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Knowledge Management Outside the Company´s Boundaries

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SUMMARY
This master thesis is based on a study conducted at Tetra Pak AB in Sweden. The aim was to understand how Tetra Pak and their customers used and managed knowledge bundled with Tetra Pak´s machines. The understanding is based on interviews with end users, technicians at the customers, and Tetra Pak´s own technicians. The paper also use findings from other studies conducted at similar companies. The main issue for Tetra Pak is the need to transfer knowledge to their customer's personnel. Not having a formal authority forces them to truly deliver knowledge in such a way that the end user continue to look for more knowledge. My suggestion in this case is to use a KMS in two different ways. The customer´s end users have a need to get instructions and best practices displayed when a problem occurs. But there is also a need for knowledge sharing between Tetra Pak´s and the customer´s technicians. This could also be supported by a KMS but the focus needs to be on creating a place to collaborate and share knowledge virtually.

Keywords: mobile users, mobile knowledge, knowledge management, knowledge, interpretive case study.

1. Introduction

We are living in the “information age” and have done so for some time now, that means that we are constantly bombarded with information. Consider how much information you receive in a single day, it is hard to comprehend. Now how much of that information do you need? How much do you want? Now, consider all the information that you chose not to read or acknowledge. How much of that information would have been useful to you? But there is always some information that interests you, or that could even be vital to you, how do you pick that information out from the gigantic flow? I reckon you got a screening process of some kind, you may only use information from a specific source or you scan a bit of all information you get your hands on and then selecting what to focus on. We all have some screening process; we would not have time to do anything else without it. But then again one could argue that we always, every second of every day, are taking in information in different forms. When talking on the phone, when driving your car, even when you sleep your brain work with information. Every human being is full with information that we use and store in different ways. Keeping that in mind, let us look at organizations. An organization could exist of any number of people, all with information dripping out of their ears. And if an organization wants to survive, then some of that information needs to be in the form of useful knowledge. People in an organization need to know things, things that can create value. Volvo, for example, would never make cars if their employees just have the information on how to make a car, they need to know. Although this knowledge could come from information it still needs to be transformed. Hopefully will the employees’ knowledge about car manufacturing lead to better ways to create cars, i.e. new information and new knowledge. The same is true for Tetra Pak AB, that is the study object in this case study. Tetra Pak knows how to package food; they have done it since 1943. Tetra Pak has approximately 21 000 employees, all of them with knowledge that could contribute to the success of the company. They gain new knowledge every day and all of them are bombarded with information every day. The question is how can Tetra Pak AB optimize the information gathering, and knowledge transformation.

Tetra Pak AB has started to discuss how they can support their mobile technicians when they work with Tetra Pak AB’s machines. These mobile technicians support Tetra Pak AB’s customers when their machines malfunction. To be more precise, Tetra Pak AB delivers packing machines to their customers. These machines require service that is provided by Tetra Pak AB’s mobile technicians. The customers, also has technicians, and they will do the majority of service and repair. Every machine are operated by the customers personal and they, too, repair the machines if they know how to. All three groups are focused on the customers´ machines; all three strive to minimize errors and downtime. A problem is that the group with most knowledge, the mobile technicians, is not on site. The operator are present, unfortunately does this group have limited knowledge about how to solve problems that causes malfunctions.
This is not surprising considering that the perators’ main task is to operate the machines, not to repair them. Instead, others who possess the right knowledge need to help the operators to get the machines up and running again. Although, I suggest that the operators would be able to solve any problem if they had the right knowledge.
The customer has access to two mobile groups that support the operators with knowledge. But why not transport needed knowledge to the operators instead? I argue that this is a common problem among companies; the people using machines often do not get access to knowledge that would help them in their work.
Instead they need to rely on other groups that possess the needed knowledge, and these groups are often mobile. The reasons for this may differ depending on the company, and I will not address those in this paper, but I see great values if the mobile knowledge could be accessible for the stationary workers. How companies create, transport, store, and use knowledge is well documented by numerous authors within the knowledge management field (e.g. Nonaka, 1994; Alavi & Leidner, 2001). This paper focus on how knowledge could flow from expertise at one company to many, without one distinctive homogeneous group of receivers.

