Supporting Individual Needs for Intra-Organisational Knowledge Sharing Activities in Pre-Industry 4.0 SMEs

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Dan Li[1], Dan Paulin[1], Åsa Fast-Berglund[1], Per Gullander[2] and Lars-Ola Bligård[1]
[1]Chalmers University of Technology, Gothenburg, Sweden
[2]Swerea IVF, Mölndal, Sweden
dan.li@chalmers.se
dan.paulin@chalmers.se
asa.fasth@chalmers.se
per.gullander@swerea.se
lars-ola.bligard@chalmers.se

Abstract: The complexity of modern manufacturing industry and the emergence of Industry 4.0 puts changing cognitive demands on human operators at work. Operators in this environment, Operator 4.0, will share knowledge through the use of new digital technologies that should be implemented in parallel with an organizational development towards Organization 4.0. On an individual level within the organization, people benefit from understanding their own knowledge needs and gain necessary knowledge through knowledge sharing activities. In pre-Industry 4.0 organizations, this is done primarily through meetings. Originally developed to create smart meetings in smart factories, an elaborated version of the MEET model (Gullander et al, 2014) is used in this paper to evaluate the needs for sharing of tacit and explicit knowledge, both in regards to how it affects the Information System and the Organization System. By adding a systematic process approach to mapping individual knowledge needs related to production activities, these needs can be identified for each process step. By using this systematic approach to apply the MEET model, two Swedish SMEs within the manufacturing industry have developed their knowledge sharing activities. This human-centred study, based on questionnaires and interviews, focuses on how shop-floor operators perceive changes in knowledge sharing activities due to the use of the MEET model. Novelty in this research lies in the attempt to link the technology-intensive Industry 4.0 development with an organizational emphasis. Results show that the applied method can be used to pragmatically improve knowledge sharing from certain aspects, but further research is required to determine the correlation between different areas and their effect on knowledge sharing. This paper suggests that knowledge sharing in organizations can be benefitted from Industry 4.0 enabling technologies, introducing this as Organization 4.0.

Keywords: Organization 4.0, Operator 4.0, Industry 4.0, knowledge sharing.

1. Introduction

To facilitate the transition to a more flexible future manufacturing industry, the idea of Industry 4.0 has emerged, which implores that factories should have visibility, transparency, predictive capacity, and adaptability to gain Industry 4.0 maturity (Schuh et al, 2017). Many companies today are yet to reach pre-Industry 4.0, i.e. not yet at the first step of digitalization, e.g. still using papers or whiteboards for communication (Fast-Berglund et al, 2014). This paradigm shift also sets cognitive demands on shop-floor operators to manage working in Industry 4.0, becoming Operator 4.0 (Romero et al, 2015). In order for Operator 4.0 to work in this technologically developed Industry 4.0, Schuh et al (2017) propose four structural areas to be developed: resources, information systems, organizational structure, and culture. Resources and information systems, mainly involving the implementation of new technology, have received the lion's share of attention, within research and practice alike (Kern-Isberner, Fürnkranz and Thimm, 2017; Stich, Schmitz and Zeller, 2017). However, the company's structure, people, and activities also need to be developed in parallel (Gullander et al, 2014; Johansson et al, 2018) to support the agile manufacturing process of Industry 4.0 (Schuh et al, 2017). To denote the importance of knowledge sharing within the agile organization in Industry 4.0, this paper introduces the term Organization 4.0. Information and communication technologies and knowledge management are vital for an organization to increase their Industry 4.0 maturity. Therefore, both Organization System and Information System must be considered in parallel, which is illustrated in the MEET model (Gullander et al, 2014). Often, the sharing of knowledge in the manufacturing industry occur in physical face-to-face meetings. Thus, meetings are an important factor in this model. The MEET model was created to improve such meetings by opening up the possibility of time-place flexibility and an increased use of smart digital solutions to share knowledge.

