practice. Second, they can explicitly represent the output from the organizational practice, that is, the value created by it. Third, the diagrams can explicitly represent artefacts in the form of machines, IT systems, human beings as well as other assets, i.e., the mechanisms in terms of IDEF0, that participate in the practice to carry out the transformation from input to output. Fourth, the diagrams explicitly show the control instruments that guide and manage the practice, such as guidelines, blueprints, and plans. Thus, IDEF0 diagrams reflect the fifth characteristic of Adler and Pouliot (2011): practice weaves together the discursive and the material world, i.e., without written and spoken communication, people cannot make a difference between behavior and practice, and the practice is mediated by material artefacts.

Workpractice theory, as proposed by Goldkuhl and Röstlinger (2006), has many similarities to the notions of IDEF0. According to the theory, a workpractice consists of people (producers) that act in favour of some people (the clients), and the producers create results from the workpractice aimed for the clients; thus, workpractices are similar to organizational practices as defined in this paper. Workpractice theory makes a distinction between transactional and infrastructural conditions, i.e., resources, which may be material as well as communicative. Transactional conditions are used for the production of some resources in a single process instance, meaning that they are transformed or consumed in that instance, analogously to input resources in IDEF0. In contrast, infrastructural conditions are used across several process instances and can be reused several times. Thus, infrastructural conditions include mechanisms in the IDEF0 sense but also controls, such as guidelines and norms. Workpractice theory goes beyond IDEF0, e.g., by including reasons for initiating process instances, i.e., product orders, as well as compensations among transactional conditions. Goldkuhl and Röstlinger (2006) point out that some resources may play the role of both transactional and infrastructural conditions, e.g., a medical record can be produced in one process instance for one patient and used in that instance as a transactional condition, but the record can then also become part of an infrastructure and be used as an infrastructural condition.

4.1 Interconnected Practices

Two practices are *interconnected* to each other if they interact by directly or indirectly exchanging information or other resources. A practice can be related to one of its interconnected practices in different ways, depending on the kind of interaction and interchange between the practices. Based on IDEF0, three main types of relationships between a practice and its interconnected practices can be identified: management, asset, and input/output relationships, see Figure 3. The input and output arrows represent input/output relationships, control arrows represent management relationships, and mechanism arrows represent asset relationships between practices.

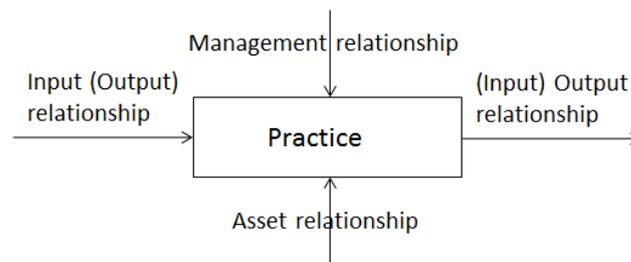


Figure 3: The different types of relationships between practices.

4.1.1 Management Relationships

One practice can manage another practice. In IDEF0 terms, this relationship corresponds to the control channel, displayed as an arrow from the managing practice to the managed one. For example, a practice can *plan* activities to be carried out in another practice, or a practice can *monitor* the activities in another practice. Some managing practices aim to improve or enable other practices. For example, a health care planning practice could improve the efficiency of a health care delivery practice. However, a managing practice may also be detrimental to the practice it manages, and

its *raison d'être* is then that it provides benefits to another practice that it does not manage or to the environment at large. For example, a governmental drug enforcement practice may contain the societal damages caused by a drug dealing practice. Summarizing, there is a *management relationship* between two practices if one of them manages the other.

Based on the PODSCORB elements proposed by Gulick (1937), the PDCA cycle (Rother, 2009), the tasks of a manager by Drucker (1954), and the classification of management practices by Hamel and Breen (2007), Table 1 presents a number of management relationships among practices. These sources include both classic texts, such as Drucker (1954) and Gulick (1937), and more modern ones, such as Hamel and Breen (2007). However, the list in Table 1 is not claimed to be exhaustive but rather indicative, and it can always be extended, modified or compressed as required by a particular application. For example, management practices such as controlling, evaluating, and monitoring could be merged into one, given the situation at hand.

Table 1: An indicative set of management relationships.

Practice Name	Definition	Sources
Planning (including setting goals) relationship	One practice can plan another practice by setting goals and outlining what needs to be done in the future to fulfil the goals	Gulick (1937) - part of PODSCORB; Rother (2009) – part of PDCA; Drucker (1954) – a manager sets objectives; Hamel and Breen (2007) – the management practice setting and programming objectives
Organizing relationship	One practice can organize another practice by establishing a formal structure of authority, which includes arrangement of units and work	Gulick (1937) - part of PODSCORB; Drucker (1954) – a manager organizes
Resource allocating relationship	One practice can allocate resources to another practice, in particular it can allocate staff to work tasks	Gulick (1937) - part of Staffing in PODSCORB; Hamel and Breen (2007) – the management practice amassing and allocating resources
Directing relationship	One practice can direct another practice by guiding people in that practice to work in the required manner	Gulick (1937) - part of PODSCORB;
Coordinating relationship	One practice can coordinate another practice by linking and interrelating its resource use to avoid misdirection and waste	Gulick (1937) - part of PODSCORB; Hamel and Breen (2007) – the management practice coordinating activities