1.1 Purpose

The focus of this paper is on understanding how knowledge that is possessed by mobile users could be optimized. The paper will investigate how a stationary group is supported by mobile users. The purpose is to evaluate if the mobile users’ knowledge could be transferred by a knowledge management system. I also focus on how the receivers use the transferred knowledge. I am interested in finding out if the knowledge could be moved and used through a system, hence creating a possibility for the mobile knowledge owners to support their customers without being mobile.
This purpose leads to the following research question that is this paper aims to answer:
Could the knowledge that the mobile technicians possess today be transferred by a knowledge management system?
How would a knowledge management system be configured to be able to support the receivers with knowledge that they need?
I conducted a case study in order to gain understanding about how different organizations used knowledge. I picked Tetra Pak AB as my object based on their knowledge intense product. Tetra Pak AB sells machines to dairies all around the world, each machine is a large investment for any dairy and its crucial, in many cases, that the machine is working without downtime. The interesting fact, in this case, is that Tetra Pak also has an interest in making the machines work as much as possible. Tetra Pak AB´s main income is created when they sell paper to be used in the machines. Hence, it the machines are running, Tetra Pak AB

and their customers are making money. This creates an environment where all parties are keen to collaborate, if it results in a higher production. I wanted to understand how knowledge could be transferred between organizations. Tetra Pak AB gave me an ideal place to study that.

2. Theoretical framework

Numerous papers have been written about Knowledge Management (KM) and Knowledge Management Systems (KMS) in the past. I have studied some of these papers to gain an understanding about how KM and KMS works in different situations. I have also tried to study difficulties and common problems that earlier studies have located, regarding implementation of KM.

2.1 What is Knowledge?

I want to understand what kind of knowledge Tetra Pak and their customer possess and use today. Although, first I need to understand what knowledge is, how it is stored and transferred.

2.1.1 Data, information, knowledge

This paper will acknowledge knowledge as a result of data that is converted to information and finally knowledge. Data is referred to as raw numbers and facts, information is processed data and knowledge depends on information. According to a number of authors (e.g. Alavi & Leidner 2001, Nonaka 1991) is knowledge personalized information (which may or may not be new, unique, useful, or accurate) related to facts, procedures, concepts, interpretations, ideas, observation, and judgment. If knowledge is personal information, depending on an individual, then each individual could, theoretically, have different knowledge about the same facts. Therefore, knowledge is not always true. I will refer to knowledge in this perspective.
Notable is that knowledge, in this way of thinking, could not exist outside an agent (an individual possessing knowledge will henceforth be defined as an agent). This leads to a series of conclusions vital to the coming discussion. First, if all knowledge dependents on the agent, that carries it, then this agents initial stock of knowledge will affect the resulting knowledge (Fahey and Prusak 1998). Thus would individuals, to arrive to the same knowledge, need to have the same initial knowledge base (Alavi & Leidner 2001). Secondly, it is impossible to spread knowledge without converting it to information first. When converted, then other agents may reflect and personalize it forming new knowledge. Viewing knowledge this way means that knowledge management systems needs to be effective in transporting information, not knowledge, making it available for the right people at the right time. Hence, there is no guarantee that the agent ends up with the knowledge intended when accessing the information. Making it difficult for an organization to know that the knowledge sought after is spread in the organization?

According to authors like Herbert Simon, Allen Newell, and Warren McCulloch knowledge is authenticated information, i.e. knowledge is a representation of the world or even more specific, knowledge is the truth. This alternative view is called the cognitive perspective has been dominating the view of knowledge from the early 1950s (von Kogh, 4 1998). To a cognitivist, knowledge is explicit, possible to store and easy to transmit to others.
The difference between these two definitions is of great interest, if knowledge is authenticated information then it should be true. Knowledge that is true and easy to transfer would be ideal to use in a KMS. The system process only needs two steps in this case, finding the knowledge and transfer it to the receivers.

2.1.2 Explicit and tacit knowledge

According to a number of researchers (Nonaka & Konno, Alavi & Leidner) could knowledge be of two kinds, tacit or explicit. Tacit knowledge is knowledge that is deeply rooted in an individual and hence influences how we act in a specific situation. There are two dimensions of tacit knowledge. The first one could be described as a person's "know-how". An example of "know-how" is riding a bicycle, you may know exactly how to balance the bike so that you do not fall but try to explain that to someone. The second dimension consist of beliefs, ideals, values, schemata, and mental models which are deeply ingrained in us and which we often take for granted (Nonaka & Konno, 1998). Manners are an example of this dimension, deeply rooted believes about how to behave in a certain occasion will guide the individual without reflection.
Explicit knowledge is the opposite, easy to articulate and communicate to others, making it possible to describe in, for example, owners manuals.
Explicit knowledge can be expressed in words and numbers and shared in the form of data, scientific formula, specifications, manuals, and the like. (Nonaka & Konno 1998, p 42)
One should remember that, even if it is easy to articulate and communicate, it is not explicit knowledge per se that is easy to spread; instead it is easy to transforms explicit knowledge to information and then spread that information. Knowledge cannot exist outside an individual.