Within the hierarchy of data-information-knowledge-wisdom, each step builds on the foundation of a previous step (Ackoff, 1989). Information systems are playing an important supporting role in the knowledge sharing of organizations (von Krogh, 2002). In order to bridge over from the information system to the organization sys-

tem, the transformation process from data, via information, to knowledge becomes vital to understand (Rowley, 2007). Inkinen (2016) claims that recent technological development has greatly benefitted knowledge management practices, e.g. combination and quicker access to knowledge. However, knowledge creation and retention are difficult to implement in practice, since it relies on the sharing of knowledge and information between knowledge workers and its environment (Massingham, 2014). Cook and Brown (1999) distinguish organizational knowledge from organizational knowing, they mean that knowledge is a tool of knowing, and that knowing is an aspect of our interaction with the social and physical world, and that the interplay of knowledge and knowing can generate new knowledge and new ways of knowing.

In this paper, the combination of Organization System, Information System and knowledge sharing is discussed with regards to industrial cases at two Swedish SMEs where four knowledge sharing activities were developed.

2. Knowledge sharing

Data can be contextualized into information when knowledge is applied (Drucker, 1988). When information is mixed with experiences and insights, knowledge can be transformed into knowing (Davenport and Prusak, 1998). Thus, knowledge is required to create and understand information (Tuomi, 1999). Unlike information, knowledge is dependent on human commitment and belief (Nonaka, 1994). While information is descriptive, knowledge is prescriptive (Ackoff, 1989). Knowledge can be divided into tacit and explicit knowledge (Smith, 2001). Tacit knowledge is regarded as more challenging to manage and a source of competitive advantage and numerous research contributions have been made within this field (Drucker, 1988). Tacit and explicit knowledge are shared differently, both with regards to if the knowledge output is tacit or explicit (Nonaka, 1994; Small and Sage, 2005) and also if it on an individual or group context (Crossan, Lane and White, 1999; Small and Sage, 2005). Small and Sage (2005) give examples of the four knowledge types that Cook and Brown (1999) proposed by crossing the tacit-explicit dimension with the individual-group context, see Figure 1.

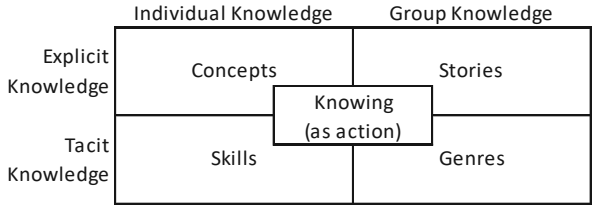

Figure 1: Types of knowledge, by Cook and Brown (1999) and adapted by Small and Sage (2005).

Another view that also considers the difficulty to disseminate knowledge is whether to regard it as an object (knowledge as an object, K-O) (Sveiby, 2007), or as something that is constructed in a social context and thus cannot be separated from the context or the individual (knowledge as a subjective contextual construct, K-SCC). Adopting a K-SCC view in line with Paulin and Suneson (2015) has two consequences for this paper. First, an understanding of the individuals' needs and perceptions are vital for the understanding of the situation, and second, the organization of knowledge sharing activities might constitute a knowledge barrier that needs to be taken into consideration.

2.1 Model for knowledge sharing

Models for knowledge sharing between individuals are commonly based on the Shannon and Weaver (1949) model for communication. Here, a knowledge dissemination model by Paulin (2013) is used (Figure 2, left). The Paulin model is a synthesized model building on Lindkvist (2001), Cummings and Teng (2003), Paulin (2006), Minbaeva (2007), and Duan, Nie and Coakes (2010), adapted for knowledge sharing in manufacturing contexts.

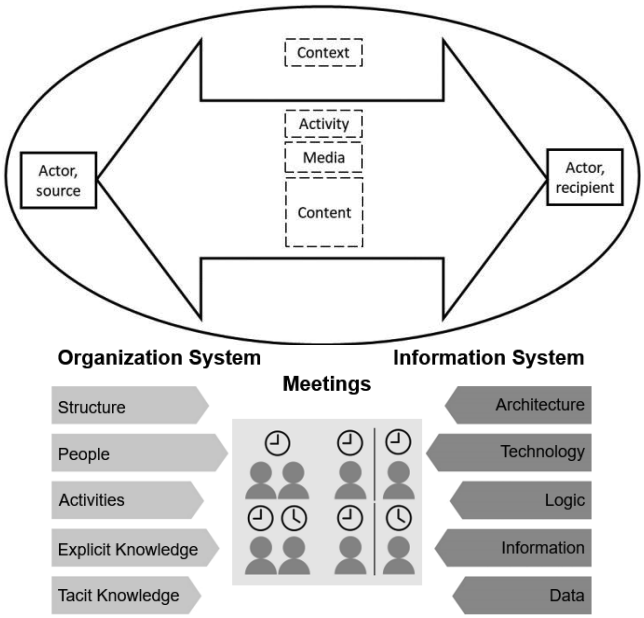

Figure 2: Model for knowledge sharing (Paulin, 2013) (left) and The MEET model (Gullander et al, 2014) (right).