Controlling relationship	One practice can control another practice by measuring the activities of that practice and taking corrective action when required	Gulick (1937) – can be seen as part of Budgeting in PODSCORB; Drucker (1954) – a manger measure; Hamel and Breen (2007) – the management practice controlling activities
Monitoring relationship	One practice can monitor another practice by monitoring the activities of that practice for problems and deviations from plan; can be seen as subtype of Controlling	Rother (2009) – can be seen as part of PDCA
Evaluating relationship	One practice can evaluate another practice by evaluating the performance and the quality of results in that practice; can be seen as subtype of Controlling	Enaohwo and Eferakeya (1989) – added evaluation to PODSCORB and called it PODSCORB (e)
Motivating relationship	One practice can motivate people in another practice by encouraging them to take more interest and initiative in their work	Drucker (1954) – a manger motivates; Hamel and Breen (2007) – the management practice motivating effort

4.1.2 Asset Relationships

One practice can support another practice in the sense that it produces or maintains assets used in that practice. In IDEF0 terms, this corresponds to the mechanism channel, displayed as an arrow from the supporting practice to the supported one. For example, a dental training practice can support a dentist practice by educating future or present dentists for it. Another example is a maintenance practice that repairs and maintains equipment in a production practice, thereby supporting it. Thus, there is an *asset relationship* between two practices if one of them produces or maintains assets used in the other one. In contrast to input/output resources, assets are only used in the latter practice but not consumed or transformed.

Five common asset relationships among practices are presented in Table 2. Asset relationships are commonly discussed in literature on information system and knowledge management, for example, (Laudon and Laudon, 2004) and (Jashapara, 2004). Again, the list in Table 2 is not exhaustive but rather indicative, and can be extended and adapted given a particular application.

Table 2: An indicative set of asset relationships.

Practice Name	Definition	Sources
Developing relationship	One practice can develop assets for the use in another practice, for example producing equipment	Jashapara (2004); Laudon and Laudon (2004)
Maintaining relationship	One practice can maintain resources for the use in another practice, for example repairing machines	Jashapara (2004); Laudon and Laudon (2004)
Educating relationship	One practice can train and educate people who participate in another practice	Gulick (1937) - part of Staffing in PODSCORB; Jashapara (2004)
Communicating relationship	One practice can support people by providing them with information to be used in another practice	Drucker (1954) – a manager communicates
Documenting relationship	One practice can manage documents to be used in another practice	Jashapara (2004); Laudon and Laudon (2004)

4.1.3 Input/Output Relationships

One practice can be related to another practice through a value chain relationship, e.g., an operations practice can produce the input for an outbound logistic practice. These practice relationships are akin to the process relationships in the value chain model of Porter (1985). From an IDEF0 perspective, they correspond to the input and output channels. Thus, there exists an *input/output relationship* between two practices if one of them produces output that is taken as input by the other one. The input is to be consumed or transformed in the practice.

The notion of interconnected practices can now be defined in terms of management, asset and input/output relationships. There is a connection relationship between two practices if there is a management relationship, an asset relationship, or an input/output relationship between them. There is an interconnection relationship between two practices A and B if there is a connection relationship between them or there exists a practice C such that there are interconnection relationships between both A and C and C and B. Thus, interconnection relationships capture both direct and indirect relationships between practices. Finally, a practice is an interconnected practice for another practice if there exists an interconnection relationship between them. All the kinds of relationships between interconnected practices discussed above are illustrated in Figure 4. The figure is drawn from the perspective of one practice (shown in the middle of the figure) around which a number of other practices exist, indicating their relationships to the practice in focus. The relationships will be used in the guidelines for context-aware artefact analysis and design in Section 5.

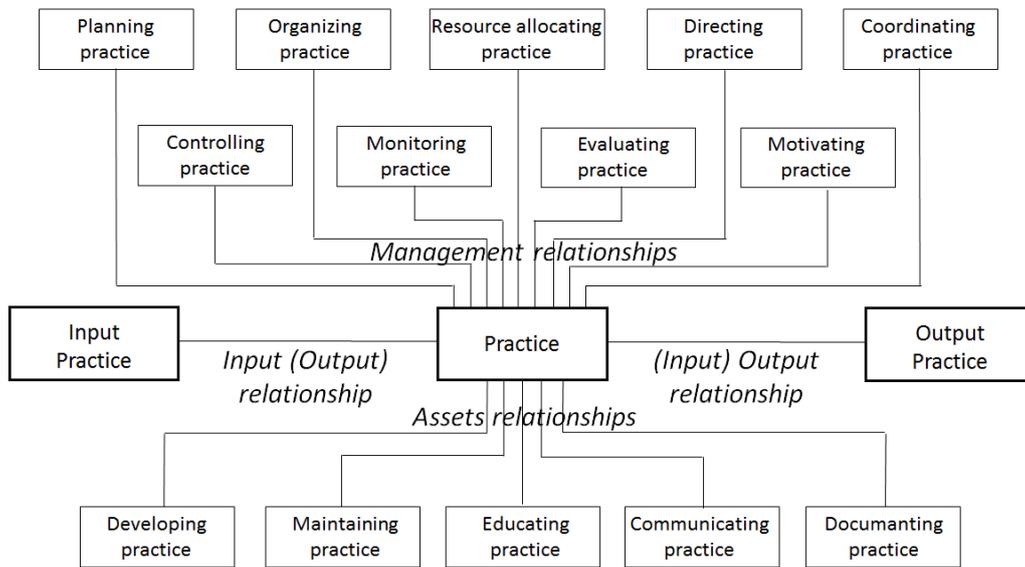


Figure 4: Interconnected practices and relationships.

