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Introduction

Human work in organizations has been influenced and shaped by digital technologies ever since their advent in the mid-twentieth century. In the earlier stages of development, digital systems were mainly used for calculation tasks that were cumbersome or time-intense for humans to perform. Such tasks are found in all domains of industry and have led to a wide-spread penetration of IT systems for planning and control tasks. In a later wave of development, linked to the advent of more powerful and interlinked digital devices, systems were devised to support the coordination and collaboration of actors—independently of whether they were humans, machines, or whole organizations. Such systems, however, mainly adopt a Tayloristic view on organizational work, aiming at top-down division, coordination, and control of work tasks in an organization. Today's digital technologies, however, also allow for a more agile, bottom-up approach to work design and execution support. In this book, we argue for such an actor-centric view on organizational work and propose a set of instruments that supports the design of collaborative work systems in an environment with ubiquitous access to digital communication technologies.

The deployment and use of digital work support systems has increasingly gained importance since the 1980s for implementing organizational

S. Oppl, C. Stary, *Designing Digital Work*,
https://doi.org/10.1007/978-3-030-12259-1_1

work processes (Curtis et al. 1992; Thome 1982). These systems do not solely aim at improving productive, value-adding work. They are also deployed as an instrument for governing and coordinating work to optimize the use of available resources (Orlikowski and Iacono 2001).

The focus on optimizing organizational resources for effective and efficient use is facilitated by conceptualizing organizational reality in enterprise architectures that describe the orchestration of resources to reach organizational goals (Jonkers et al. 2006). This abstraction is usually implemented by encoding and interlinking the social and technical elements of these architectures in conceptual models. These models can be processed by means of Information and Communication Technology (ICT) to provide support in process optimization as well as implementation (Curtis et al. 1992; Herrmann et al. 2002).

When enterprise architecture models are used as organizational artifacts to direct and control organizational work practices, the social and cognitive skills of the involved human actors are usually not explicitly considered (Davidson 2006). This can lead to suboptimal use of resources, as individual improvement of relevant skills might be ignored (Herrmann et al. 2002), and can hamper adequate reactions on changing conditions in the organizational environment (Davidson 2006). Organizational behavior and functions of ICT-based support measures gradually diverge, leading to a misfit between actors' expectations and actually provided support. This ultimately results in actors' ignorance of and resistance against IT-based support and guidance measures (Feldman and Pentland 2003).

Despite these challenges, socio-technical work support instruments such as ERP-systems (Enterprise Resource Planning), SOPs (Standard Operating Procedures), or MES (Manufacturing Execution Systems) are widely deployed in industry (Ragowsky and Somers 2002). Adoption has also risen in Small and Medium Enterprise (SMEs) in the last decade (Haddara and Zach 2012), confronting virtually every organization directly or indirectly with guidance and support measures originating in these systems.

Operative actors in an organization thus have to cope with the potential discrepancy between the support measures provided based on idealized or out-dated models of a work task and the perceived reality of their work situation (Davidson 2006). These perceived mismatches can range from inappropriately designed on-screen forms for data entry, over lacking information required for a specific work step, to work procedures that cannot be implemented in the way prescribed by a support system. They lead to workarounds, which increase the cognitive load and effort required by an organizational actor to complete the respective task, or to an accommodation of one's behavior to the routines and constraints encoded in the support systems (Davidson 2006; Soh et al. 2003).

Still, today's organizational work is shaped and influenced by requirements on standardization and documentation that can hardly be met without deploying socio-technical support systems (Botta-Genoulaz and Millet 2006; Davies et al. 2006). Active involvement of organizational actors in articulating and aligning their collaborative work processes thus has to be embedded in the context of the organizational reality shaped by these systems. Feldman and Pentland (2003) recognize this constraint and conceptualize it by distinguishing ostensive aspects from performative aspects of work in an organization. They argue that, in order to influence the ostensive aspects of organizational work, the performative aspects have to be made visible in a form that is acceptable on all layers of an organization. While Feldman and Pentland (2003) do not detail this requirement any further, it shows that operative organizational actors—being the sources of performative aspects of work—have to be enabled to recognize and understand the ostensive mechanisms influencing their work (Weick et al. 2005), relate them to their performative behaviors (Davidson 2006), and articulate them in a form that allows them to directly influence the way their work is (ostensively) understood within the organization.

The skills necessary to create these commonly acceptable representations of work cannot be taken for granted (Frederiks and van der Weide 2006; Recker and Rosemann 2009). Existing research addressing this issue considers organizational actors as mere sources of information, whose utterances about their work need to be transformed into a form that can be processed by expert analysts (Herrmann and Nolte 2014; Hjalmarsson et al. 2015; Simões et al. 2016). This indirect approach, however, does not facilitate the alignment of different perspectives on and understandings about a work task (Türetken and Demirörs 2011) and might cause modelers' bias that manifests in incomplete or inappropriate representation of the work process (Goncalves et al. 2009). We here consider a work process as a sequence of specific activities to complete a work task. The alignment between the performative and ostensive aspects of organizational work thus is hampered and might lead to the introduction of further discrepancies between expected and actually provided work support measures.

This book introduces support measures and instruments for articulating, aligning, and enacting performative aspects of organizational work. These measures and instruments should allow organizational actors to actively design their collaborative work processes based on their individual views using their own conceptualizations of their work, while ensuring and still leading to a syntactically correct and semantically valid sound conceptual model for further processing in digital work systems.

Since the book addresses and involves knowledge from various disciplines, an ontological glossary has been developed (see appended Ontological Glossary). It provides conceptual and terminological orientation. The remainder of this chapter describes the conceptual foundations informing the methods and framework proposed in this book.

1.1 Conceptual Foundations—An Overview

This book focuses on examining how human actors perceive, understand, articulate, and align their collaborative work in an organizational context. It ultimately aims at supporting this articulation and alignment processes by socio-technical means (Baxter and Sommerville 2011) to ultimately improve operative organizational work processes and work support systems in an increasingly digitized work environment. The theories informing the design of the artifacts to be developed consequently can be found in areas researching human interaction and collaboration in an organizational context. Figure 1.1 situates these theories in the MTO-framework (Mensch-Technik-Organisation—German for human-technology-organization) (Strohm and Ulich 1997) to show their respective foci.

Organizations are viewed as entities in which actors use their knowledge to perform business processes. If they are not able to satisfactorily complete their work, they deploy compensation activities and ultimately

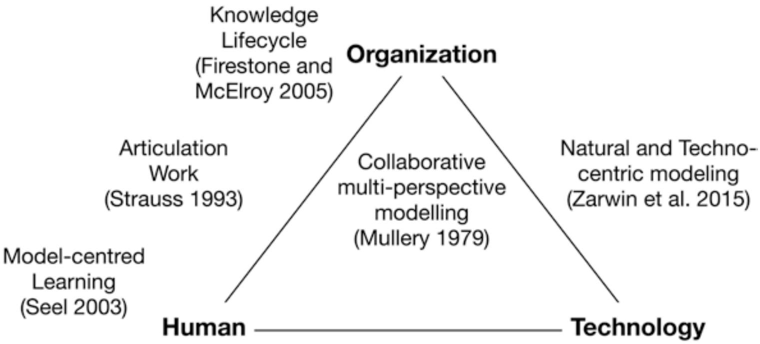

Fig. 1.1 Kernel theories situated in the MTO-framework

question the knowledge foundations they build their decisions on. In such a case, new knowledge is created in the organization that should allow the avoidance of observed problems. The theory explaining and conceptualizing this process for the present work is the *Knowledge Lifecycle* of Firestone and McElroy (2003).

The Knowledge Lifecycle does not explicitly explain the activities of actors that lead to the alignment of operative work in case contingencies arise. This issue is addressed by Strauss (1993) in his theory of *Articulation Work* that offers a descriptive framework of how workers overcome perceived obstacles in their collaborative work processes by implicit or explicit coordination activities (Strauss 1988). In the course of Articulation Work, the involved actors develop new knowledge that shapes their expectations of the behavior of their organizational environment in general and their collaborators in particular.

Neither the Knowledge Lifecycle nor the concept of Articulation Work provides input on the mental processes of actors when developing new knowledge and how to support it. The theory of *model-centered learning* (Seel 2003), however, conceptually describes these mental processes and offers insights into how to facilitate them. Enabling actors to explicitly articulate their mental models leads to their refinement (Ifenthaler et al. 2007), and creates results that can serve as boundary objects for making the mental models understandable for others (Dann 1992), ultimately making them accessible for alignment to create common ground on how to collaborate (Convertino et al. 2008).

The process of articulation and alignment of mental models can be supported by conceptual modeling practices (Recker and Dreiling 2011; Herrmann et al. 2002). In collaborative modeling, one challenge is to make sure that the views of all involved actors are considered in the final result. *Multi-perspective modeling* (Mullery 1979) addresses this issue by splitting the modeling process in a first phase, where the involved actors individually create models of their own perspective on the subject of modeling, and a second phase, where these models are consolidated in a structured way to form a single, agreed upon model.

In order to support operative work processes, the results of articulation and alignment need to be made accessible for processing on an organizational and/or technical level. This poses requirements on the syntactical correctness of conceptual models that might not have been relevant during actor-centric modeling (Zarwin et al. 2014). The theory of the continuum between *natural and techno-centric modeling* (ibid.) enables us to derive requirements on the artifacts to be developed in order to provide a link between articulation and alignment practices and the integration of the results in existing enterprise architectures (Jonkers et al. 2004).

The following subsections summarize the mentioned kernel theories. At the end of each section, the respective theory is linked to its use in the present research.

1.2 Knowledge Lifecycle

The Knowledge Lifecycle (KLC) proposed by Firestone and McElroy (2003) is a process-oriented approach to knowledge management that builds upon different earlier approaches on organizational learning processes (mainly and foremost Argyris and Schön's (1978) concept of single- and double-loop learning). The KLC introduces a fundamental distinction among activities performed in the 'business processing environment' and activities performed in the 'knowledge processing environment'. Figure 1.2 provides an overview of the Knowledge Lifecycle as originally described by Firestone and McElroy (2003). Operative activities directly contributing to achieving a business goal are executed in the scope of the business processing environment. As long as the outcome of

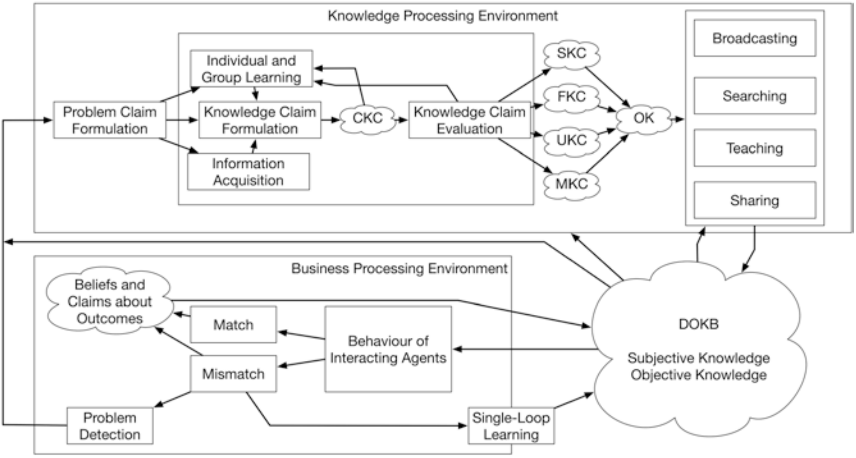

Fig. 1.2 The Knowledge Lifecycle of Firestone and McElroy (adapted from Firestone and McElroy 2003)

all activities and interactions is as expected, organizational actors (referred to as 'interacting agents' in Fig. 1.2) continue their activities in this mode. If problems occur, that is, if some outcome does not comply with the expectations of any actor, learning occurs. Learning here always refers to a change in an organizational phenomenon referred to as the distributed organizational knowledge base (DOKB). The DOKB contains all knowledge an organization builds upon to pursue its aims, in both uncodified and codified form, that is, being anchored in the memory of actors or being explicitly implemented in specified business processes or IT systems.

The content of the DOKB is not altered without reason. If outcomes of particular activities match what has been expected based on knowledge from the DOKB, the beliefs about the correctness of the particular knowledge artifact are strengthened. If mismatches occur (i.e., if the outcome of an activity does not fit the expectations derived from the DOKB), learning occurs and affects the content of the DOKB. Learning conceptually is distinguished in single-loop- and double-loop-learning, following the approach of Argyris and Schön (1978). Single-loop learning does not question the fundamental beliefs the activities that led to the mismatching outcome are based on. Rather, the way such activities are performed is adapted and populated back to the DOKB.

If a more fundamental problem occurs and cannot be incorporated into the DOKB by assimilating a problem solution, the mismatch requires a more fundamental consideration. Detection of such problems triggers a double-loop learning process, which is executed in the knowledge processing environment (cf. Fig. 1.2). Neither Firestone and McElroy (2003) nor Argyris and Schön (1978) specify the decision process that leads to either single-loop or double-loop learning in detail. The theory of model-centered learning provides an approach to describe this decision process from an individual perspective. The concept of Articulation Work allows bridging the conceptual gap between the KLC and model-centered learning and provides a starting point for developing support for this decision. Both theories are described below.

The knowledge processing environment is triggered with the formulation of a problem claim, that is, a description of the problem that needs to be resolved. This problem claim is not necessarily yet agreed upon by all involved or affected actors—involvement of other actors mostly happens during knowledge production activities following later on. Based upon the problem claim, a knowledge claim is formulated. The knowledge claim contains the 'new' knowledge (e.g., a fundamentally new version of a business process) and evolves over time in the iterative process of knowledge production. This process includes knowledge evaluation that takes an already codified (i.e., externalized) knowledge claim and verifies its correctness and applicability in the business processing environment based upon the current contents of the DOKB. As soon as no further revisions of the knowledge claim are considered necessary, Firestone and McElroy (2003) provide no statements on how to decide upon this—again, Articulation Work can be used as a starting point here), knowledge distribution is triggered. Knowledge distribution takes the outcome of the knowledge production activities (which can also be falsified or undecided knowledge claims, that is, knowledge claims that did not solve the problem that occurred in the business processing environment) and makes it accessible to the organization as a whole. The means of distribution are manifold, with the common objective of integrating the new knowledge in the DOKB. Activities here can range from distributing the codified knowledge claim to the relevant actors (as they carry the actual work knowledge and need to apply it when acting in a work process) and stakeholders in the organization to implement it in an IT-system that prescribes new behavior in the business processing environment. The Knowledge Lifecycle is closed via the re-integration of the outcomes of the knowledge-processing activities into the DOKB. New knowledge persisting in the DOKB can be used eventually for future activities in the business processing environment.

1.3 Articulation Work

The Knowledge Lifecycle does not explicitly address how work is organized by interacting actors in the business processing environment and how they react upon observed contingencies. Work is an inherently cooperative phenomenon (Helmberger and Hoos 1962). Whenever people work, they have interfaces with others, either cooperating directly or mediated via shared artifacts of work (Strauss 1985).

Cooperative work requires that participating parties have a common understanding of the nature of their cooperation. This includes dimensions such as when, how, and with whom to cooperate using certain means. The mutual understanding of cooperation has to be developed when cooperative work starts and has to be maintained over time, as changing environment factors may influence cooperation (Fujimura 1987). All activities concerned with setting up and maintaining cooperative work are summarized using the term, "Articulation Work" (Strauss 1985). Articulation Work mostly happens implicitly and is triggered during the actual productive work activities whenever contingencies arise (Gerson and Star 1986). Cooperative practices are established without a conscious act of negotiation in "implicit" Articulation Work, relying on social norms and observation to form a mutually accepted form of working together (Strauss 1988).

Implicit Articulation Work, however, is not sufficient when cooperative work situations are perceived to be 'problematic' or 'complex' by at least one of the involved parties (Strauss 1993). The terms 'problematic' and 'complex' here explicitly refer to individual perceptions, and are intrinsically subjective. As such, they cannot be detailed from an outsider's perspective. Consequently, relying on implicit Articulation Work can influence cooperation substantially. Different understandings of the same work situation impact the way of accomplishing tasks and the quality of work results, as long as Articulation Work remains on an implicit level.

Negotiation and development of a common understanding has to be carried out deliberately and consciously in such cases. This has been termed "explicit" Articulation Work by Strauss (1988). The expected outcome is to enable involved stakeholders starting or continuing their cooperative work towards a shared goal. The roles and activities of stakeholders involved in explicit Articulation Work need to be clarified, as it goes beyond implicit Articulation Work and the prevention of "problematic" (as termed by Strauss) situations.