Actors refer to the individuals involved in the knowledge sharing activity. In the Shannon and Weaver (1949) model there is an emphasis on sender and receiver, but without any feedback loops included. Here, the interaction between actors is included. Content refers to shared knowledge. Media include the channels or knowledge carriers by which knowledge is shared. This can be, for example, face-to-face interaction or e-mails. Context is the situation in which knowledge is shared. These components in the model are emphasized when a K-SCC view is applied. Each of the five components in the model consists of associated factors that have an influence on knowledge sharing (Paulin and Winroth, 2013): facilitators (with a positive impact on knowledge sharing), inhibitors (with a negative impact), and obstacles (that obstruct until certain conditions are fulfilled).

2.2 The MEET model for analysing knowledge sharing activities

The MEET model, as introduced by Gullander et al (2014) in Figure 2 (right), is separated into Organization System and Information System. These two integral systems are further divided into five areas each, with the aggregate bottom four areas (explicit knowledge, tacit knowledge, information, and data) being the content that is shared. In the centre, between the Organization System and Information System stands the representation of the time-place flexibility, which signifies that knowledge sharing activities can occur with the actors participating during the same or different time, and at the same or at different places (Baecker, 1993).

2.3 Knowledge sharing in the MEET model

In this paper, the models from Figure 2 are used to explain the knowledge sharing process and the MEET model is used by the case companies to promote the development of their knowledge sharing activities. The relationship between these two models is presented in Figure 3.

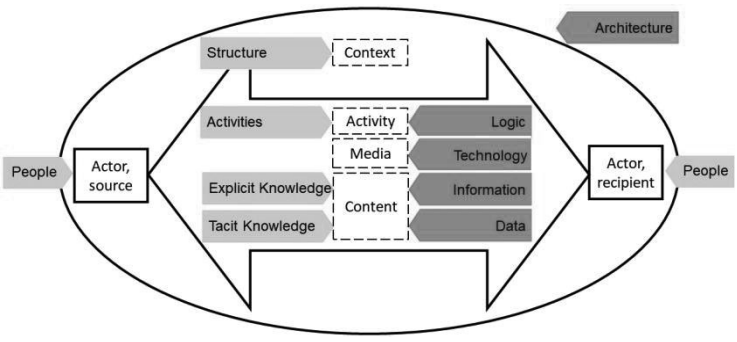

Figure 3: Relationship between the Paulin model and the MEET model.

People are the participants of the knowledge sharing activities, which can be both source and recipient actors. These activities occur in a certain context, which can be placed in the company's organizational structure. Data, information, tacit and explicit knowledge are various types of content that are shared during the activities.

While activities are what is done during the knowledge sharing activities, the logic dictates how the knowledge sharing activities are useful for the actors. The technology constitutes the media, or carrier, that cognitively supports the knowledge sharing activities. Linking technology with documentation of the shared content in repositories are the back-end IT architecture.

3. Industrial cases

The elaborated version of the MEET model with a focus on knowledge sharing from Figure 3 was used at two case companies. Both case companies, A and B, are SMEs located in Sweden and are subsidiaries of Finnish parent companies. Company A sells, installs and provides service for scales and weighing information management systems. Its parent company manufactures and delivers the products to them. Company B manufactures, sells and installs heat and smoke exhaust ventilators and roof domes for intake of natural light.

Both case companies wanted to use the MEET model to help themselves develop their knowledge sharing activities with the purpose of improving the communication between employees. By studying the components of a specific knowledge sharing activity, they can adapt these to better suit the knowledge needs of recipient actors. Two knowledge sharing activities were studied at each company, A1 and A2, B1 and B2 respectively.

3.1 Methods

The applied research approach was the same for studying the implemented changes for the four knowledge sharing activities at the two case companies. First, an introductory workshop was held at each case company during a first visit. During this workshop, company participants were introduced to the MEET model by the authors, and the companies identified two knowledge sharing activities themselves for development work. For each of these knowledge sharing activities a questionnaire was filled out, and together with documentation from the workshop, it constituted a description of the situation before changes were carried out. The case companies applied the MEET model and carried out changes themselves to their selected knowledge sharing activities. Afterwards, during a second visit, the same questionnaires as before were filled out, followed up by interviews. The research activities were conducted in Swedish.

3.1.1 First visit: Introductory workshop

The introductory workshops had three purposes. First, to introduce the MEET model, so that the companies may use it. Second, to select which knowledge sharing activities to study. Third, to gather empirical results, both qualitative documentation of the situation before changes and quantitative questionnaire responses.

The selection of knowledge sharing activities centred on individuals' needs of knowledge in their work. It started with a process mapping of current operations and a prioritization of processes based on participants' sense of urgency. After processes were selected, its sub-processes were outlined. The individuals that work at the sub-processes inventoried required knowledge to execute tasks at each sub-process, and subsequently how that knowledge was shared. The participants agreed on two of the sub-processes for further studies and filled out a questionnaire concerning one of their selected knowledge sharing activities, which together with their newly gained knowledge about the MEET model served as a basis for discussion of their development work.

The MEET model, and its ten focus areas, including the participants' own questionnaire results, formed the basis for the companies' own discussions and consequent planning and implementation of changes to the selected knowledge sharing activities.

3.1.2 Second visit: Interviews

By the time of the second visit, the companies had implemented some changes to their selected knowledge sharing activities. Interviews with individual participants were held, which were broken up into two portions. First, with a structured interview approach, the participants were asked to explain the reasons for their responses to the questionnaire. Second, with a semi-structured interview approach, the participants were asked to explain their perception of the changes since the first visit.

3.1.3 Both visits: Questionnaires

Questionnaires for their knowledge sharing activity were filled out by the participants during both visits. Each of the questions in the questionnaire is connected to either two or three of the MEET areas (Li et al, 2016; Li et al, 2017). There were four-choice options for answering and the weights of the answer options were: 0, 0.25, 0.75, and 1. The weighting was not shown to the respondents, but the connection to the MEET areas was visible however not in the centre focus. The questions and answering options are detailed in Li et al (2016) and Li et al (2017).

3.2 Company A

Company A has 5 employees, including CEO, at their main site that work with sales and management. Additionally, regional service operators work from other locations in Sweden. All of the 5 employees at the main site participated in the introductory workshop, filling out questionnaires and interviews. The CEO participated in questionnaires and interviews for both A1 and A2, thus why the sum of participants for A1 and A2 is 6. The participation by Company A, along with Company B are summarized in Table 1.

3.3 Company B

Company B has 11 employees, including CEO, working at their main site. 4 employees work with sales and production management, and 7 employees work on the shop-floor. Additionally, regional installation operators work from other locations in Sweden. As summarized in Table 1, the 4 employees working with sales and production management participated in the introductory workshop, and all of the 11 employees at the main site participated in filling out questionnaires and interviews except for one shop-floor operator who did not want to participate due to leaving the company close in time.

Table 1: Summary of participation of the case companies

Company	Number of employees	Participants at introductory workshop		Knowledge sharing activity	Number of questionnaire respondents	Number of interviewees	Dates of first and second visits
A	5	5	A1	Weekly via phone, order planning	3	3	29 May, 2017
			A2	Irregularly via phone, service planning	3	3	6 March, 2018
B	11	4	B1	Daily face-to-face, production preparation	4	4	31 August, 2017
			B2	Daily face-to-face, shop-floor planning and feedback	7 (first visit) 6 (second visit)	6	5 March, 2018

4. Results

For each of the four knowledge sharing activities, the results from the interviews and questionnaires are described as the status during the first visit, the implemented changes until the second visit, and questionnaire comparisons.

4.1 Knowledge sharing activity A1: weekly phone meetings, order planning

4.1.1 First visit (before)

Knowledge sharing activity A1 is a same time-different place weekly phone meeting *(technology)*. The *content (activity)* concerns delivering orders to customers regarding Company A's sales and its priorities and planning. The *actors (people)* include the management team at the main site on one side, and service manager and regional service operators on the other side. Apart from the phone meeting, the content is documented in minutes and distributed by e-mail to the meeting participants afterwards.

4.1.2 Second visit (after)

Not much change to the *carrier* (phone meeting and distribution of minutes) has been done, but *activity*-wise the *logic* of the meeting has switched from a 3 weeks' perspective to a 2 weeks' foresight of sales planning while keeping the same meeting agenda.

In Table 2, the average responses to the questionnaires of the knowledge sharing activity A1 are presented. The average of the responses for each question is presented in columns "Before" (first visit) and "After" (second visit). The questions are sorted after its connected MEET areas. The column "Change" compares the difference between "Before" and "After". The column "Area change" averages the 2-3 questions connected to that specific MEET area. In the "Before" and "After" columns, values below 0.125 or above 0.875 are highlighted with black and grey backgrounds respectively, to indicate a low or high value, since these values are half-

way between the two lower and higher weighting values for the answer options. For the columns "Change" and "Area change", values below or above 0 are highlighted with black and grey backgrounds respectively to indicate a decrease or increase of the average among the related questions.

From "Before" and "After" columns in Table 2, the respondents think that they have a good dialogue to start with (Q4), but after the change, the standard for how the meeting should be conducted (Q1) and its documentation (Q7) also improved. In the "Area change" column, most improvements occurred for *data* and *information*, because the respondents feel encouraged to participate more actively during the meetings (Q3) and good technological support tools exist for presenting and documenting *data* and *information* (Q5, Q6 and Q7).

Table 2: Questionnaire results, knowledge sharing activity A1

Organization System areas	Question	Before	After	Change	Area change
Structure	Q1	0.83	0.92	0.08	0.00
	Q9	0.83	0.75	-0.08	
People	Q2	0.58	0.58	0.00	0.04
	Q4	0.92	1.00	0.08	
Activities	Q1	0.83	0.92	0.08	0.00
	Q9	0.83	0.75	-0.08	
Explicit Knowledge	Q2	0.58	0.58	0.00	0.13
	Q3	0.58	0.83	0.25	
Tacit Knowledge	Q4	0.92	1.00	0.08	-0.04
	Q8	0.83	0.67	-0.17	

Information System areas	Question	Before	After	Change	Area change
Architecture	Q7	0.67	1.00	0.33	-0.03
	Q8	0.83	0.67	-0.17	
	Q10	0.83	0.58	-0.25	
Technology	Q5	0.50	0.75	0.25	0.08
	Q6	0.50	0.75	0.25	
	Q10	0.83	0.58	-0.25	
Logic	Q5	0.50	0.75	0.25	0.08
	Q9	0.83	0.75	-0.08	
Information	Q3	0.58	0.83	0.25	0.25
	Q6	0.50	0.75	0.25	
Data	Q6	0.50	0.75	0.25	0.29
	Q7	0.67	1.00	0.33	

Based on the interviews, most changes relate to *logic*, which is not reflected by the questionnaire results in Table 2. This can be explained by that despite good technological support tools (Q5), the meetings' relevance for the daily work (Q9) was already high for the first visit so that it was difficult for further improvement.

4.2 Knowledge sharing activity A2: irregular phone meetings, service planning

4.2.1 First visit (before)

Knowledge sharing activity A2 is a same time-different place phone meeting occurring irregularly when necessary. The content concerns managing and delivering service to two specific products in Company A's portfolio. The actors include an administrative staff at the main site on one side and a regional service operator on the other side. Apart from the phone meeting, the *content* is documented in a system for managing work orders that is visible for both *actors* as well as in an Enterprise Resource Planning system that is only visible for the administrative staff, who also manually links together these two IT systems *(architecture)*.

4.2.2 Second visit (after)

Not much change to the *carrier* (phone meeting and documentation in IT systems) has been done, but *activity*-wise an agenda supporting the sharing of knowledge has been formalized and a template for documentation has been simplified to match the *knowledge* needs of both *actors*.

Comparing "Before" and "After" in Table 3, the respondents agree that originally for these meetings, the dialogue was good (Q4), but there were no standards *(activities)* for how to conduct them (Q1), which improved after the change, along with better use of their technological support tools (Q5). These changes are entailed in column "Area change", where most improvements occurred for *structure*, *activities*, and *logic*. Additionally, a clearer connection between the meeting *content* and its relevance for the daily work (Q9) contributes to the improvement of these MEET areas.

Most changes relate to *logic* and *activities* according to the interviews, which is reflected by the questionnaire results in Table 3. However, Table 3 also shows a change in *structure*, which is innately related to the same questions as *activities* (Q1 and Q9).

Table 3: Questionnaire results, knowledge sharing activity A2

Organization System areas	Question	Before	After	Change	Area change
Structure	Q1	0.00	0.75	0.75	0.54
	Q9	0.25	0.58	0.33	
People	Q2	0.42	0.58	0.17	0.00
	Q4	0.92	0.75	-0.17	
Activities	Q1	0.00	0.75	0.75	0.54
	Q9	0.25	0.58	0.33	
Explicit Knowledge	Q2	0.42	0.58	0.17	0.13
	Q3	0.50	0.58	0.08	
Tacit Knowledge	Q4	0.92	0.75	-0.17	-0.13
	Q8	0.50	0.42	-0.08	

Information System areas	Question	Before	After	Change	Area change
Architecture	Q7	0.67	0.67	0.00	-0.17
	Q8	0.50	0.42	-0.08	
	Q10	0.83	0.42	-0.42	
Technology	Q5	0.42	1.00	0.58	0.08
	Q6	0.67	0.75	0.08	
	Q10	0.83	0.42	-0.42	
Logic	Q5	0.42	1.00	0.58	0.46
	Q9	0.25	0.58	0.33	
Information	Q3	0.50	0.58	0.08	0.08
	Q6	0.67	0.75	0.08	
Data	Q6	0.67	0.75	0.08	0.04
	Q7	0.67	0.67	0.00	

4.3 Knowledge sharing activity B1: daily face-to-face meetings, production preparation

4.3.1 First visit (before)

Knowledge sharing activity B1 is mainly a same time-same place meeting concerning production planning. The *content* concerns knowledge required to prepare work orders for production based on customer orders. The *actors* include various functions in the sales and production management teams. Participants may join the meeting by phone if not physically present. The outputs of these meetings are work orders, which get distributed to knowledge sharing activity B2.

4.3.2 Second visit (after)

The interviewees agree that the *carrier* has remained the same. However, the *activities* of the meetings have changed from solving urgent problems to ensuring the quality of all prepared work orders before these are sent to the shop-floor. Previously, the meetings occurred spontaneously when needed, around once a week, but now it occurs on a daily basis.

From "Before" and "After" columns in the questionnaire results of Table 4, the respondents often use their opportunity to speak (Q3), both before and after the change. It is continuously unclear how the meeting should be documented (Q7). However, it's the relevance for the daily work has become clearer (Q9). In the column "Area change", most improvements occurred for *architecture*, which can be attributed to that the respondents thought that it has become easier to access *knowledge* required for the meeting (Q8), connecting the meeting to Company B's other information systems (Q10).

Table 4: Questionnaire results, knowledge sharing activity B1

Organization System areas	Question	Before	After	Change	Area change
Structure	Q1	0.56	0.56	0.00	0.06
	Q9	0.75	0.88	0.13	
People	Q2	0.63	0.81	0.19	0.03
	Q4	0.56	0.44	-0.13	
Activities	Q1	0.56	0.56	0.00	0.06
	Q9	0.75	0.88	0.13	
Explicit Knowledge	Q2	0.63	0.81	0.19	0.09
	Q3	0.94	0.94	0.00	
Tacit Knowledge	Q4	0.56	0.44	-0.13	0.13
	Q8	0.13	0.50	0.38	

Information System areas	Question	Before	After	Change	Area change
Architecture	Q7	0.00	0.00	0.00	0.23
	Q8	0.13	0.50	0.38	
	Q10	0.50	0.81	0.31	
Technology	Q5	0.38	0.25	-0.13	0.08
	Q6	0.50	0.56	0.06	
	Q10	0.50	0.81	0.31	
Logic	Q5	0.38	0.25	-0.13	0.00
	Q9	0.75	0.88	0.13	
Information	Q3	0.94	0.94	0.00	0.03
	Q6	0.50	0.56	0.06	
Data	Q6	0.50	0.56	0.06	0.03
	Q7	0.00	0.00	0.00	

While most changes, when interviewing the participants, seem to be related to *activities*, this is not reflected by the questionnaire results in Table 4. Despite the change of agenda, the interviewees argued that they felt that it's a continuous development effort, thus maintaining the perception of the question (Q1) which moderated the already high perception of improved relevance for daily work (Q9).

4.4 Knowledge sharing activity B2: daily face-to-face meetings, shop-floor planning and feedback

4.4.1 First visit (before)

Knowledge sharing activity B2 is a same time-same place face-to-face meeting concerning production planning that occurs on a daily basis. The *content* concerns clarifying knowledge required to perform the production work based on work orders produced from knowledge sharing activity B1. The *actors* include on one side the production manager and on the other side the shop-floor operators. The work orders are placed on a white-board *(technology)*, which supports this knowledge sharing activity.

4.4.2 Second visit (after)

Most operators perceived that the *activities* of the meetings have changed, but not all agree. Some detailed *knowledge* concerning specifics only relevant to a few meeting participants have been excluded from this meeting and are addressed later. This extraction has shortened the meeting substantially but hasn't changed the meeting *activities* for most participants. The *carrier* (whiteboard) has changed considerably, which can be compared in Figure 4. Few operators think that even though the whiteboard has changed, it hasn't affected their work. However, most operators agree that the shared knowledge has become more clear after the change because of the colour-coded indicators replacing illegible hand-writing. In general, most operators think that the shared knowledge is received better, reducing the need to ask for a repetition of certain knowledge later.

Figure 4: Left: Whiteboard before the change, the signs above translate to "To do", "Ongoing", and "Finished". Right: Whiteboard after the change, the headers above are Company B's workstations.

"Before" and "After" columns in the questionnaire results of Table 5 shows the standard agenda *(activities)* of the meeting was quite clear from the beginning, however, after the change, some thought it became less clear (Q1), but still high. Most respondents thought that the use of support tools during the meeting have become better after the change (Q5 and Q6). However, its connection to other information systems has deteriorated with the change (Q10). This has subsided *technology* in "Area change" column. Further, the good use of technological support tool (Q5) together with the relevance for the daily work (Q9) gives *logic* the highest increase.

The mixed opinion of the impact of changes to *activities* is reflected in Table 5 with a very small average change. The *technology* change of carrier and the *logic* way to use it are noticeable in Table 5, only moderated by unclear connection to other information systems (Q10) of Company B.

Table 5: Questionnaire results, knowledge sharing activity B2

Organization System areas	Question	Before	After	Change	Area change
Structure	Q1	0.96	0.83	-0.13	-0.04
	Q9	0.79	0.83	0.05	
People	Q2	0.64	0.79	0.15	0.13
	Q4	0.71	0.83	0.12	
Activities	Q1	0.96	0.83	-0.13	-0.04
	Q9	0.79	0.83	0.05	
Explicit Knowledge	Q2	0.64	0.79	0.15	0.03
	Q3	0.68	0.58	-0.10	
Tacit Knowledge	Q4	0.71	0.83	0.12	0.02
	Q8	0.82	0.75	-0.07	

Information System areas	Question	Before	After	Change	Area change
Architecture	Q7	0.86	0.83	-0.02	-0.12
	Q8	0.82	0.75	-0.07	
	Q10	0.50	0.25	-0.25	
Technology	Q5	0.39	0.79	0.40	0.09
	Q6	0.50	0.63	0.13	
	Q10	0.50	0.25	-0.25	
Logic	Q5	0.39	0.79	0.40	0.22
	Q9	0.79	0.83	0.05	
Information	Q3	0.68	0.58	-0.10	0.01
	Q6	0.50	0.63	0.13	
Data	Q6	0.50	0.63	0.13	0.05
	Q7	0.86	0.83	-0.02	

5. Discussion

In this paper, the MEET model has been used by the case companies to develop their knowledge sharing activities. Table 6 summarizes the results from the four knowledge sharing activities. It shows that the MEET model was applied to different situations.