4.2 Resembling Practices

When developing artefacts for a practice, it is relevant to take into account not only that practice but also its interconnected practices, as these may be directly or indirectly affected by the use of the artefacts. It can also be fruitful to consider practices that are similar to the one under consideration, because they may provide solution ideas that can be transferred and reused. Such practices are here called *resembling practices*. In contrast to interconnected practices, resembling practices do not need to interact and exchange resources with each other; they only need to be similar to each other in some respect. Thus, the notions of interconnected practice and resembling practice are complementary to each other.

Resembling practices can be similar to each other in different ways. In particular, they can be similar by (1) having similar activities, (2) making use of similar input, control or mechanisms, or (3) having similar output. These relationships are informed by the IDEF0 functional modelling technique, which describes a system through its relationships between functions (activities), input, control, mechanism, and output. In this paper, input, control and mechanism are categorized as means, see Figure 5. Thus, three kinds of resembling relationships between practices can be identified: activity resembling, means resembling, and output resembling.

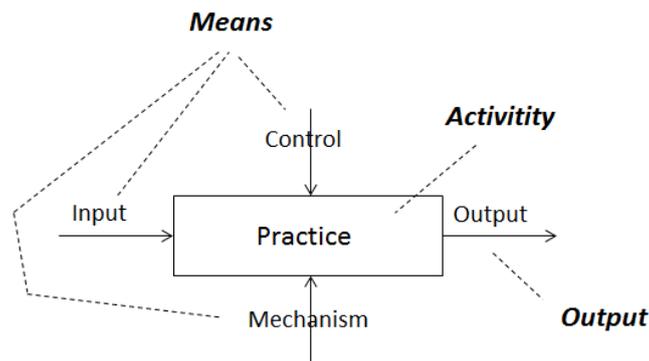


Figure 5: IDEF0 notions for classifying resembling practices.

4.2.1 Activity Resembling Relationships

Two practices are activity resembling if they include similar activities. It is often the case that activity resembling practices are also output resembling, but this is not always so. An example could be a sales practice and a religious practice that both include persuasive talks as key activities in the form of sales presentations and sermons, respectively. These two practices have different output, at least on a certain level of abstraction, for example, increased revenue and strengthening of a religious community, respectively. Another example of activity resembling practices are a product testing practice and a scientific practice that both include measurements as key activities, but produce different high level output. Thus, there is an *activity resembling relationship* between two practices if they include similar activities.

4.2.2 Means Resembling Relationships

Two practices are means resembling if they make use of similar means. As suggested by IDEF0, the means can be used as input, as mechanisms, or as controls. An example of means resembling practices are a plastic producing practice and a fossil power plant practice that both consume oil as an input resource. Another example is a taxi service practice and a car racing practice that both use cars. Thus, there is a *means resembling relationship* between two practices if they make use of similar means.

4.2.3 Output Resembling Relationships

Two practices are output resembling if they have similar output. The outputs do not need to be identical but should have some common features in terms of the values being produced (recall that only organizational practices are considered). An example of output resembling practices are surgery practices carried out in veterinary and medical settings, respectively. Another example of output resembling practices are monitoring practices in a university and a high school setting, respectively. Thus, there is an *output resembling relationship* between two practices if they have similar outputs.

Using the above relationships, the resembling practices of a practice can now be defined as all the practices that are related to it through an activity resembling relationship, a means resembling relationship, or an outcome resembling relationship.

The different categories of relationships between practices presented in this paper are shown in Figure 6.

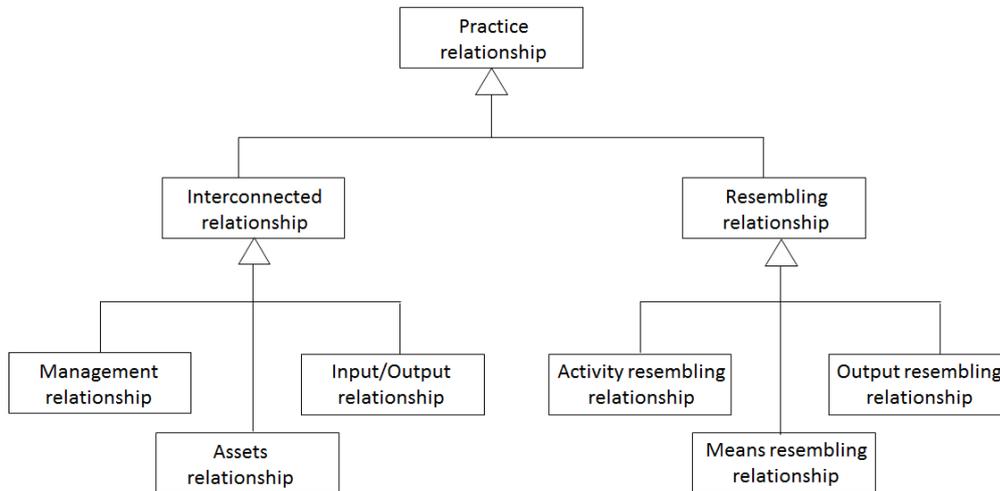


Figure 6: The different categories of practice relationships.

5 Context-aware Analysis and Design

In this section, we propose a methodological support for context-aware analysis and design in the form of three guidelines, which suggest how to take into account related practices with regard to effects, requirements, and solutions. These guidelines are not to be viewed as cookbook recipes; rather they are meant to spur a developer to reflect creatively about the context of the practice for which she designs an artefact.