2.2 Knowledge management

What exactly is knowledge management? Numerous definitions have been formulated throughout the years; this paper will use the following one:
Knowledge management refers to identifying and leveraging the collective knowledge in an organization to help the organization compete (von Krough 1998 p. 137)
Von Kroughs definition of knowledge management focuses on finding collective knowledge and optimizing its use in the organization. This will lead to competitive advantages according to von Krough (1998). He is supported by a number of authors that recognize an organization's knowledge as its main source to competitive advantage, see

for example Drucker (1995) and Spender & Grant (1996).
Von Kroughs definition could be representative for the majority of knowledge management researchers according to me. Differences exist but creating new knowledge and using knowledge to gain competitive advantages are the main objectives in knowledge management according to researchers from different parts of the world. Therefore will von Kroughs definition of knowledge management be this papers view as well. Nevertheless are there other definitions that are interesting to study; Malhortas (1999) is one example:
Knowledge management is a framework within which the organization views all its processes as knowledge processing, where all business process involve creation, dissemination, renewal and application of toward organizational sustenance and survival.
Malhorta's definition could lead to the assumption that knowledge management demands change in the entire organization. I argue that it is not the case; an organization can implement knowledge management selectively, although not implementing knowledge management fully could lead to lesser results. Entire organizations that manage knowledge in an optimal way have much to gain, although it is hard to change an entire organization at ones.
Going back to this papers definition, knowledge management is used to create competitive advantage through optimizing collective knowledge according to von Krough. He describes the goal for KM, but how should an organization reach that goal? Alavi & Leidner (2001) suggests a four steps process that should lead to competitive advantages. These four are creating/acquiring, storing/retrieving, transferring and applying knowledge.

2.2.1 Creating/Acquiring knowledge
Creating new knowledge is one of the most important things that an organization does, considering that a number of researchers see knowledge as an organizations main source of competitive advantage. Nonaka (1994) argues that knowledge is created in an organization through social and collective processes as well as an individual's cognitive processes (e.g. reflection). These processes also lead to that knowledge is shares, amplified, enlarged, and justified in the organization. He suggest four different processes that lead to new knowledge; socialization, externalization, internalization, and combination. (Nonaka 1994) Each of these processes describes how new knowledge is created from different sources. The source could be a person from within or outside the organization and the knowledge could be tacit or explicit. For a KM-organization is it vital to support the creation of new knowledge, hence understanding and supporting the different processes.

2.2.1.1 Socialization
Nonaka and Konno (1998) have named the process, of creating new tacit knowledge from existing tacit knowledge, socialization. They describes how new tacit knowledge is created through joint activities, such as being together, spending time, and living in the same environment, rather than through written or verbal instructions. Created knowledge is defined as new, although it may only be new to the recipient and not to the organization. The author suggests that the socialization process gives an individual a chance to understand how individuals in the organization think and feel. The way of thinking and how they react and feel in different occasions depend heavily on tacit knowledge. Socialization refers to when this tacit knowledge is transferred to another individual by social interaction and shared experience among organizational members, for example apprenticeship. If socialization succeeds will the result be that the individual understand others', in the organization, way of thinking and feeling.

2.2.1.2 Externalization
The externalization process refers to when tacit knowledge is converted to new explicit knowledge (e.g., articulation of best practices or lessons learned) (Alavi & Leidner 2001). This process is time-consuming, Nonaka and Koono (1998) suggests that an individual needs to commit to a group, being one with that group, to be able to pass on tacit knowledge, hence creating explicit knowledge. The individual's intentions and ideas may be integrated with the group's mental world, if he or she commits to that group. Nonaka and Koono (1998) see two key factors that support externalization. First, it is crucial that the individual finds techniques that enable him or her to articulate tacit knowledge to the group, for example will the process be easier if the knowledge owner and receiver use the same words, concepts and figurative language. Second, externalization depends on a good dialogue between the knowledge owner and receiver. When an individual has committed to the group is it vital that that individual also gets a chance to listen and contribute to the dialogue in that group.

