MEASUREMENT OF CONDITIONS FOR KNOWLEDGE SHARING

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This paper describes a model to quantify conditions that enable knowledge sharing in an organization. Based on this 'level of facilitated knowledge sharing' we are able to identify the next steps to be taken, i.e. which conditions are most appropriate to stimulate. In addition, this measurement provides an indicator of the effectiveness of (one or more) actions taken, and may help in steering knowledge sharing efforts.

1 Objective of this article

This article helps organizations to determine their next steps in facilitating and stimulating knowledge sharing. The article is structured in three main parts. We first introduce the conditions that we consider enablers of knowledge sharing in an organization. We also define phases that differentiate between possible stages in the development of knowledge sharing in an organization and we propose a relation of the enabling conditions to these phases. The second part of the paper describes a model to measure the enabling conditions — based on a pragmatic quantification and ranking of these conditions — to determine the applicable knowledge sharing phase. This identifies which conditions are the most appropriate to stimulate. In the third part of this article we describe our method as a continuous cycle of measurement and action.

2 Conditions that enable knowledge sharing

We propose three entities as key factors in knowledge sharing: people, organization, and technology. That is because we consider knowledge sharing as a social interaction between people. Also, organizational issues have a major impact on knowledge sharing. Furthermore, (information and communication) technology is an important facilitator of knowledge sharing. The social, organizational, and technological conditions that we recognize as enablers of knowledge sharing (see Figure 1) are detailed below (Brink 2001).

2.1 Social conditions

Davis (1998) states that "Effective knowledge management requires a fundamental change in the way most companies do business, and people are at the heart of any effective change". The human factor in knowledge sharing focuses on the drivers that trigger people to do what they do, on the possible skill levels of a person, and on the roles an individual can play in an organization.

care: In an organizational context care has the meaning of warm, genuine interest of one employee in another employee, giving attention and helping him or her whenever needed, and stimulates his or her personal growth and development (Krogh 1998). This may constitute a foundation for people to be open to thoughts of other people, to engage in a dialogue with each other, and to reconsider one's own basic beliefs

appraisal: Senge (1992) observes that people should redesign their mental models — 'constructed' in traditionally competitive environments — in order to support sharing and transfer of knowledge and expertise. People need to be stimulated and motivated to

do so, they need incentives to participate in the knowledge sharing process (Hansen 1999, Trussler 1998, Elliott 1997).

empowerment: Empowerment is involving people in the changes that will affect them (Schein 1995, Ulrich 1998). Nonaka (1995) believes that this may improve an individual's motivation to create knowledge because the autonomous individual strives for personal development and has the possibility to create his or her own concepts.