Effects Guideline - Effects on Interconnected Practices

The first guideline is about identifying the effects an artefact could have on its interconnected practices. By understanding these effects, designers and users can take steps to avoid that the use of the artefact results in undesirable side effects. But also opportunities for positive side effects on interconnected practices can be captured. The use of an artefact can influence a practice in three different dimensions: instrumental, normative, and power. Instrumental influence concerns the effects of the artefact use on the goals of a practice. Normative influence concerns the effects of the artefact use on the norms and values of practices. Power influence concerns the effects of the artefact use on the distribution of power between agents within and between practices (Markus, 1983, Buchanan and Bedham, 2008).

When developing and analyzing an artefact for a practice, identify possible effects on its interconnected practices with respect to instrumental, normative and power aspects

Example: A monitoring practice is interconnected to a home care service practice in a management relationship. For the monitoring practice, a time monitoring function is developed that monitors how much time a care giver spends at a client in the home care service practice, and it signals if the recommended amount of time is exceeded. This function may affect a norm (i.e., a normative aspect) in the home care service

practice, which says that the care giver should act gently even if time is short. For example, the function may influence the care giver to violate this norm and start acting less gently when the time at the client is out. This is a negative side effect of the function developed.

Requirements Guideline - Requirements from Interconnected Practices

The second guideline is about identifying additional requirements by considering interconnected practices. Through the Effects guideline, a number of potential side effects on interconnected practices can be identified. It may then be useful to modify the artefact in such a way that positive side effects are better captured and negative side effects are reduced or avoided. How to modify the artefact can be expressed through additional requirements.

When developing an artefact for a practice, identify requirements on the artefact based on its potential effects in the interconnected practices

Example: A *procurement practice* is interconnected to a *sales practice* in a department store in an *input/output relationship*. For the procurement practice, a *procurement system* is planned to be developed. A *requirement* on the procurement system is to include a function that automatically creates and sends out procurement orders when products are on the way to be sold out in the sales practice. The reason for this requirement is that employees in the procurement practice today send out procurement orders manually to suppliers of products when their products are on the way to be sold out in the department store. However, since procurement orders are handled manually, orders are often created and sent out too late, and, therefore, there is often a lack of products at the department store. This issue can be handled by introducing such a function in the procurement system.

Example: A governmental *controlling practice* of prescriptions is interconnected to a *health care prescription practice* in a *management relationship*. For the health care prescription practice, a *health care prescription system* is planned to be developed. A *requirement* on the prescription system is to include a function that enables and encourages physicians and nurses to justify their prescription of antibiotics. The reason for this requirement is that the governmental practice wants to reduce the amount of unnecessary prescriptions of antibiotics. This reduction can be achieved by encouraging physicians and nurses to justify why they prescribe antibiotics to patients, for example, by introducing such a function in the health care prescription system.

Solutions Guideline - Solutions from Resembling Practices

While the first two guidelines address effects and requirements, the next guideline is about solutions. By studying solutions in resembling practices, it is possible to identify ideas, solution fragments or templates that can be reused.

When developing an artefact for a practice, identify relevant solutions in resembling practices

Example: A directing practice is interconnected to a teaching and learning practice at a university in a management relationship. For the directing practice, a best practice template is planned to be developed. (A best practice is not to be confused with a practice, as a best practice is an ideal example of how best to execute a particular task (Szulanski, 1996).) The template is planned to be used by teachers to collect best practices in a structured way, and also to effectively disseminate these best practices among teachers. In order to define the structure of the template, the directing practice makes use of best practice templates from other knowledge intensive practices, such as software and vehicle production. This is an example of making use of a means resembling relationship between resembling practices.

Example: A maintenance practice is interconnected to a printing practice in a printing firm through an asset relationship. For the maintenance practice, a maintenance application is planned to be developed that should keep track of dates and situations when parts of the printing and copy machines need to be replaced. Thereby, the maintenance practice can be more proactive and prevent failure of the machines by replacing parts of them when this does no harm to the printing practice. In order to decide the functionalities of the maintenance application, functionalities from applications in other practices with similar outcomes can be identified, e.g., the aircraft and nuclear power industries. In particular, proactive maintenance solutions can be identified, reused and appropriated. This is an example of making use of an outcome resembling relationship between resembling practices.

6 Demonstration

In this section, the three practice context guidelines are demonstrated by studying three components of an IT system for schools, called SchoolSoft (2015). SchoolSoft is a web-based system used by many pre-schools, elementary schools and upper secondary schools in Sweden. SchoolSoft supports school staff, pupils, and parents with administration, documentations, and dialogue. For example, teachers can publish learning goals, plans, assignments, homework, results and grades; students can plan their individual goals and make study plans; parents can report sick leave and send messages to individual teachers. Moreover, parents can be informed about students' progress, workload and attendance, and potential employers can use the student portfolio developed in SchoolSoft for recruiting purposes.

In the following, the three components of SchoolSoft in focus for the study are presented; the practices related to the components of SchoolSoft are described; and the result of applying the practice context guideline on Schoolsoft is specified.

6.1 SchoolSoft - Components in Focus

SchoolSoft can be seen as consisting of several components, each supporting one or several practices. The following three components were selected for this study, as they together sufficed to illustrate all the proposed guidelines:

Attendance Control Component. SchoolSoft includes a component for attendance control that supports teachers in identifying and recording students that are absent from scheduled activities. The component also informs parents about student absence.