2.2.1.3 Combination
A large organization possesses heaps of explicit knowledge, knowledge that different individuals have gained throughout the years. One of KM's challenges is to combine different explicit sources, creating new knowledge that may be both more complex and more accurate. Available knowledge needs to be communicated within the organization. And at the same time should other sources of explicit knowledge be located and encourage to be contribute. The goal is to maximize the flow of explicit knowledge.
The combination process relies on three dimensions, according to Nonaka and Konno (1998). First, capturing and integrating new explicit knowledge is essential. Sources from outside as well as within the company need to be used and combined. Second, combination will be optimized if the gathered knowledge is spread rapidly in the organization, targeting the individuals that could gain from it. Third, by editing the

knowledge, it could be more useful. Every bit of knowledge does not need to be a part of the combination process; in fact it would complicate things for individuals involvedthe process. There could be too much information to handle, by editing the knowledge could also false knowledge hopefully be discarded.

2.2.1.4 Internalization

The internalization process refers to an opposite process, creating tacit knowledge from explicit, for example learning and understanding results from reading or discussing (Alavi & Leidner. Internalization could be seen as the final step in a knowledge creation spiral. Explicit knowledge that is gathered and used in the organization will eventually become a part of that organizations tacit knowledge, making it something that is used automatically. This is supported, according to Nonaka & Konno (1998), by two dimensions. First, explicit knowledge has to be embodied in action and practice. In other words does individuals in the organization act according to the strategies and plans made up from explicit knowledge available in the organization. Second, the organization needs to motivate its personnel to follow the strategies and plans, hence using the new knowledge and at the same time making it a part of the organization's tacit knowledge.

2.2.1.5 The four processes will intertwine

These four processes will intertwine when knowledge is created, making all four vital for knowledge creation in the organization (Alavi & Leidner 2001). The four knowledge creation processes could be seen as an ever lasting spiral. Consider a scenario where a new employee joins an organization, by working with others could a socialization process begin and new tacit knowledge could be spread within the group. An externalization process that creates new explicit knowledge may start when the tacit knowledge is deeply rooted in the group. This new explicit knowledge could be used in a combination process and lead to new explicit knowledge. If used by individuals in the organization will an internalization process create new tacit knowledge and then the spiral can start over.

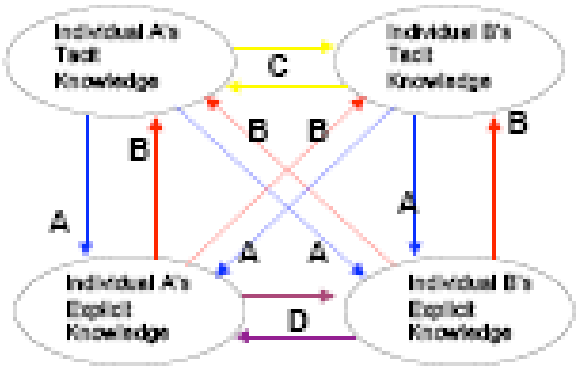


Figure 2.1 Source: Alavi & Leidner (2001) p. 117

Figure 2.1 illustrates how Nonaka's knowledge creation processes interplay with each other.

2.2.2 Where knowledge is created

Four processes to create knowledge is described above, these suggests how a particular type of knowledge is created. The next question is where these processes could take place; Nonaka and Konno (1998) suggest that the creation of new knowledge is most effective if the processes are undertaken within the right *Ba*. *Ba* , a Japanese word that could roughly be translated to "place", is used by Nonaka and Konno to describe a shared place that serves as a foundation for knowledge creation. A *Ba* will, according to Nonaka and Konno, speed up the process of knowledge creation. They have identified four types of *Ba* that correlates to the four processes of knowledge creation: O*riginating Ba*, *Interacting Ba*, C*yber Ba*, and *Exercising Ba*.
An *Originating Ba* describes a context where people share feeling, emotions, Experiences, and mental models through face-to-face interaction and being in the same place for longer periods of time. *Origination Ba* supports the socialization process; the *Ba* motivates sharing of experience which is vital when transferring tacit knowledge.
(Nonaka & Konno, 1998) An *Interaction Ba* supports the process of creating explicit from knowledge tacit, i.e. support the externalization process. Dialogue and collaboration is key dimensions for successful externalization, thus is the *Interaction Ba* a place where the right people with