Table 6: Summary of results

Knowledge sharing activity	A1	A2	B1	B2
Type of shared knowledge	Group knowledge, explicit knowledge.	Individual knowledge, tacit knowledge.	Group knowledge, tacit knowledge.	Group knowledge, explicit knowledge.
Time-place flexibility, MEET model	Same time-different place. Weekly phone meeting.	Same time-different place. Phone meeting occurring irregularly when necessary.	Same time-same place. Face-to-face meeting; daily, production preparation.	Same time-same place Face-to-face meeting: daily, shop-floor planning and feedback.
As expected from Tables 2-5	Activities: remains the same.	Logic and activities: increases.	-	Activities: small change. Technology and logic: increase.
Surprising from Tables 2-5	Logic: increase is lower than expected.	-	Activities: increase is lower than expected.	-

While A1, B1, and B2 shared group knowledge in common for the employees, A2 solved specific problems on an individual level. A2 and B1 contained more tacit knowledge based on experiences of the actors, while more explicit knowledge was shared in A1 and B2.

Based on the workshops and interviews, many of the questionnaire responses were expected. However, for A1 and B1, despite the interviewees voiced positively, the questionnaire results were lower than expected (Table 6, bottom row). However, the MEET model was useful in supporting the case companies' development of knowledge sharing activities from an Organization System perspective. Adopting a K-SCC view of knowledge sharing has prioritized individual needs for knowledge sharing, which in these cases has manifested as Organization System, containing the activities. Not many technological changes were made, perhaps because of inhibitors to invest in this kind of change, which also signifies the pre-Industry 4.0 context.

Individuals' needs for knowledge were supported by the use of the questionnaires before and after the change. The questionnaires before helped to create a picture among the participants for what changes were required and desired and the questionnaires afterwards helped review that picture. However, further research is required to determine the correlation between different areas that affect knowledge sharing and revise the questions of the questionnaire. Such a development may help with the understanding of how knowledge sharing in Industry 4.0 affects Operator 4.0.

In Table 6, with most expectations and surprises relating to the areas of activities, logic, and technology, the latter two (Information System) were mostly deliberate changes made by the companies, while the changes to the activities (Organization System) itself were often a consequence of that. The exception being knowledge

sharing activity A2, where the development focus of company A was on the Organization System rather than the Information System. In general, for knowledge sharing activities A1, B1, and B2, if instead of developmentally prioritizing the areas of technology and logic, more efforts were spent on the areas of structure, people, and activities, other results that are more favourable for the Organization System in Tables 2, 4, and 5 should be expected, and thus, enabling the development and subsequent implementation of an Organization 4.0.

6. Conclusion

This paper has shown that the MEET model can be used by SMEs for developing the support for individuals' needs of knowledge sharing. Individuals' needs were supported by adopting a systematic approach to analysing sub-processes of work tasks, and how related knowledge sharing activities can be developed to cater to these needs in the work tasks. This was demonstrated by the two companies' ability to use the MEET model.

By using the MEET model with this systematic approach, the case companies have managed to implement some changes to their Organization System and Information System, which affected the perception of shared tacit and explicit knowledge in a mostly positive way. The four cases had different pre-conditions, which also shows a versatility of the use of the MEET model.

In a pre-Industry 4.0 setting, this paper has shown the difficulty for SMEs to implement new digital technology to support individuals' knowledge needs, since most implemented changes was related to the Organization System. While it may be easier to implement organizational changes as a consequence of more deliberate efforts of technological development, the emergence of Industry 4.0 bears organizational challenges. Obstacles for SMEs to implement Industry 4.0 enabling technologies need to be identified and mitigated to support the knowledge needs of Operator 4.0.

This can be accomplished by developing the structure, people and activities (Organization System) of a company to better support knowledge sharing activities. Hence, this paper's emphasis on elevating the importance of developing concepts and starting discussions concerning a future Organization 4.0.

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