Conducting Articulation Work facilitates the alignment of individual views about collaborative work. Strauss (1993) argues that these individual views (termed as 'thought processes' and 'mental activities') affect human work and direct individual action. In particular, for problematic or complex work situations, where social means of alignment (Wenger 2000) might not be sufficient, a closer look at the individuals' understandings of their and others' work is of interest. It should enable the design of effective support measures for explicit Articulation Work. From how 'thought processes' are described by Strauss (1993), they correspond to instances of 'schemes' and 'mental models' in cognitive sciences (Johnson-Laird 1981). The modification of mental models in the course of Articulation Work can thus be described using the theory of model-centered learning (Seel 2003).

1.4 Model-Centered Learning

People's activities in a work process, their decisions, and reactions to contingencies are driven by their perception of organizational reality (Weick et al. 2005). How people perceive their work context in an organization and how they derive their reactions on these perceptions is examined in cognitive sciences in the field of mental model theory (Johnson-Laird 1981). Mental model theory has also been used in knowledge management to explain operative triggers of organizational change processes (Firestone and McElroy 2003). Mental model theory here is used to describe individual and collective learning processes, that is, the adaptation of mental models to accommodate perceived changes in the organizational environment (Seel 2003).

Mental models are cognitive constructs that are used by persons to make plausible and assess their perceptions of phenomena in the real world (Seel 1991). Consequently, the alignment of individuals' views on work manifests in changes of the individuals' mental models—these changes are considered a form of learning (Seel 1991). The concept of 'model-centered learning' (Seel 2003) thus provides the foundation to design support instruments for explicit Articulation Work.

Model-centered learning is based on the constructs 'scheme' and 'mental model' (cf. Fig. 1.3). They serve to explain different strategies of humans to cope with external stimuli. Schemes are generalized abstract

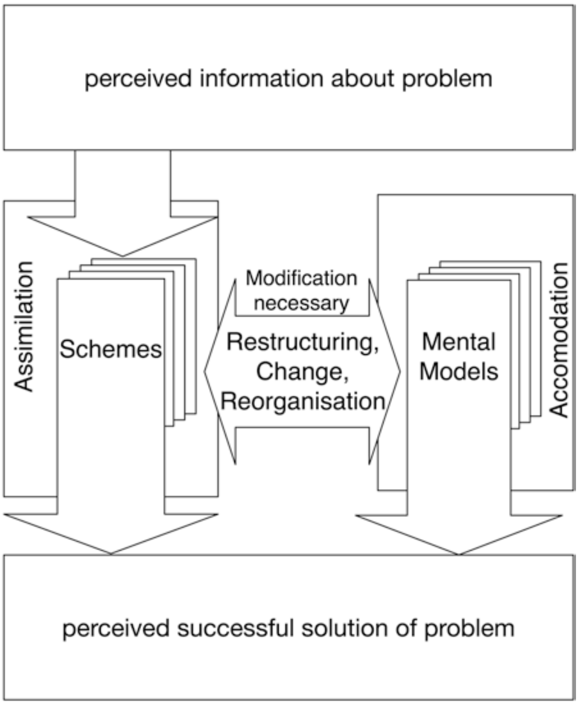

Fig. 1.3 Schemes and mental models (translated and adapted from Ifenthaler 2006)

knowledge patterns that are derived from prior experiences. They are used to immediately react on phenomena in the perceived reality without further planning activities. In situations that differ from prior experiences or are completely new to an individual, schemes are not applicable. Individuals create mental models in these cases to explain their perceptions and derive adequate reactions. Mental models might be incomplete or even be inherently contradictory. Individuals develop mental models for one particular situation only to a point enabling them to react to the stimulus in a way they consider adequate.

Mental models become more elaborate as more and more external stimuli and perceived information about the environment are incorporated. This process of 'accommodation' of mental models is considered a form of learning (Seel 1991). In the course of learning, mental models evolve from 'novice models' over 'explanatory models' to 'expert models' (or 'scientific models'), where the amount of information about causal relationships referring to phenomena in the real world increases from the former to the latter (Ifenthaler 2006). It is, however, important to note that expert models are not considered the desired aim of learning in any case. Due to the complexity of expert models, ad-hoc decisions based on perceived situations become more difficult and the perceived 'usefulness' of the mental models degrades (Ifenthaler 2006). In most cases, explanatory models are perceived as 'most useful', as they contain all information necessary to correctly judge a given situation (Ifenthaler 2006).

Depending on the situation, explanatory models may be rather simple or complex and contain less or more information, making them either more similar to a novice or an expert model. In terms of Articulation Work, expert models are hardly ever necessary, as they would require the individual to fully comprehend the entire work situation including the contributions and rationales of all other participants. In most situations, it is sufficient to develop an explanatory model of one's role in the overall work process and the interfaces to immediate co-workers. Elaborate explanatory models reduce the perceived complexity of work situations and thus enable focusing on the actual productive cooperative work.

Mental models evolve through experience in real world situations. Whenever an individual is confronted with perceptions that cannot be assimilated by existing schemes or be explained by current mental models, these models evolve and accommodate to the new perceptions (cf. Fig. 1.3). The goal of accommodation is to enable adequate action in situations similar to the one just perceived.

Mental model change requires recognizing the lack of adequacy of one's mental model and the opportunity and willingness to reflect on and adapt the mental model. In collaborative work settings, mental model change might not be restricted to a single person, but might require that all actors are involved in the work process in the reflection and change process. The willingness of changing a mental model that has been recognized to be inadequate by an individual can be assumed (Weick et al. 2005) (not imposing any assumptions about the quality of the change). Still, having the opportunity to adapt a mental model by gathering the required input and being able to retrieve it in an adequate form, can be an issue (ibid.). Furthermore, in collaborative settings, the willingness of other actors to change their mental models must not be assumed. If they do not perceive the environmental setting to be 'problematic' Strauss (1988), inquiries for change are usually met with resistance (Ifenthaler et al. 2007).

The challenges outlined above can be met with explicit activities dedicated to articulation, reflection, and alignment of individual mental models (Seel et al. 2009). Such activities need to be facilitated by providing artifacts that can serve as focal points of discussion and act as anchors for developing mutual understanding about the subject at hand (Dix and Gongora 2011). Conceptual models have been widely recognized as an appropriate mean to serve as external artifacts representing mental models (Novak 1995; Pirnay-Dummer and Lachner 2008; Chabeli 2010).

1.5 Collaborative Multi-perspective Modeling

Using collaborative conceptual modeling activities for creating a shared understanding about organizational phenomena has already been discussed extensively in prior research. Recently, research in the area of conceptual modeling has recognized that the added value of collaborative modeling not only is generated via the resulting models, but also by creating common ground about the modeled process for the involved people (Hoppenbrouwers et al. 2005). Research has started to examine how these modeling processes can be facilitated to support the evolution of common ground (Hoppenbrouwers and Rouwette 2012). In this line of research, several efforts have been made to qualitatively describe the effects occurring in such modeling sessions (Rittgen 2007; Seeber et al. 2012). The modeling process is considered to be a series of negotiation acts, with the model being an artifact generated as an outcome. Support measures in the process of modeling consequently focus on enabling and documenting negotiation acts. The process of process modeling has also been examined from a cognitive perspective, focusing on the development of understanding on the subject of modeling for the individual modeler (Soffer et al. 2011), where the authors discuss the cognitive fit of available modeling constructs as a factor influencing the process of modeling.

In the area of conceptual modeling of work processes, the idea of enabling multiple actors to explicitly articulate their individual understanding of their work contribution in separate models and use them as the foundation for consolidation in a structured way was first proposed by Mullery (1979). The multi-perspective modeling paradigm focuses on the representation of individual work contributions in models and subsequently merges them into a common model by agreeing on the interfaces among the individual models. It explicitly specifies the model elements which are subject to alignment, distinguishing them from the model parts that remain the responsibility of the individual actors.

This approach has been picked up by Türetken and Demirörs (2011), who propose a decentralized process elicitation approach (“Plural”) in which individuals describe their own work. It uses eEPC (Nüttgens and Rump 2002) as a modeling language. Plural uses tool support built upon a commercial modeling environment, which identifies inconsistencies between individual models. Front et al. (2017) adopt multi-perspective modeling in the ISEA approach (‘Identification, Simulation, Evaluation, Amelioration’). Perspectives here do not exclusively refer to individual work contributions, but are understood as putting different aspects of an organization into the focus of observation (e.g., information, organization, interaction). Modeling is tightly integrated with means of simulation, which allows to evaluate the perceived correctness of the models and to alter them accordingly.

Collaborative modeling and negotiation are also promoted by the Collaborative Modeling Architecture (COMA) approach (Rittgen 2009), which focuses on providing support for articulating and consolidating models during collaborative modeling with a language-agnostic negotiation approach. The COMA tool enables actors to communicate via the software in a structured way specified by the COMA methodology. Following its negotiation-oriented approach, COMA provides guidance for model consolidation (i.e., the negotiation process), which thus makes explicit divergent views and suggestions for a common view, which is ultimately agreed upon with the support of a human facilitator.

The usefulness of multi-perspective modeling as proposed by Mullery (1979) has also been backed by results for cognitive sciences in the field of collaborative learning (Engelmann and Hesse 2010) and mutually revealing and understanding mental models (Groeben and Scheele 2000). Engelmann and Hesse (2010) show that sharing of individually created concept maps about a topic improves mutual understanding within a group and improves the group members' performance in terms of problem solving skills related to this topic. Groeben and Scheele (2000) propose to adopt a dialogical approach to create a shared understanding about mental models. They use a tailored conceptual modeling language to explicitly represent these mental models and make them a subject of dialogue that ultimately reflects the reached consensus.

Dean et al. (2000) have examined the effects of different group modeling approaches, and found that having participants work on separate parts of a single model increases individual involvement, but leads to inconsistencies that need to be resolved in a separate step. These inconsistencies can be partially prevented when using a modeling approach that is guided by a human facilitator. Similar results have been observed by Hjalmarsson et al. (2015), who conducted empirical research in the area of facilitation of business process modeling workshops. They were able to identify different facilitation styles that are characterized by different behavioral patterns of the facilitator. The appropriateness of these styles is dependent on situational factors of the modeling setting and prior modeling knowledge of the participants.

1.6 Natural Versus Techno-Centric Modeling

The involvement of process participants in modeling tasks is linked to a major challenge: they cannot be expected to have modeling skills, and might not be willing to acquire these skills (Prilla and Nolte 2012). Trying to deploy modeling languages with a strict syntax and semantics and many different symbols often leads to even more resistance, as its added value does not become immediately visible (ibid.). What process participants would prefer is describing their knowledge through representational means that are as simple as possible in terms of both syntax and semantics (Zarwin et al. 2014). Zarwin et al. (2014) refer to these preferences as *natural modeling*. This term shifts the focus of attention from the technical and formal aspects of modeling to human aspects, with the aim of making it more widely accepted. Natural modeling follows three principles:

- modeling should be based on intuitive symbols and constructs
- modeling should be collaborative, so that models can serve as vehicles of communication facilitating knowledge sharing and promoting negotiation and commonly agreed-upon decisions, and
- modeling should be flexible in a sense that the symbols do not have a predefined meaning but rather the language used should emerge dynamically based on the situation at hand

Only if the ultimate goal of a model is its technical processing, modeling support instruments need to enable modelers to work in a continuum between "natural and formal modelling", which "should be fundamentally understood as the two polarities" (Zarwin et al. 2014, p. 29) on a continuum—the degree of formal syntax and semantics a model adheres to thus can evolve over time during its design.

Much existing research on collaborative modeling focuses on natural modeling practices (although not necessarily referred to as such). Research on supporting inexperienced modelers focuses on measures to guide them through the process of creating a model without overloading them with syntactic formalism. Existing research (e.g., Santoro et al. 2010; Fahland and Weidlich 2010; Kabicher and Rinderle-Ma 2011; Lai et al.

2014) suggests that starting modeling based upon a concrete work case makes it easier for inexperienced modelers to develop an understanding of the concepts necessary to represent a work process in an abstract model.

Using a case-based approach to modeling also reduces the number of language elements necessary to depict the work process. Case-based modeling omits alternatives in a process and exception handling and thus leads to smaller models, which usually also do not require complex semantic constructs. While the number of modeling elements alone appears not to have a notable impact on the understanding of a modeling language for inexperienced modelers (Recker and Dreiling 2007), empirical evidence shows that the number of language constructs used during modeling is limited and highly dependent on the modeling objective (Muehlen and Recker 2008). When involving inexperienced modelers, it seems to be appropriate to limit the number of available language constructs a priori to those appropriate for the intended modeling perspective and targeted outcome (Genon et al. 2011; Britton and Jones 1999).

Furthermore, Herrmann and Nolte (2014) and Santoro et al. (2010) provide evidence that non-formalized information and annotations to model elements can aid the externalization process, as this does not force the modelers to express all information using the constructs of the modeling language. Some results also point at the importance of (human or automatic) facilitation and scaffolding during the model creation process (Hjalmarsson et al. 2015) and the model alignment process (Rittgen 2007), particularly for inexperienced modelers (Davies et al. 2006). In addition, procedural and structural scaffolds provided by a facilitator or an automated system may support the elaboration of incomplete models (Herrmann and Loser 2013; Hoppenbrouwers et al. 2013; Oppl 2016; Oppl and Hoppenbrouwers 2016).

1.7 Taking an Integrated Socio-technical System Perspective

The presented kernel theories have been used as the foundation for artifact development as discussed in the introduction to this section. The MTO-framework (Strohm and Ulich 1997) can be used again to

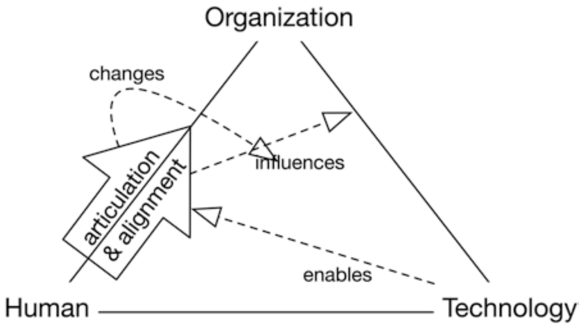

Fig. 1.4 Foci of research addressed in this book

visualize the different foci of research addressed in this book (cf. Fig. 1.4).

The main focus of the digital work design is to facilitate human actors' articulation and the alignment of their views on collaborative organizational work practices. Socio-technical artifacts are developed to enable this facilitation. In the following chapters, we examine how the deployment of such artifacts change the involved actor's perception of their work in an organizational context and how they progress to develop a shared understanding about their collaborative work. The articulation results are represented in a form that enables to influence existing enterprise architectures on both, an organizational and technical level, making use of concepts developed in the fields of business process management and information system design.

In this way, we further enrich the design space of socio-technical system design. While human resource management and work process organization from a technical perspective are understood in most cases (cf. Attewell 1992; Orlikowski 2000), we incorporate conceptual models of mental representations into socio-technical development cycles. The promoted integrated business and knowledge management perspective separates running business operations from dynamic capabilities while keeping them aligned through (i) deriving knowledge claims from existing operational procedures and (ii) either embodying accepted knowledge claims to changes in the business processing environment, or in all other cases, keep the handled knowledge claims in some living organizational design memory.

The approach gives space for development drivers in motivating and shaping cross-functional collaboration and allowing members of an organization to elaborate how operation could work across different boundaries (cf. Hsiao et al. 2012; Beane and Orlikowski 2015). Moving beyond singular dimensions of developing organizations allows suggesting a conceptual framework capturing the dynamics of social and technical work system patterns (cf. Edmondson et al. 2003; Jones 2013). It enriches the original socio-technical system paradigm (cf. Trist 1981; Mumford 2000) by explication of mental models, while keeping the assessment of system-wide implications of change and process innovation. The organization as a social subsystem of people and a technical subsystem of work process elements is linked through support instruments for continuous adaptation.

We supplement the original technical subsystem model comprising the structures, tools, and knowledge needed to perform the work with methodologically grounded technologies for handling the social system's attitudes, beliefs, and relationships between individuals and among groups. Active alignment support ensures the compatibility of individual mental models and finally that of the social and the technical subsystem. Hence, the technical and social subsystems form the entire work system when being kept adjusted to its development system (cf. Teece 2018). They require joint consideration to reflect on organizational enabling conditions and to promote people *and* technology as key drivers of development. The presented interventions and artifacts show the facilities to be encountered for stakeholder support.

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