the right knowledge can meet face to face and can contribute with own knowledge and build new one. The *Interaction Ba* is going to need to be influenced by a good company culture and have motivating leaders to succeed in supporting the externalization process, mainly because people need to feel that sharing their knowledge will give the company and themselves advantages. (Nonaka & Konno, 1998)
The combination process, where explicit knowledge from different part of the organization as well as outside is combined to more complex explicit knowledge, needs interaction from many sources to work effectively. The *cyber ba,* is therefore, a good support in the knowledge creation process, *cyber ba* means interacting in a virtual place instead of a real one makes the process more effective. The *cyber ba* gives the process great support when it comes to systemize the knowledge as well. The authors points out online networks, group-ware, and databases, as great tools in the *cyber ba*. The *cyber ba* do not exclude the use of face to face interaction or other contexts as lectures meetings and so forth but the authors sees it as the most effective context when using the combination process. (Nonaka & Konno, 1998)
Exercising ba supports the internalization phase that is creating tacit knowledge from explicit knowledge. This *ba* emphasize on active and continuous learning, to succeed with internalization does time and place need to be available for the individual and mentor/teacher. (Nonaka & Konno, 1998)
Being aware of the four processes of creating knowledge and supporting each one by providing the right *ba* will, according to Nonaka and Konno (1998), make the knowledge creation process more effective.

2.2.3 Storing/Retrieving

The organizations collected knowledge needs to be stored for the obvious reason that knowledge cannot be used if it is forgotten. It also need to be stored in such a way that is easy to access when the organization needs it. Storing knowledge effectively and making it easy to retrieve is therefore a vital part of KM.
Knowledge stored in an organization is, according to a number of authors (e.g. Tan et al. 1999), referred to as the organizational memory. The organizational memory could include knowledge in various forms, tacit knowledge possessed by individuals in the organization, written instructions, databases, and organizational routines are example of what could be stored and hence be a part of the organizational memory (Tan et al. 1999).
Organizational memory is classified as either semantic or episodic by El Sawy et al (1996). They define semantic memory as explicit and articulated knowledge. Episodic memory refers to context-specific and situated knowledge, for example specific circumstances of organizational decisions and their outcomes, place and time.
The organizational memory could have both positive and negative effects. Solution that has been tried and proven to work can be stored and used again, making it easier to predict the outcome and at the same time make the work less resource demanding. On the other hand, the organizational memory could also be a hinder for change, if the memory is used frequently and successfully could it be hard for individuals to break with old ways when it is needed in a change process. (Alavi & Leidner 2001)
A organizational memory could, as described above, persist of a number of different storing “devices”. This leads to the conclusion that knowledge can be stored in different ways and still be a part of the organizational memory. Depending on which type of knowledge that is to be stored it is needed to be stored in different ways. We also need to remember that knowledge is impossible to store outside an agent, if knowledge needs to be stored independently from agents then it will be information that is stored. Alavi and Leidner (2001) suggests that computer storage technology, such as databases and intranet, can be effective tools for storage but it also have benefits in retrieving stored information effectively. But all information is not practical to be stored in computer systems, deciding on how to store knowledge in the organization is important in the KM process.

2.2.4 Transferring

Knowledge that has been created and stored will need to be transferred do create value in the organization. Transfers could occur at various levels and from different types of sources; knowledge could be transferred from an individual to a group or from a group to an organization. (Alavi & Leidner, 2001)
Gupta and Govindaranjan (2000, pp 489) suggest that in order to map the knowledge flow in an organization is one required to take into account five major elements, these five are:
1. The perceived value of the knowledge possessed by the source
2. Motivational disposition of the source unit regarding the sharing of its knowledge
3. The existence, quality, and cost of transmission channels
4. Motivational disposition of the target unit regarding acceptance of incoming knowledge
5. The target unit's absorptive capacity for the incoming knowledge.