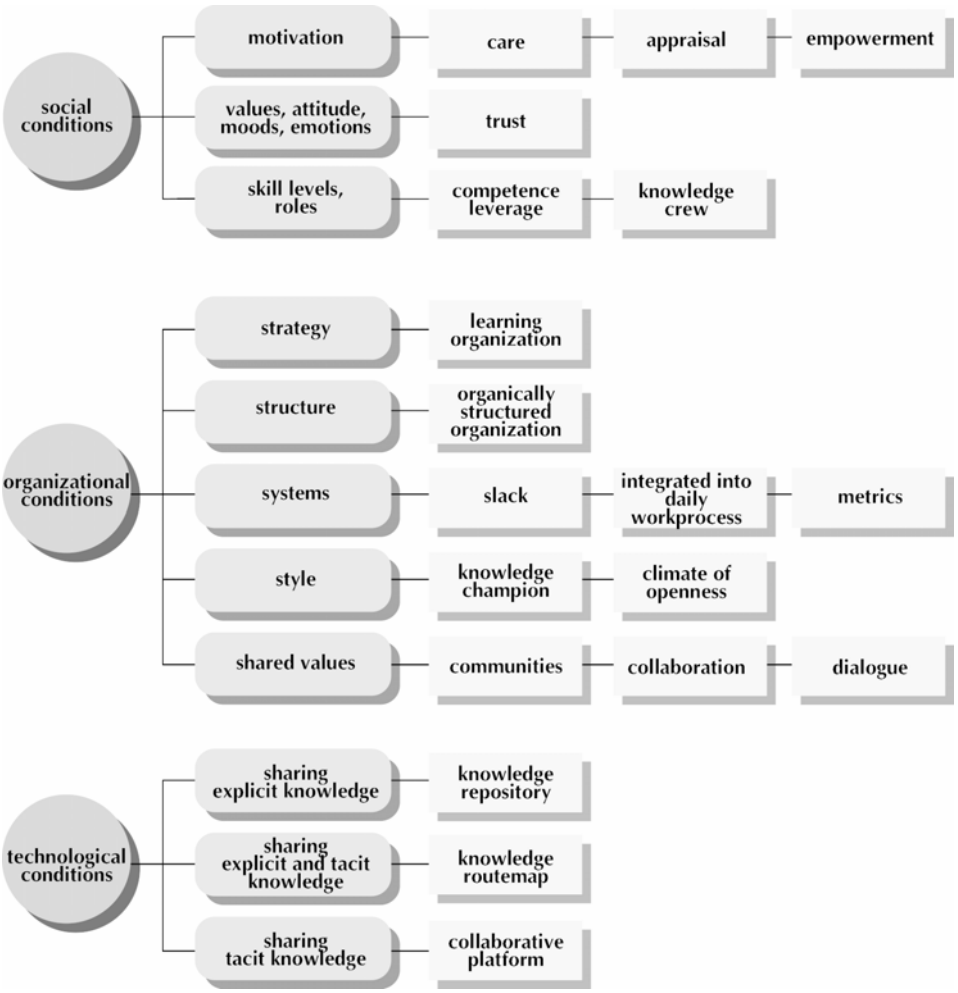

Figure 1: Social, organizational, and technological conditions for knowledge sharing

trust: Trust is used to lower uncertainty regarding the behavior of other people or objects (Landry 1992, Jones 1998). It is a — to some extent emotional — confidence in the reliability of a person or object with respect to past, current, and anticipated future behavior. Trust lays the primary basis for a social relation and is therefore a prerequisite for people to share their ideas, information, and knowledge.

competence leverage: Competence can be defined as the ability of a person to accomplish tasks (Weggeman 1997). It is dependent on the professional knowledge, experience, natural talent, craftsmanship, and skills of the individual. Competence leverage stimulates knowledge sharing because creation of new skills and transfer of knowledge is intentionally encouraged.

knowledge crew: Nonaka (1995) regards the knowledge crew as "the project leaders of the organizational knowledge-creation process". The knowledge crew structures and maintains a platform for creating and distributing knowledge to people and controls the quality and integrity of the knowledge components. They organize the knowledge

repositories, they hunt for new appropriate knowledge, they valuate and classify the knowledge components, they support competence centers, and they encourage people to make (better) use of this platform (Stewart 1997a).

2.2 Organizational conditions

We exploit the 7S framework by McKinsey (that consists of seven organizational factors: strategy, structure, systems, staff, skills, style, and shared values) to distinguish which organization related conditions facilitate knowledge sharing.

learning organization: We note that organizations learn in order to improve their adaptability and efficiency during times of change (Balasubramanian 1996). A learning organization has an enhanced capacity to learn, adapt, and change and sees every experience (like contact with a customer, information gathering about competitors, and new ways to solve problems) as an opportunity to improve (Hamel 1994).

organically structured organization: The organization is seen as a learning organism: living systems who are dependent on the environment in which they live. Such organizations are structured as open, adaptive systems that live in constant interaction with their surrounding. Because this structure ought to be able to deal with greater amounts of uncertainty it tends to be organic rather than mechanistic (Glynn 1996, Fiol 1985, Stebbins 1998). This flexible, organic structure supports and encourages — cross-functional — teamwork, small and interlinked (networked) task-oriented organizational units, free information flow, participative design, empowerment, evolutionary development, flatter hierarchy, knowledge distribution, and minimal formalization and bureaucracy. These characteristics are all favorable to cooperation, collaboration, innovation, reflective action-taking, and learning within the organization (Gephart 1996, Fiol 1985, Powell 1997, Balasubramanian 1996).

slack: Mohrman (2000) observes that “the time for needed knowledge exchange is repeatedly crowded out by the pressure to meet the latest deadline”: knowledge sharing should not be stacked on top of everything else. Organizations therefore help their knowledge sharing activities by allowing their employees slack time to be reflective, reframe issues, and learn new competences (Schein 1995a and 1996a, Brown 1997, Ulrich 1998, Beath 1991).

systems integrated into daily workprocess: Knowledge sharing seems to work best when it is an automatic part of organizational life, so the systems that support it must work transparently and seamlessly with other elements of the daily workprocess.

metrics: To gain insight in the effectiveness of activities connected to knowledge sharing there ought to be a way to measure this ‘Return On Knowledge’. Elliott (1997) observes “Because someone will ultimately question whether benefit is being derived from spending on knowledge management, the value and impact should be monitored from the beginning”.

knowledge champion: A knowledge champion (or sponsor) is a member of topmanagement who understands the need for knowledge sharing and realizes how it can leverage the performance of the organization. He or she has the authority, the clout, and can command the necessary resources (like people and budget) to bring about the needed organizational change (Elliott 1997).

climate of openness: It is important to have the right organizational climate in order for people to create, reveal, share, and use knowledge (Davenport 1998, Choo 1995). A climate of openness may, according to Choo (1995), influence the attitude of people to obtain “an open-mindedness to deal with the unfamiliar and the unfavorable, and the

boldness to experiment and innovate": inquiry, dialogue, creativity, experimentation, and risk-taking are encouraged (Gephart 1996, Powell 1997).

communities: Stewart (1997) argues "a company needs to foster teamwork, communities of practice, and other social forms of learning". These communities consist of individuals from diverse and possibly dispersed organizational units who have a sense of cohesion among them and are self-motivated to achieve their goals. Communities are mechanisms and platforms for the exchange of experiences, ideas, views, and thoughts between people.

collaboration: Collaboration is more than working together on the basis of compensation for help received in the past or in anticipation of help needed in the future (Jones 1998). People share activities, processes, develop products together, and share responsibility. Long (1997) expresses the view that: "When norms and practices promote collaboration between functions and operating units, interactions are much more likely to create new organizational knowledge and apply it more effectively".

dialogue: Senge (1992) notes that the Greek interpreted *dialogos* as a free flow of thoughts within a group of people, which created the possibility of enlightenment that could not be attained on an individual basis. Through free horizontal and vertical communication flows in an organization, mutual dependencies within and across organizational functions and units increase. This allows for more frequent and elaborate communications among disparate interests, and stimulates mutual exploration across sub-culture boundaries (Powell 1997, Schein 1996a). Dialogue creates a shared context and atmosphere for knowledge sharing because people put forward their beliefs and ideas that are normally kept to oneself (Tenkasi 1996).

2.3 Technological conditions

A major objective of information and communication technology in facilitating knowledge sharing is to connect people with other people or with explicit knowledge (possibly irrespective of time and place). We distinguish three, related dimensions. One dimension is to have information and explicit knowledge components online, indexed and mapped, with easy access and accurate retrieval for all users — in this situation the emphasis is put on explicit knowledge. Another dimension is to improve coordination, communication, and collaboration between people, teams, or groups to transfer the knowledge from those who possess this to people who need or can use this (McGee 1996) — here the emphasis is on tacit knowledge. The third dimension is to offer pointers to people with a special expertise or to documents that describe knowledge — in this dimension the emphasis is on both tacit and explicit knowledge.

knowledge repository: Knowledge repositories hold collections of knowledge components that have a structured content like information from business applications, manuals, reports and articles, or customer related databases. A content classification scheme or taxonomy is used to organize the knowledge repositories to facilitate grouping, sorting, visualization, searching, publication, manipulation, refinement, and navigation.

knowledge routemap: Knowledge routemaps are guides, directories, or pointers to an organization's internal and external information and knowledge sources — both tacit and explicit. Knowledge routemaps provide pointers to sources of knowledge that can include people with a special expertise or may offer links to documents that describe research results, best practices, lessons learned, diagnostics tools, or list frequently asked questions. Another functionality that knowledge routemaps offer is that of online learning (computer based training), in which access to — possible interactive, multimedia — educational material is given.

collaborative platform: A collaborative platform is a functionality of information and communication technology that — electronically — facilitates group or teamwork and collaboration. It is a distributed virtual environment that may encourage debate, dialogue, interaction, creativity, innovation, and sharing (Duffy 1996) that otherwise would have been constrained by barriers of time and place.

2.4 Knowledge sharing phases

These enabling conditions may be clustered according to their nature (Brink 2001): motivational (they tend to create a feeling of well being for people), cultural (they try to increase the ability of the organization to act upon signals from the environment), or instrumental (they supply instruments to facilitate knowledge sharing). This leads us to believe that some conditions are more appropriate to stimulate in a certain situation than others. We argue that this can be related to the development in knowledge sharing of an organization.

We characterize the development of an organization with respect to knowledge sharing by several phases. Gephart (1996) observes that when an organization passes through each phase, knowledge sharing "moves from being unintentional, individualistic, and not integrated to being formalized, expanded, and connected; until it is a collective, strongly integrated, and daily part of the whole organization". As each phase reflects a particular stage in the development of knowledge sharing in an organization it follows that some enabling conditions are more relevant to certain phases than to others.

These phases are derived from the knowledge sharing strategy of an organization, the — often visible — role information and communication technology can play in an organization with respect to knowledge sharing, and from the existing literature (Parlby 1999, Gephart 1996, Bair 1997). We propose the following knowledge sharing phases:

unawareness phase: An organization in the unawareness phase does not realize the possible contribution of knowledge to its competitiveness (Parlby 1999). Knowledge sharing is not addressed in the organizational vision or strategy.

knowledge repository phase: The knowledge repository phase is applicable to organizations that have become aware of the potential value of information and knowledge. In its strategy the organization pays attention to information management and it is willing to invest in information systems.

knowledge routemap phase: An organization in the knowledge routemap phase realizes the benefits of knowledge and undertakes increasing effort in knowledge sharing. This phase focuses not only on sharing of explicit knowledge but also on sharing of 'indirect' knowledge by means of knowledge routemaps (Bair 1997).

collaborative platform phase: Organizations in the collaborative platform phase use knowledge to compete and to address their business drivers. The way of working is focused on participative decision-making, collaboration, and learning together (Schein 1995), for instance in communities of practice.

organizational learning phase: Learning by trial and error is sided by explicit, systematic (double loop) learning. Competitive advantages are attained through collective learning in the organization, through combination and coordination of skills, competencies and technologies (Schein 1996, Choo 1998, Gephart 1996, Garvin 1993).

The borders between each phase are ambiguous for most organizations, but nevertheless this distinction in phases will help to indicate the status quo of an organization with regard to the maturity level in knowledge sharing.

2.5 Stable and dynamic environments

In our theory we also consider the environment in which the organization operates. We distinguish between a *stable* and *dynamic* environment. Whether the environment is stable or dynamic has its repercussions on the knowledge sharing strategy. The knowledge sharing strategy ought to be guided by the characteristics of the products or services of the organization (Hansen 1999). If the products and services are standard or mature and do not vary much, we call this a stable environment and the strategy should focus on elaborate storage and easy access of explicit knowledge. If however an organization sells customized, unique, or innovative products and services, knowledge about those products or services doesn't have a high re-usage value or becomes out of date quickly. An organization in such an environment — which we label dynamic — should consider offering easy access to specialists and experts because people need to share information and knowledge that would get lost if it had been codified.

We argue that the knowledge sharing strategy is to be reflected in the sequence of the knowledge sharing phases. An organization in a stable environment puts emphasis on explicit knowledge and therefore will go through the unawareness phase, the knowledge repository phase, the knowledge routemap phase, the collaborative platform phase, and the organizational learning phase. On the other hand, an organization in a dynamic environment is focused on tacit knowledge and will move from the unawareness phase, to the collaborative platform phase, the knowledge routemap phase, the knowledge repository phase, and to the organizational learning phase. We see that the difference in the sequence of the knowledge sharing phases for the two types of environment is demonstrated through an interchange of the knowledge repository phase with the knowledge routemap phase.

2.6 Knowledge sharing phases related to enabling conditions

In the table below we postulate — for each type of environment — for each phase relationships with their most appropriate social, organizational, and technological conditions that enable knowledge sharing. Within each cell we list its conditions in a sequence that we identify as an indication of the influence of such a condition on knowledge sharing when compared to the other conditions in the cell. Brink (2001) provides a justification for the positioning of each condition.

STABLE ENVIRONMENT			
	Social	**Organizational**	**Technological**
Unawareness phase	none		
Knowledge repository phase	appraisal; competence leverage	slack; systems integrated into daily workprocess	knowledge repository
Knowledge routemap phase	knowledge crew	knowledge champion; metrics	knowledge routemap
Collaborative platform phase	trust; care; empowerment	climate of openness; dialogue; communities; collaboration	collaborative platform
Organizational learning phase		organically structured organization; learning organization	

DYNAMIC ENVIRONMENT			
	Social	**Organizational**	**Technological**
Unawareness phase	none		
Collaborative platform phase	trust; care; appraisal; competence leverage; empowerment	climate of openness; slack; dialogue; communities; knowledge champion; collaboration	collaborative platform
Knowledge routemap phase	knowledge crew	metrics	knowledge routemap
Knowledge repository phase		systems integrated into daily workprocess	knowledge repository
Organizational learning phase		organically structured organization; learning organization	

Table 1: Knowledge sharing phases and enabling conditions

3 A model for measurement

Our model to measure the enabling conditions is based on a pragmatic quantification and ranking of these conditions. First we present the basic formula of this model. Next we propose a ranking of the enabling conditions to indicate a possible difference in the significance of these conditions for knowledge sharing. This ranking takes the nature of the environment — stable or dynamic — of the organization into account. We also calculate minimum, maximum, and threshold values for each knowledge sharing phase that we identified.

Using our formula, the ranking and a realistic quantification of the existing conditions, we can calculate the level of facilitated knowledge sharing for the organization at hand. When we subsequently make use of the values defined for the knowledge sharing phases, we are able to determine the applicable knowledge sharing phase. After contemplation whether we need to strengthen the current knowledge sharing phase or to accomplish a transition to the next phase, we can establish which conditions — using Table 1 and their current values — are the most appropriate to stimulate.

3.1 The basic formula

Our formula for measurement is constructed from the identified conditions that facilitate knowledge sharing. We define the level of facilitated knowledge sharing in an organization as determined by a function of its enabling conditions.

$$Level\_of\_Facilitated\_Knowledge\_Sharing = f(Conditions)$$

Multiplication of (the value of) these enabling conditions indicates that all conditions contribute to knowledge sharing, and it also shows that a low score on one condition significantly reduces the overall level of facilitated knowledge sharing. However, in order to damp a perhaps too strong propagation of a change in a condition we propose to use the

logarithm function, which is of a slowly increasing nature. In this respect a useful property of the logarithm function is the following:

$$\log\left(Condition_i \times Condition_j\right) = \log Condition_i + \log Condition_j, \quad i, j \geq 1$$

When we thereby choose to quantify all conditions in the closed interval of 1 to 10, the logarithm function results in a value that falls in the closed interval of 0 to 1 (and this compactness has a practical arithmetic value):

$$Condition_i \in [1, 10] \quad \Rightarrow \quad \log Condition_i \in [0, 1], \quad i \geq 1$$

Because we want to create a possibility to indicate a possible variance in significance of these enabling conditions, we associate weights (i.e. coefficients) to these conditions. This results in our basic formula:

$$Level\_of\_Facilitated\_Knowledge\_Sharing = \sum_{i=1}^{n} \lambda_i \cdot \log Condition_i$$

When we rank the enabling conditions, we can arrange their coefficients in an ordinal scale:

$$\lambda_1 > \lambda_2 > \ldots > \lambda_k > \ldots > \lambda_n, \quad k \in \{1..n\}$$

Because they are all weights, we define the sum of these coefficients as equal to 1:

$$\sum_{i=1}^{n} \lambda_i = 1$$

And applying the expression:

$$1 + 2 + \ldots + n = \frac{1}{2} \cdot n \cdot (n+1)$$

Gives the following ordinal value for an arbitrary coefficient:

$$\lambda_k = \frac{n - k + 1}{\frac{1}{2} \cdot n \cdot (n+1)}, \quad k \in \{1..n\}$$

The minimum value of our basic formula is 0 and the maximum value equals 1:

$$\forall_{i=1..n} Condition_i = 1 \quad \Rightarrow \quad \forall_{i=1..n} \log Condition_i = 0 \quad \Rightarrow$$

$$Level\_of\_Facilitated\_Knowledge\_Sharing = \sum_{i=1}^{n} \lambda_i \cdot 0 = 0 \Leftrightarrow \min$$

$$\forall_{i=1..n} Condition_i = 10 \quad \Rightarrow \quad \forall_{i=1..n} \log Condition_i = 1 \quad \Rightarrow$$

$$Level\_of\_Facilitated\_Knowledge\_Sharing = \sum_{i=1}^{n} \lambda_i \cdot 1 = 1 \Leftrightarrow \max$$

3.2 Ranking of the social, organizational, and technological conditions

In this section we propose a ranking of the 19 enabling conditions. This ranking indicates a difference in the significance of these conditions for knowledge sharing. We use their motivational, cultural, or instrumental nature (as addressed in Brink 2001) and their positioning in Table 1 to establish this ranking.

We argue that conditions that are focused on motivational aspects bear the most significance on knowledge sharing because when people are not motivated to participate, any knowledge sharing program will most likely fail. Next, we consider conditions of a cultural nature to have more impact on knowledge sharing than instrumental conditions, because we regard these instrumental conditions in the sense that is given in the 'structurational' model of Orlikowski (1992): as a facilitator or medium of human action, and when the (organizational) environment is not conducive to knowledge sharing there is no human action to facilitate.

This means that the motivational conditions appraisal, care, and competence leverage will have the highest ranking. The cultural conditions empowerment, trust, climate of openness, collaboration, communities, dialogue, learning organization, organically structured organization, and slack come — with respect to ranking — after that. The lowest ranking will be held by the instrumental conditions knowledge crew, knowledge champion, metrics, systems integrated into daily workprocess, collaborative platform, knowledge repository, and knowledge routemap.

We detail this ranking using the sequence of the knowledge sharing phases, because knowledge sharing in phase$_i$ builds on knowledge sharing in phase$_{i-1}$. We saw that this sequence is not the same for the two types of environment. In addition, we use the positioning of the conditions in each cell of Table 1, because this order also indicates an influence on knowledge sharing relative to the other conditions listed in this cell. We resolve conflicts (where more than one condition will end up with the same ranking) by considering the type of these conditions (social, organizational, and technological), and we apply the same reasoning as above to define which condition has more significance on knowledge sharing: in this view social conditions rank higher than organizational conditions, which in their turn rank higher than technological conditions. Our ranking is shown in Figure 2.

We can summarize our ranking method as follows: we rank the enabling conditions differently for the stable and dynamic environment. We first consider the motivational, cultural, or instrumental nature of a condition. Subsequently we take the knowledge sharing phase of that condition into account and use the relative importance of that condition. If necessary, we also consider the type of a condition (whether it is social, organizational, or technological).

3.3 Values for knowledge sharing phase intervals

For each knowledge sharing phase we will calculate an interval that gives an upper and lower limit of the level of facilitated knowledge sharing in that phase. We therefore divide the interval of [0, 1] of the basic formula into intervals associated with the knowledge sharing phases. For each phase we will define its interval using the ranking of the most appropriate

conditions for this phase, where the ranking is indicated by the ordinal number. Since the number of identified enabling conditions is 19, we have the following ordinal value for an arbitrary coefficient:

$$\lambda_k = \frac{20-k}{190}, \quad k \in [1,19]$$

When we apply the ranking as defined in the preceding section, we can write our basic formula as a scalar product of two vectors in a 19-dimensional space: the coefficients are multiplied with the log function of the ranked conditions. The vector that consists of the ranked conditions, for a stable or dynamic environment respectively, is presented below:

$$\log \begin{pmatrix} \textit{appraisal} \\ \textit{competence leverage} \\ \textit{care} \\ \textit{slack} \\ \textit{trust} \\ \textit{empowerment} \\ \textit{climate of openness} \\ \textit{dialogue} \\ \textit{communities} \\ \textit{collaboration} \\ \textit{organically structured organization} \\ \textit{learning organization} \\ \textit{integrated into daily workprocess} \\ \textit{knowledge repository} \\ \textit{knowledge crew} \\ \textit{knowledge champion} \\ \textit{metrics} \\ \textit{knowledge routemap} \\ \textit{collaborative platform} \end{pmatrix} \qquad \log \begin{pmatrix} \textit{care} \\ \textit{appraisal} \\ \textit{competence leverage} \\ \textit{trust} \\ \textit{empowerment} \\ \textit{climate of openness} \\ \textit{slack} \\ \textit{dialogue} \\ \textit{communities} \\ \textit{collaboration} \\ \textit{organically structured organization} \\ \textit{learning organization} \\ \textit{knowledge champion} \\ \textit{collaborative platform} \\ \textit{knowledge crew} \\ \textit{metrics} \\ \textit{knowledge routemap} \\ \textit{integrated into daily workprocess} \\ \textit{knowledge repository} \end{pmatrix}$$

Figure 2: Vector of ranked conditions for stable (left) and dynamic (right) environments

The vector that arranges the coefficients in an ordinal scale is as follows:

$$\left(\frac{19}{190} \; \frac{18}{190} \; \frac{17}{190} \; \frac{16}{190} \cdots \frac{4}{190} \; \frac{3}{190} \; \frac{2}{190} \; \frac{1}{190} \right)$$

Figure 3: Vector of 19 coefficients in an ordinal scale

In Table 2 below we propose values for knowledge sharing phase intervals that quantify and confine a knowledge sharing phase. We present this for both (stable and dynamic) environments. The table lists the conditions most appropriate to a certain phase (as defined in Table 1 above), and all social, organizational, and technological conditions have the numerator of their ordinal number attached (which is derived from the vectors above). For example: the condition *slack* in a stable environment has the coefficient (or ordinal number) $\frac{16}{190}$, therefore in the table after *slack* (in the stable environment) we list the number *16*.

To calculate the maximum value of a knowledge sharing phase interval we assign each condition — that we defined in Table 1 as most appropriate to this phase — its maximum value of 10, which results in a value of 1 for its logarithm function. This enables us to add all ordinal numbers of these conditions to yield the maximum value of the knowledge sharing phase. For example: let us calculate the maximum value for the knowledge repository phase in a stable environment. In Table 1 above we related five conditions with this phase: appraisal, competence leverage, slack, systems integrated into daily workprocess, and knowledge repository. The ordinal numbers of these conditions in this environment are respectively: $\frac{19}{190}, \frac{18}{190}, \frac{16}{190}, \frac{7}{190}, \frac{6}{190}$. When we sum these ordinal numbers we get approximately 0.3474 as the maximum value for the knowledge repository phase in a stable environment.

This maximum value is used to calculate the threshold of the phase at hand. We choose the threshold to be 75% of this maximum value, but this percentage may be adapted to fit specific characteristics of an organization. For example: the threshold of the knowledge repository phase in a stable environment is 75% * 0.3474 = 0.2605.

The maximum value is also used to determine the upper limit of the phase at hand: it is added to the lower limit (which is the upper limit of the preceding phase). The lower limit of the first phase is 0, for this is the minimum value of the interval of the basic formula. For example: the interval of the knowledge routemap phase in a stable environment is [0.3474 , 0.4211), because 0.3474 (which is the upper limit of the knowledge repository phase) added to 0.0737 (which is the maximum value of the knowledge routemap phase) gives 0.4211.

STABLE ENVIRONMENT						
	Social	**Organizational**	**Technological**	**Maximum**	**Threshold**	**Interval**
Unawareness phase	none	none	none	not applicable	not applicable	not applicable
Knowledge repository phase	appraisal = 19; competence leverage = 18	slack = 16; systems integrated into daily work-process = 7	knowledge repository = 6	66/190 ≅ 0.3474	0.2605	[0 , 0.3474)
Knowledge routemap phase	knowledge crew = 5	knowledge champion = 4; metrics = 3	knowledge routemap = 2	14/190 ≅ 0.0737	0.0553	[0.3474 , 0.4211)
Collaborative platform phase	trust = 15; care = 17; empowerment = 14	climate of openness = 13; dialogue = 12; communities = 11; collaboration = 10	collaborative platform = 1	93/190 ≅ 0.4895	0.3671	[0.4211 , 0.9106)
Organizational learning phase		organically structured organization = 9; learning organization = 8		17/190 ≅ 0.0894	0.0671	[0.9106 , 1]

DYNAMIC ENVIRONMENT						
	Social	**Organizational**	**Technological**	**Maximum**	**Threshold**	**Interval**
Unawareness phase	none	none	none	not applicable	not applicable	not applicable
Collaborative platform phase	trust = 16; care = 19; appraisal = 18; competence leverage = 17; empowerment = 15	climate of openness = 14; slack = 13; dialogue = 12; communities = 11; knowledge champion = 7; collaboration = 10	collaborative platform = 6	158/190 ≅ 0.8316	0.6237	[0 , 0.8316)
Knowledge routemap phase	knowledge crew = 5	metrics = 4	knowledge routemap = 3	12/190 ≅ 0.0632	0.0474	[0.8316 , 0.8948)
Knowledge repository phase		systems integrated into daily work-process = 2	knowledge repository = 1	3/190 ≅ 0.0158	0.0119	[0.8948 , 0.9106)
Organizational learning phase		organically structured organization = 9; learning organization = 8		17/190 ≅ 0.0894	0.0671	[0.9106 , 1]

Table 2: Knowledge sharing phase intervals

3.4 The level of facilitated knowledge sharing

Table 2 is used to determine which knowledge sharing phase is applicable to an organization, i.e. which phase — with its specific characteristics — typifies the development of that organization with respect to knowledge sharing.

We apply the actual value of the conditions to calculate the level of facilitated knowledge sharing. These actual values — as they are present in the organization — can be obtained from conducting semi-structured, in-depth interviews with pre-selected interviewees who are in a position to discuss a variety of aspects about knowledge sharing and have a broad overview on the way-of-working in their organization. The interview protocol consists of asking a quantification for each condition — on a scale from 1 to 10 (to indicate a *not present* up to a *completely fulfilled* condition) — and a justification for this perception.

However, the resulting overall value is constructed from all conditions, i.e. also from conditions that are related to different knowledge sharing phases. To be able to determine the right phase that is applicable to an organization, we apply thresholds (as listed in Table 2). We consider a phase 'fulfilled' when the actual value of the conditions related to that phase yield a value greater than or equal to its threshold. Because knowledge sharing in $phase_i$ builds on knowledge sharing in $phase_{i-1}$ we always check the first phase (in case of a stable environment this is the knowledge repository phase, in a dynamic environment this is the collaborative platform phase) to see whether it is fulfilled. If so, we check the next phase until the threshold of the phase under scrutiny can not be passed. The last fulfilled knowledge sharing phase is the phase applicable to the organization at hand.

The overall value can be used — when measured periodically — to indicate a possible progress in the level of facilitated knowledge sharing.

When the phase indicated by the overall value for the level of facilitated knowledge sharing is not the same as the applicable phase, this may suggest that the knowledge sharing efforts are unfocused and unconnected, or that an organizational knowledge sharing strategy is lacking or does not fit the characteristics of the organization. It may also mean that the relationships between the enabling conditions and the knowledge sharing phases — as defined in our theory — need to be refined.

4 A continuous cycle of measurement and action

Our method can be characterized as a continuous cycle of action and measurement. Action is defined as the stimulation of appropriate enabling conditions. By quantifying conditions, before and some time after a condition is stimulated, a change in the level of facilitated knowledge sharing may become visible. This measured variation may become an indicator of the effectiveness of (one or more) actions taken.

This continuous cycle is started by an initial measurement and an initial action that consists of the following steps:

- decide on the nature of the environment of the organization: stable or dynamic;
- quantify all enabling conditions present by estimating their degree of fulfillment in the organization, where the value of a condition is defined to be in the interval between 1 and 10;
- use the values of these conditions and their ranking (considering the type of environment) to calculate the scalar product as formulated in § 3.4: this results in an overall value for the level of facilitated knowledge sharing in the organization at hand;
- employ also the values of these conditions, their ranking, their relation with the knowledge sharing phases, the thresholds, and the ‘fulfillment’ of the phases to determine which phase is applicable to the organization, in the way as presented in § 3.4;
- based on this identified knowledge sharing phase we decide whether we enhance the current knowledge sharing phase or whether we facilitate a transition from the present phase into the next phase;
- than we know which conditions — from Table 1 and their current values — are most appropriate for stimulating knowledge sharing and we can put into practice actualizations of these conditions.

The initial actions taken to stimulate the identified conditions will have their effect on the level of facilitated knowledge sharing in the organization. A continuous cycle of measurement and action should follow. After some time the impact of the actions taken is assessed by calculating the altered overall value for the level of facilitated knowledge sharing using the — presumably — changed values of the enabling conditions. This can be used to monitor progress and measure results. The measurement will give rise to another action, i.e. an additional stimulation of conditions involved.

5 Discussion and conclusion

In this paper we developed a diagnostic model to measure the level of facilitated knowledge sharing level in an organization. This model identifies the enabling conditions most appropriate to stimulate and it facilitates measuring the effectiveness of actualizations of these conditions.

Some propositions in this article warrant a discussion to obtain a necessary refinement and a perhaps better attunement to reality:

- Are the 19 enabling conditions that we identified in this paper, the key conditions that enable knowledge sharing?
- Is the breakdown into the knowledge sharing phases — as we introduced them in this article — correct?
- Is it advisable for organizations to go through all phases and reach the 'ultimate' or organizational learning phase, no matter what costs are incurred?
- Do the conditions belong to the knowledge sharing phases in the way that we presented them? A related issue is whether the sequence of the conditions as we listed them in the table-cells is indeed the correct sequence?
- Do we apply the proper argumentation when we define the ranking of the conditions? Is it logical to make use of an ordinal scale when ranking the conditions? Are the intervals of the knowledge sharing phases determined in a correct way? Do we define the thresholds in a realistic manner?
- Is the quantification of the enabling conditions always executed in a subjective manner? If so, can you prevent that a personal bias slips into this process?

With respect to quantifying the perceived influence conditions may have on knowledge sharing, we comment that the outcomes will often be an approximation of the exact, actual real-life situation. Without any abstraction, reality is hard to quantify: organizations are of a highly complex nature, the interactions between people are characterized by phenomena that are neither directly observable nor easily discernible, and it is intricate to determine whether behavioral change (of people or of organizations) can be attributed to knowledge sharing. We argue that the possible influence of conditions on knowledge sharing is not clearly demonstrable: knowledge sharing itself is barely quantifiable and there does not exist a standard or norm value to compare to. Therefore we emphasize the primary objective of our research: to understand and gain insight into conditions related to knowledge sharing in an organization. Measurement as defined in this paper should always be seen from this perspective and should be regarded as a general, applicable, understandable, and practical tool. It helps organizations to become more aware of their current status with respect to knowledge sharing and it helps to measure the effect of actions taken to stimulate knowledge sharing.

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