Thus, the component supports a monitoring practice that focuses on the attendance of the students.

Learning Content Management Component. SchoolSoft includes a component for managing learning content, which allows teachers to make learning content available to students. Thus, the component supports a documentation practice that focuses on learning content management (LCM).

Student Portfolio Component. SchoolSoft includes a component for managing student portfolios, which supports students in building a portfolio of their study assignments. Thus, the component supports a documentation practice that focuses on documenting the outcomes of student activities.

6.2 SchoolSoft - Interconnected Practices

In this section, the teaching and learning practice that SchoolSoft supports is presented as well as its interconnected practices, which are also supported by SchoolSoft. We focus only on the practices related to the three components of SchoolSoft presented above, see Figure 7 for these practices and their relationships.

Teaching and learning practice. The practice in which teachers and learners participate in teaching and learning activities, such as lectures, lessons, seminars, and different kinds of project work. It also includes the certification of the knowledge and abilities of the students.

Monitoring practice. The practice in which teachers monitor students' attendance as well as other behaviors.

LCM documentation practice. The practice in which teachers document the learning content for the courses and make it available to students.

Portfolio documentation practice. The practice in which students document their work for evaluation by teachers or for building a portfolio of their study assignments for recruiting purposes.

Teacher evaluation practice. The practice in which teachers are evaluated by management, peers and students.

Student evaluation practice. The practice in which teachers evaluate the result of the students' work.

Recruiting practice. A practice in an external organization that aims at recruiting students as future employees.

Pre-teaching and learning practice. A practice in an external organization, e.g., pre-school or lower school, which aims at preparing the studies.

Figure 7 shows the input/output, asset and management relationships between the practices presented in this section. The input/output relationships indicate that there

are resources being transferred between the practices. For example, children are input to the teaching and learning practice in which they are transformed into output, in form of knowledgeable and competent students, which are the input to the recruiting practice. There may also be other complementary resources that are input to the recruiting practice, e.g., grade documents and portfolios that help employers to determine whether to recruit a student or not. Furthermore, there are asset relationships indicating that some assets are produced or maintained in one practice and used in another. For example, learning content is created and documented in the LCM documentation practice and then used in the teaching and learning practice. Finally, there are management relationships, more precisely, evaluating relationships and a monitoring relationship.

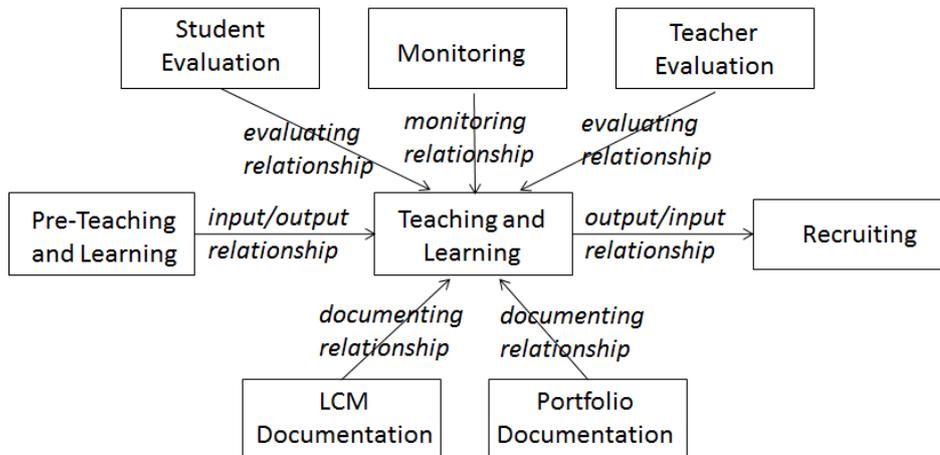


Figure 7: Practices and their relationships used in the demonstration.

6.3 SchoolSoft - Result of Applying the Guidelines

In this section, the three practice context guidelines are demonstrated by applying them on the three components of SchoolSoft. The results of applying the guidelines are shown in the form of tables.

6.3.1 Attendance Control Component in Monitoring Practice

The Attendance Control Component is a component of the SchoolSoft system that is used within the monitoring practice to monitor students' attendance. The component supports, as mentioned above, the teachers in identifying and recording students that are absent from scheduled activities, and informs parents about student absence.

This component affect three practices interconnected to the monitoring practice, see Figure 8: the teaching and learning practice, the student evaluation practice and the recruitment practice. The component does not affect the teacher evaluation practice and the two documentation practices.

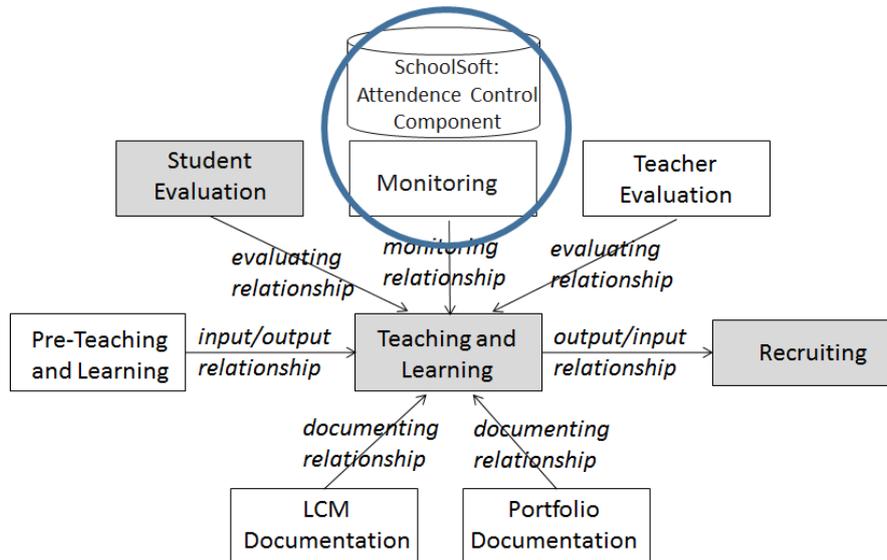


Figure 8: The Attendance Control Component in the monitoring practice effects three interconnected practices.

The Effects and Requirements guidelines are applied on the Attendance Control Component. Applying the Effects guideline results in a list of potential effects on practices interconnected with the monitoring practice, see Table 3. Applying the Requirement guideline results in a list of requirements on the Attendance Control Component based on these effects, also presented in Table 3.

The Solutions guideline is applied on the Attendance Control Component as well. Applying the Solutions guideline results in ideas, solutions, or parts of solutions for the Attendance Control Component, based on resembling practices, see Table 4. The first row in the table suggests resembling practices, while the second row presents possible ideas and solutions from these practices.

Table 3: Applying the Effects and Requirements guidelines for the Attendance Control Component.

	Instrumental effects	Normative effects	Power effects	Requirements
Teaching and learning practice	Cause waste of time and effort by making students and teachers spending time on attendance control	Emphasize the importance of attendance for school	Affect student - parent - teacher relationships by making attendance information transparent to parents and teachers	Minimize negative influence on efficiency in the teaching and learning practice, i.e., make the component inobtrusive - minimize time and effort spent by teachers and students
Student evaluation practice	Support student grading, where teachers assess students based on their attendance	Emphasize the importance of attendance for grading		Produce aggregated reports on student attendance
Recruiting practice	Support recruitment at potential employers by making attendance information available for them	Emphasize the importance of attendance for recruitment	Affect student - employer relationships by making attendance information transparent to employers	

Table 4: Applying the Solutions guideline for the Attendance Control Component.

	Outcome resembling	Activity resembling	Means resembling
Practices	Surveillance in any domain Attendance control at University	Military	
Ideas and solutions	Bar code use ID control	Rollcall	

6.3.2 Learning Content Management in Documentation Practice

The Learning Content Management (LCM) Component is a component of the SchoolSoft system that is used within the LCM documentation practice in which the teachers are documenting the learning content for the courses. The component allows, as mentioned above, teachers to make learning content easily available to students.

The component primarily effects two practices interconnected to the monitoring practice, see Figure 9: the teaching and learning practice, and the teacher evaluation practice (i.e., the teachers are evaluated by management, peers and students). The component could have some impact on the other practices, for example, the learning content can have effect on the quality of the students' portfolio documentation. However, this is not further elaborated in this section.

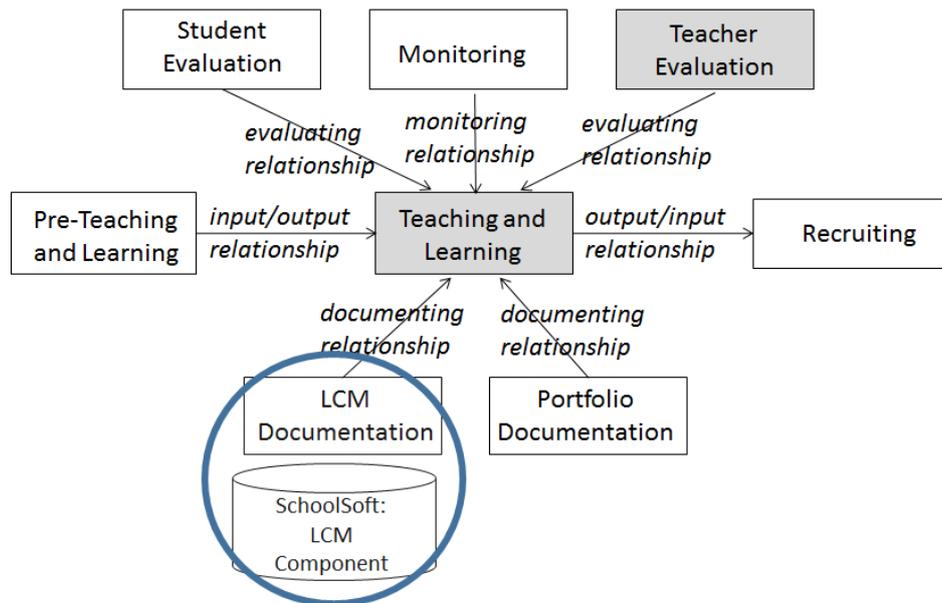


Figure 9: The LCM Component in the LCM Documentation practice primarily effects two interconnected practices.

The Effects and Requirements guidelines are applied on the LCM Component. Applying the Effects guideline results in a list of potential effects on practices interconnected with the LCM documentation practice, see Table 5. Applying the Requirement guideline results in a list of requirements on the LCM Component based on these effects, also presented in Table 5.

The Solutions guideline is applied on the LCM Component as well. Applying the Solutions guideline, results in ideas, solutions, or parts of solutions for the LCM Component, based on resembling practices, see Table 6. The first row in the table suggests resembling practices, while the second row presents possible ideas and solutions from these practices.

Table 5: Applying the Effects and Requirements guidelines for the Learning Content Management Component.

	Instrumental effects	Normative effects	Power effects	Requirements
Teaching and learning practice	Improve efficiency as students can easily retrieve teacher provided material	Emphasize the value of transparency		Give access to teacher provided material adapted to mobile devices so that students can study the material anywhere
Teacher evaluation practice	Support teacher evaluation since the teacher provided material can easily be retrieved by school management		Affect teacher - school management relationships by making teacher provided material available to the school management	

Table 6: Applying the Effects guideline for the Learning Content Management Component.

	Outcome resembling	Activity resembling	Means resembling
Practices	Learning content management at university Intranet		Digital Libraries Social sharing practice
Ideas and solutions	Make student generated content available		Suggest further recommended content You Tube Google Scholar (providing published research papers)

6.3.3 Student Portfolio in Documentation Practice

The Student Portfolio Component is a component of the SchoolSoft system that is used within the student portfolio documentation practice, in which students are documenting their work for evaluation by teachers or for building a portfolio for recruiting purposes. The component supports the students in managing their portfolios.

The component primarily effects three practices interconnected to the monitoring practice, see Figure 10: the teaching and learning practice, the student evaluation practice and the recruitment practice. The component does not affect the teacher evaluation practice, but it could be argued that the component could affect the monitoring

and LCM documentation practices, but this has not been elaborated further in this section.

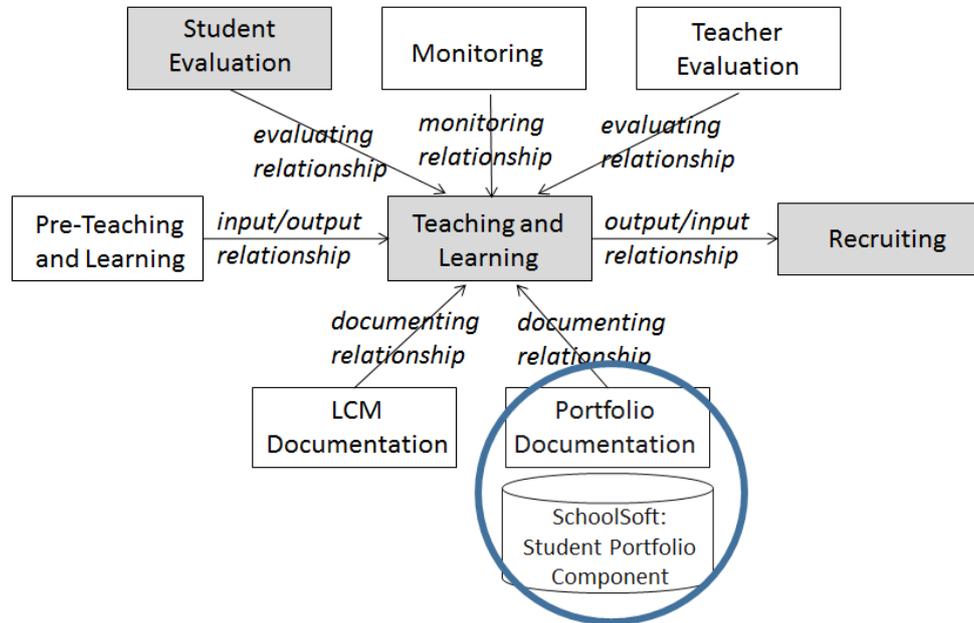


Figure 10: The Student Portfolio Component in the portfolio documentation practice primarily effects three interconnected practices.

The Effects and Requirements guidelines are applied on the Student Portfolio Component. Applying the Effects guideline results in a list of potential effects on practices interconnected with the student portfolio documentation practice, see Table 7. Applying the Requirement guideline results in a list of requirements on the Student Portfolio Component based on these effect, also presented in Table 7.

The Solutions guideline is applied on the Student Portfolio Component as well. Applying the solution guidelines results in ideas, solutions, or parts of solutions for the component, based on resembling practices, see Table 8. The first row in the table suggests resembling practices, while the second row presents possible ideas and solutions from these practices.

Table 7: Applying the Effects and Requirements guidelines for the Student Portfolio Component.

	Instrumental effects	Normative effects	Power effects	Requirements
Teaching and learning practice	Improve efficiency as students can easily retrieve and reuse work they have produced	Emphasize the value of cooperation, as the component can facilitate sharing of work results		Include functions for sharing and searching
Student evaluation practices	Support grading of the students, as teachers can access students' previous results		Affect student - teacher relationships by making student results easily accessible to teachers	
Recruiting practices	Support recruitment by making detailed student information available	Affect values about privacy and integrity, as potentially sensitive information can be disclosed to third parties		Make it possible for students to authorize access to the portfolio

Table 8: Applying the Solutions guideline for the Student Portfolio Component.

	Outcome resembling	Activity resembling	Means resembling
Practices	Art portfolio Project portfolio		Social sharing practice
Ideas and Solutions	Make the portfolio unique and original		Functions for liking certain content

6.4 Reflection on the Demonstration

The aim of a demonstration is to show how an artefact can address a problem, or some aspects of it, in an illustrative or real-life case. Since a demonstration shows that the artefact can address the problem in one case, it might be able to do so in other cases as well. Therefore, a demonstration can be seen as a lightweight evaluation. The problem specified in our research is that practitioners lack methodological support for taking into account relevant practices for artefact development. The methodological support presented in this paper is the three practice context guidelines, and in this

section they have been applied for analyzing three components of a real life IT system, SchoolSoft.

Our experiences from the demonstration indicate that the guidelines are easy and straightforward to apply. They effectively supported brainstorming for eliciting requirements as well as effects on the various components of the system. We also experienced that the guidelines did help to identify effects and requirements that were otherwise difficult to detect, thereby effectively supporting the creative process. In particular, thinking about the normative effects of a component spurred us to reflect on unintended consequences of using the system's components and to suggest measures for addressing these consequences. Moreover, we were surprised to find so many ideas and solutions, such as bar code use, rollcall, social sharing practice, by applying the resemblance practices.

While the guidelines overall were easy to apply, one issue that surfaced was how to identify and separate practices. The approach requires that the practices under consideration can be clearly delimited from each other, but doing so can in some cases be somewhat arbitrary, as practices often are deeply entangled with each other. As a consequence, the results of applying the guidelines can vary depending on the selection and separation of practices. While this is a weakness of the approach, it also means that different groups using the guidelines can arrive at alternative and complementing suggestions, which together offer a comprehensive understanding of the system and practices under consideration.

7 Concluding Remarks

Artefacts are to be used in practices, and artefact development, therefore, needs to take into account the needs and ways of working of the stakeholders in these practices. But it is not sufficient to consider only the practices in which an artefact is to be used; other related practices should also be taken into account. To address this issue, this paper offers two contributions, both a theoretical and a practical one. The theoretical contribution consists of identifying and highlighting the notion of practice relationship. The notion can serve as a tool that supports researchers in practice theory to reflect about practice boundaries, in particular their interfaces to other practices. The notion can also be helpful for investigating how a practice is maintained and how it evolves over time, as this dynamics does not only depend on the practice itself but also on its environment, including related practices. Furthermore, the paper offers a classification of practice relationships, which is based on the function modelling of IDEF0. While believing that this classification is useful for many purposes, we are aware that other classifications also can be designed and applied for other purposes. Thus, our proposed classification can inform and inspire efforts for developing alternative or complementing classifications. The practical contribution of the paper consists of three guidelines that support designers in identifying effects, requirements and solutions based on an investigation of related practices. These guidelines help designers to adopt a holistic perspective on artefact design by drawing attention to the environment of the practice for which an artefact is developed.

In order to validate the result of the research, a demonstration has been carried out, indicating the feasibility of the proposed guidelines. Moreover, as stated in Section 3, two requirements on the proposed guidelines are that they should be efficient and support reflection and sense-making. To argue that these requirements are satis-

fied, we use informed argument. First, the use of the guidelines is efficient in terms of time and resources. It supports designers to take the entire context of a practice into account by providing a small number of intuitively understandable categories that help to identify the most relevant related practices. Using the guidelines also helps the designers to focus on effects, requirements and solutions, which are key notions in artefact design. Second, the guidelines and the classification of practice relationships support reflection and sense-making in artefact design, since they help to create situational awareness and understanding of practices in context. As pointed out by Weick (1995), people extract cues from the context to determine what information is relevant and what explanations are acceptable. The proposed guidelines, thus, help to identify and explore this context by focusing the attention of the designers on related practices as well as the effects of artefact use and potential requirements.

The practical usefulness of the third presented guideline in this paper, the Solutions guideline, may be questioned, as it requires knowledge about resembling practices. This may not be an issue for experienced systems analysts and architects, who typically have internalized a large amount of such knowledge and can draw on this in new contexts. But those less experienced would not have access to this knowledge, and it would in most cases also be difficult to get access to people with relevant domain expertise. One line of solution could be to collect and organize a repository of practices, which would be similar to the work by Malone et al. (1999), though the result would not be a handbook of processes but rather a handbook of practices.

A topic for future work is to consolidate and extend the proposed approach. One issue concerns the adequacy of the proposed classification of practice relationships, which is based on the function modelling of IDEF0. It might be argued that function modelling limits the view on potentially relevant relationships and even imposes a top-down perspective on practices, akin to workflow-oriented business process approaches. These limitations do not invalidate the proposed classification, but they open up for studies that aim at identifying additional types of practice relationships, including subtypes of the management, asset and input/output relationships introduced so far. For the input/output relationships, the kinds of relationships probably are contingent on the domain. In this work, alternative frameworks to IDEF0 could be utilized, such as the workpractice theory framework by Goldkuhl and Röstlinger (2006), which proposes a more elaborate classification and analysis of resources than IDEF0.

Another issue is to extend the practice relationships also to artefacts, i.e., investigate what kinds of relationships that exist among artefacts in different practices. This work could be informed by the notion of artefact exaptation as defined by Gregor and Hevner (2013), where artefacts from one domain are appropriated and reused in another. We envisage that it would be fruitful not only to take into account the effects of artefact use, but also the internal structure and behavior of artefacts.

Another topic for future research is to apply the artefact in a real organizational setting, and evaluate its benefits and drawbacks with involved stakeholders. This would provide a stronger empirical grounding for the value of the developed artefact. Such a grounding should also consider additional requirements than those so far introduced, i.e., efficiency and sense-making.

Acknowledgement

The authors want to thank the editor and the anonymous reviewers for detailed comments and constructive advices during the review process of the paper. Their input has improved both the structure and content of the paper.

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