In this paper these five elements will be taken into account when knowledge transfer flows at Tetra Pak AB is going to be examined.
Element three focus on transmission channels, channels that are needed for knowledge to be transferred. Holthan and Courtney (1998, in Alavi and Leidner 2001) suggest four different channels, informal, formal, impersonal, and personal. Informal channels, such as unscheduled meetings, may be effective in socialization process when creating knowledge. On the other hand, it is hard to transfer knowledge outside a group with informal channels. A channel between the organizations needs to be created, a formal channel. Formal channels such as training sessions and plant tours could be effective, although the formal rules could be a hinder for knowledge transfer. Personal
channels, such as apprenticeship, may be effective for distributing specific or complex

knowledge. Impersonal channels, such as databases, are most effective when it contains knowledge that is general and independent of context.
All four channels has different strong and weak attributes, selecting which channels to use require an understanding of what kind of knowledge that is going to be transferred.
If the wrong channel is used when transferring knowledge, vital knowledge could be made unavailable for people in the organization (Hotham & Courtney, 1998).

2.2.5 Applying

An organization need to constantly create new knowledge, store that knowledge and at the same time distribute it to individuals or groups that could use it, but most importantly does the organization need to apply the knowledge. It is only when applied that knowledge can create competitive advantages, although it is not enough just applying the knowledge, some ways are better then others. Grant (1996) suggests three mechanisms for integration of knowledge to create organizational capability, directives, organizational routines, and self-contained task teams.
When knowledge is applied using directives it usually is tacit knowledge that has been converted to rules, standards, or instructions, when followed then the knowledge is applied in the organization. Applying knowledge this way give the organization an opportunity to transfer a specialist's knowledge to non-specialists, the recipient will eventually learn how to apply the knowledge without consulting the instructions every time, hence creating new knowledge. One need to remember that this knowledge is limited to the instructions, the non-specialist probably does not have an understanding over what the instructions are based on. (Grant, 1996)
Organizational routines make it possible for individuals in the organization to apply their knowledge to a process without needing to articulate and communicate what they know to others. For example when a car is made on an assembly line do a number of people contribute with their knowledge without sharing it. Needed knowledge is applied but the organization needs to consider if the knowledge is stored in the organization or if just one person possesses it. (Grant, 1996)
The last knowledge integration mechanism, according to Grant (1996), is the creation of self contained task teams. When organizational routines and directives fails due of complexity or uncertainty could teams be created with individuals that combine their knowledge to solve the problem. These teams could create new knowledge with the combination process and apply it straight away, here the organization need to fins away to store the new knowledge and transfer it to other parts of the organization that is facing similar problems.

2.3 Difficulties with Knowledge Management

A number of researchers see knowledge management as a tool for organizations to gain competitive advantages by optimizing the use of knowledge in the organization. But all organizations that have implemented knowledge management have not received positive results. Although a number of success stories have been communicated by researchers could no one say that knowledge management is a guaranteed success. Minsoo Shin has focused, in his paper *A framework for evaluating economics of knowledge management systems* (2004), on why some organizations succeed with knowledge Management and why others fail. Considering that Knowledge Management is defined as a tool to create competitive advantage is an economical perspective vital to be able to evaluate if a specific organization can reach that goal. Shin divides possible difficulties into three perspectives, Resource Based Perspective, Transaction Costs Perspective and Agency Perspective.
The resource-based view of Knowledge Management suggests that firms can and differentiate themselves on the basis of their Knowledge Management resources (Chuang 2004, p 460).
In other words, according to Chuang, a company could create competitive advantages by optimizing their Knowledge Management resources. KM resources include, for example, patents, skilled human resources, research and development, and organizational knowledge of customers (Shin 2004). These resources needs to be optimized by the organization by making them available everywhere the resource could benefit the organization, at the same time should an organization constantly try to create new resources. The KM resources that the company possess could loss its value if a competitor copy the resource or other, superior, resources is developed by competitors or by the organization.
When dealing with resources in a company, normally, the organization need to decide if they like to actively try to create new and improved resources and in that way create competitive advantages. The answer is not obvious, does the organization want to make the needed investment and face the risks that are involved when being innovative in their market? The organization could just the same wait until another organization find a better way of doing a specific thing, and then copy it, if it is proven more effective. One could argue that an organization takes smaller risks if they use that method to learn.
Knowledge management resources has another dimension, when dealing with knowledge management resources a organization need to decide if it is worth the investment and risk that is involved to extract the resource from its bearer. As stated before is an employee that possesses a specific knowledge which is vital to the organization a knowledge management resource, unfortunately for the organization is this resource not stable. It could be lost if the employee leave the organization for examaple. But as stated in earlier chapters could this resource be spread in the organization using knowledge management, hence will the risk of losing the knowledge diminishes. But some researcher point out that if knowledge is extracted from the resource, in this case the employee, and spread to others, there will always be a risk that a competitor get that knowledge. In that case, the competitive advantage is gone (Shin 2004). Extracting and sharing knowledge

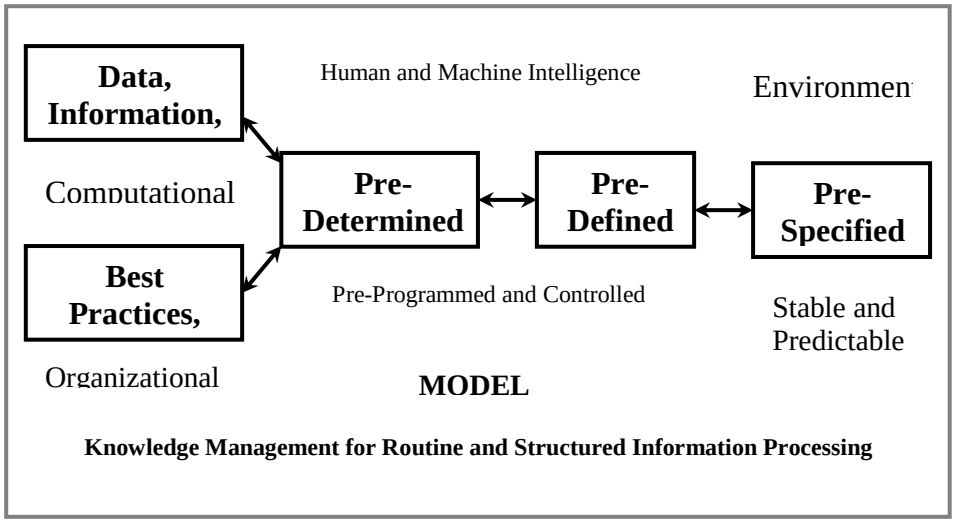
are also linked to some kind of costs, different from case to case, thus is it not always wise to share knowledge in the organization. (Shin 2004)
A number of researchers have found barriers to knowledge-sharing, these barriers hinder knowledge to be spread and used in the organization. Table 2.2 summarizes a number of these barriers.

Barriers preventing effective knowledge-sharing
Entity Barriers preventing effective knowledge-sharing
Source Fear of loss of hegemony
Lack of up-to-date knowledge
Lack of commitment, or negligence
Context Weaker co-location
Unfriendly relationships between source and recipient
Limitations in individuals' network of knowledge or doubt
about the network
Cultural incompatibility
Knowledge diversity due of lack of common experience or
to environment
Knowledge transferred Limitation in interpretative ability
Immobility (tacitness) of knowledge
Casual ambiguity
Recipient Limited knowledge-processing capability
No information on knowledge existence or limitations in
pre-existing knowledge
'Not invented here' syndrome
Limitations in the capacity to institutionalize new
knowledge application

Table 2.2, source: Shin (2004) Information & Management 42, p 187

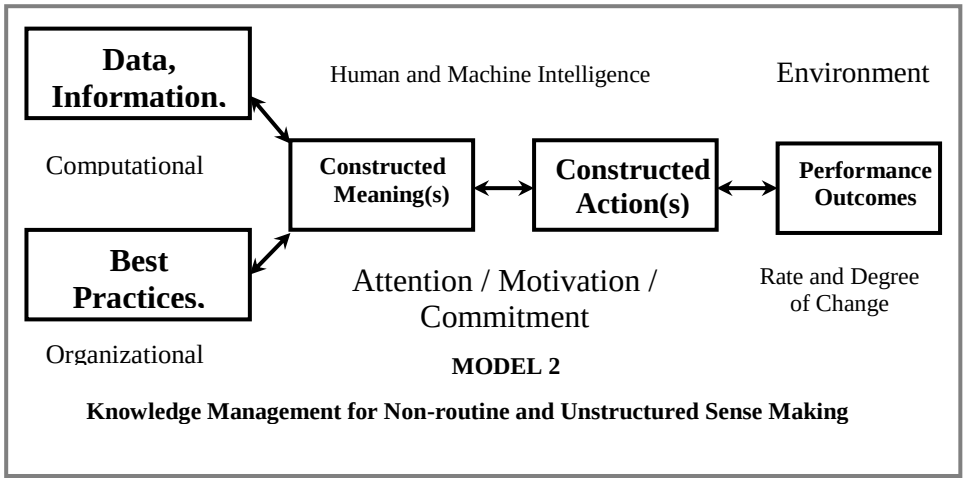
2.4 Knowledge Management System

Malhotra (2004) describes two extreme archetypes of KMS, where Model 1 is focused on "getting the right information to the right person at the right time."



Figur 2.3 source: Malhotra (2004) Information Today, p 88

A KMS with a Model 1 definition assumes that the user will act in a pre-determined way when specific information is visualized in the system, assuming that all users will interpret the information in the same way. Model 1 is used to spread best practices or instructions, according to Malhotra, there are no room for transferring tacit knowledge in any of the ways Nonaka suggest.
Model 2 give more credit to the user it is he or she that has to make the right decisions based on the information stored in the KMS. Malhorta claims that the final action and result will be influenced by data, information, rules, procedures, best practices and traits such as attention, motivation, commitment, creativity, and, innovation.



Figur 2.4 source: Malhotra (2004) Information Today, p 89

Malhorta compares these two extremes and points out some interesting claims. Where Model 1 is more rigid and structured to create a given outcome, Model 2 supports its users giving them the tools to be creative. Although, Tetra Pak AB are looking to use KMS between organizations and they are hoping to be able to predict the actions the users will take based on a instruction. Tetra Pak AB could try to base their relationship on trust, although consindering that they are a supplier to the other organizations I argue that the majority of customers wants/needs contracts that stipulates how the KMS should be used. I believe that these two models could be mixed when an organization is looking for optimal KM but I also believe that Tetra Pak AB will be forced to use Model 1 if they want to be able to sell their solution to 3rd party organizations i.e. organizations that are not part of the original KMS project.

Enablers and Constraints of KMS: Model 1 and Model 2 Compared

Enablers & Constraints	Model 1 KMS	Model 2 KMS
Business & Technology Strategy	Pre-definition of Outcomes	World of re-everything
Organizational Control	Control for Consistency	Self-Control for Creativity
Information Sharing Culture	Based Upon Contracts	Based Upon Trust
Knowledge Representation	Static and Pre-specified	Dynamic and 'Constructed'
Organization Structure	Insular and Top-Down	Inclusive and Self-Organized
Managerial Command and Control	For Achieving Compliance	For Achieving Commitment
Economic Returns	Decreasing Returns	Increasing Returns

Figur 2.4 source: Malhotra (2004) Information Today, p 90

2.4.1 Related Work

Knowledge management has been a focus for knowledge intense organizations for some time now. A number of research papers have been written were focus has been on organizations that has tried, or are trying, to use a KMS for mobile users. Bobrow, Daniel G and Whalen (2002), for example, published a paper focused on Xerox´s numerous attempt to create a working KMS. They found that computerized instructions, similar to the Model 1 KMS, were impressive but not really useful for the technicians at Xerox. The technicians were so skilled that they easily solved issues that was known and recorded in the manual. Instead, they needed help when new problems arrived, problems that didn´t have any answers in the manual. Although, great value derived from workshops where technicians could share stories about difficult problems encountered and solved. Hence, Xerox created a KMS focused on spreading these stories, spreading knowledge created by technicians to others. Another interesting paper on mobile user´s knowledge management is written by Fagrell, Ljungberg and Kristoffersen (1999). They suggest four different types of knowledge transferring, these are

- Sharing: Several parties exchange knowledge.
- Indexing: One party explains to another which knowledge to retrieve
- Diagnosing: Two parties make sense of a situation, i.e., how it should be interpreted.
- Foreseeing' One party (or more) uses knowledge to project the future.

One can claim that the goal for Tetra Pak is to create a KMS that enable diagnosing and indexing in advance, making it possible for a machine to suggest the correct solution. If successful Tetra Pak´s own technicians could focus on foreseeing and sharing with or without a KMS that support this effort. This goal is shared by Xerox but also with Malmö University Hospital according to Björgvinsson and Hillgren (2002) who studied KM at Malmö University Hospital where knowledge was supposed to be transferred with movies created by the staff. They found out that the movies did help, but more importantly, the creation of the movies created a collaboration where knowledge could be transferred and developed. The result was movies with instructions, were the instructions was superior to the best practice used before the recordings. Another hospital study conducted by Wiredu and Sörensen (2006) found that distance did matter, especially when users had different objectives. They studied a project at the British National Health Service where a new profession was to be added to the hospital. This new profession, