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Knowledge and Expertise Sharing for Coordination in Digitalization Production Contexts

Marcel Manuel Sanchez Martin

University of Siegen, Siegen, Germany
marcel.smartin@student.uni-siegen.de

Abstract. In the process of ongoing digitalization of the production world, manufacturing companies are increasingly faced with the challenge of using new technologies to maintain their competitiveness. In this context, knowledge and expertise sharing is becoming more and more important, which may increase the requirements for articulation and coordination in cooperative settings. CSCW systems can potentially support these cooperation processes by promoting interaction between employees and supporting the formation of awareness. However, awareness can be related to factors of leadership and motivation and influence required learning processes through ongoing digitalization as well. As the use of CSCW systems affects technical, environmental and organizational factors of group work, knowledge and expertise sharing at different and between hierarchical levels also needs to be considered. Furthermore, group performance often is influenced by social forces and norms that act as group effects on group behavior. This is a qualitative research to explore the relationships of awareness, leadership, motivation, and learning processes and their influence on knowledge and expertise sharing in hierarchies, taking into account social processes in cooperative settings. The research focus is on small and medium-sized companies of the metalworking industry, which are in constant digitalization.

Introduction

Across the years, companies in the industrial sector have increasingly been undergoing a revolutionary transformation through digitalization of their processes. This trend is supported by the growing use of cyber-physical-production-systems and the expansion and use of the Internet of Things (Carvalho et al., 2018; Hoffmann et al., 2019; Kagermann et al., 2013; Schwab, 2017) to design digital work environments, in which new technologies are becoming increasingly important (Carvalho et al., 2018; Hertel, 2015; Hoffmann et al., 2022; Mura et al., 2016; Rijswijk et al., 2020). This in turn requires a strong focus on knowledge and expertise sharing (KES), which can be considered a strategic resource to achieve potential competitive advantages (Grant and Baden-Fuller, 2004; Watson and Hewett, 2006).

In addition, this highlights the significant role of coordination of people, information, and organizational units in cooperative settings, where interdependencies between employees or organizational units, such as the use of the same resources to achieve their goals, occurs (Schmidt and Bannon, 1992; Sudweeks and Allbritton, 1996). Here, awareness is particularly required, which can influence cooperative interactions by mediating between the three dimensions of cooperation, communication, and coordination (Fuks et al., 2008; Mantau and Barreto Vavassori Benitti, 2022; Steinmacher et al., 2013). In order to support these processes more efficiently, CSCW systems have been designed over the years to promote coordination, communication, and awareness in organizations to enhance cooperation among employees (Chen et al., 2019; Farshchian, 2019; Haines, 2020; Luther and Bruckman, 2008). One strand of CSCW research has placed a special focus on social behavior in KES (Ackerman et al., 2013). This is based on information spaces in which knowledge is gathered and made accessible (Pipek et al., 2012).

However, technology mediated cooperation also influences the development of social forces and norms in work groups (Kamel and Davison, 1998; McKinlay et al., 1999; Sudweeks and Allbritton, 1996). These in turn lead to certain behaviors, which have already been extensively discussed in different bodies of literature under the rubric of group effects (Ingham et al., 1974; Rose, 2011; Suleiman and Watson, 2008; Wajcman and Rose, 2011).

Research Context and Questions

This research project focuses on KES and requirements for articulation and coordination in the context of digitalization in manufacturing companies. In these, group work is often found in a cooperative setting, which forms the framework for cooperation and is considered as an important factor for the organization and

development of social processes (Schmidt and Bannon, 1992; Sudweeks and Allbritton, 1996).

The dynamics of group performance usually present themselves as complex and are subject to various influences by the group members. These include not only the feeling of belonging to the group (Blauner, 1964), but also situational awareness of one's own environment (Olson and Olson, 2000) and access to the communication behavior of other group members (Whittaker, 2003).

Awareness requires having understanding of the activities of others in the context of one's own task (Dourish and Bellotti, 1992). It does not only refer to hard facts; instead, it be understood as a social construct (Gross, 2013; Hancock et al., 2009; Morrison-Smith and Ruiz, 2020), in which motivation is implicitly considered as an outcome of awareness (Haines, 2020).

Furthermore, Atzenbeck and Hicks (2008) showed that awareness can have a positive impact on motivation and cooperation. Especially in the case of cooperation across spatially and temporally distances, technical support is helpful to compensate lack of awareness (Bardram and Hansen, 2010). For these use cases, there are already various systems that can be used cooperatively, but they still show deficiencies in the support of mutual awareness (Niemantsverdriet et al., 2019). Therefore, it is important to identify possible solutions within CSCW that help to compensate for the lack of awareness even more.

Within CSCW a number of constructs have been devised to support cooperative actors with cooperation challenges. Among them are common information spaces, coordination mechanisms and articulation spaces (Boden et al., 2014; Schmidt and Bannon, 1992; Schmidt and Simone, 1996). Also, many and various digital solutions have been explored in the field to promote effective coordination, KES, and successful cooperation (Balakrishnan et al., 2010; Bardram et al., 2006; Boden et al., 2014; Dabbish and Kraut, 2008; Goyal et al., 2014; Hoffmann et al., 2022). Nevertheless, the potential of digital systems to meet these requirements often cannot be fully exploited (Carvalho et al., 2018; Hoffmann et al., 2019; Mura et al., 2016; Niemantsverdriet et al., 2019). Especially factors of individual behavior in groups that influence the effectiveness of CSCW systems demand a deeper analysis (Carvalho et al., 2022).

Behavioral coordination also poses a particular challenge. Among other things, this can be influenced by motivational reasons of the employees and thereby has a direct impact on articulation work and thus the benefit of KES. In addition, it must be taken into account that the use of CSCW systems can also affect technical, environmental and organizational factors of group work (Cornell et al., 1989), which is why interactions between group members at different hierarchical levels must also be considered (Schmidt, 1994).

Regarding this, one particular issue that drew attention of past CSCW research is the role of leaders in information flows. Through their communication capabilities, they have a significant influence on the formation of awareness and

thus on the quantitative and qualitative performance of a group (Ehrlich and Cataldo, 2014). Moreover, in a study on digital group work, Haines (2020) found that, contrary to previous studies, a regular flow and exchange of information promoted by leaders can enhance the awareness of a group and increase its motivation and performance in various work contexts. Therefore, companies need to develop appropriate strategies that take into account the specific factors influencing the exchange of information in hierarchies (Pratt and Cakula, 2020). Particularly considering that effective communication is a key factor in motivation and is impeded by technology-based channels, it is important to generate support mechanisms for leaders to exchange knowledge and expertise at different and between hierarchical levels (Cakula and Pratt, 2021; Pratt and Cakula, 2021).

However, this requires a continuous learning process in organizations in order to constantly adapt the development of cooperation to the changing challenges of digitalization (Redmiles et al., 2007). Nevertheless, the learning material used in the manufacturing industry rarely meets the requirements of the respective workplaces (Weinert et al., 2022). In addition, the ongoing digitalization has increased the complexity of manufacturing processes (Fuller et al., 2020). This in turn affects the required skills and knowledge of employees and thus their need for learning (Weinert et al., 2022), which increases the importance of KES and challenges the formation of awareness.

Furthermore, technologies should not only be seen as a positive contribution to group cooperation. CSCW systems can equally lead to negative outcomes in a socio-technical environment (Carvalho et al., 2022; Neale et al., 2004). In addition, group effects lead to the fact that, contrary to the frequent assumption that group work leads to enhanced productivity, people perform less collectively than the sum of their individual performance (Ingham et al., 1974; Wajcman and Rose, 2011). These phenomena also occur frequently in cooperative settings of production work and can help to explain the impact of ongoing digitalization on cooperation in production.

To respond to the gap in the literature, this Doctoral research addresses the following research questions:

- (1) How is awareness related to leadership and motivation and influences the development of social processes referent to KES within ongoing digitalization contexts and vice versa?
- (2) How does KES work at different and between hierarchical levels and how can negative group effects be possibly mitigated when knowledge and expertise is shared in the context of digital processes?
- (3) How does awareness impact learning processes in ongoing digitalized production environments and what are the implications for the development of social processes in cooperative settings?

Research Procedure and Methodology

To answer the above mentioned research questions, a series of qualitative studies will be conducted. This approach fits the purpose, in that it allows for deeper understanding of the socio-technical issues (Wulf et al., 2018). As an instrument for data collection, semi-structured in-depth interviews will be conducted to give participants the opportunity to deepen their views and understanding of specific topics (Hermanowicz, 2002). Subsequently, the data will be thematically analyzed according to Braun and Clarke's (2012) approach.

The recruitment of the study participants will be based on purposive sampling (Bryman, 2012) and will consider employees of different hierarchical levels. The interviews should preferably be conducted in German small and medium-sized companies of the metalworking industry that are in an ongoing digitalization process, as they represent the industrial structure of our region.

Similar to what has been previously reported in the literature (Mura et al., 2016), in the metalworking industry, the workplaces of most participants are expected to be characterized by physical and noise-intensive activities that take place while handling different materials on various machines. Also, various sources of danger, such as forklift traffic and cranes (Patil et al., 2019) may play a role. This will require protective clothing, such as gloves, helmets, or even heat protective clothing, for most of them. These measures serve to ensure safety, but hinder the use of simple communication tools such as pens, keyboards, small switches, or headsets (Mura et al., 2016). Furthermore, the workplaces of the study participants may be spatially separated from those of their colleagues, which complicates direct personal contact between the employees.

Moreover, it is not uncommon for production employees to interrupt their work to retrieve work instructions or necessary information from systems (Evans et al., 2017) or to coordinate tasks within their group (Carvalho et al., 2018). In addition, the work content of participants may also vary as they are faced with changing tasks. This suggests some socio-technical challenges for cooperation, especially regarding articulation as the base of coordination and KES in cooperative settings. Therefore, the studies will focus on aspects of KES and how employees experience the ongoing digitalization of their workplace and how it affects their work practices.

Research Contributions

This research aims to contribute to CSCW by providing an account of how KES is affected by social processes in cooperative settings in the context of digitalized processes. In particular, the effects of the relationships of awareness with leadership and motivation as well as changing learning processes in the context of ongoing digitalization of work processes and the specifics of KES in hierarchies will be

considered. It is expected that the current state of the art in these topics can be advanced through a deeper understanding and that relevant information for implementation in practice can be gained.

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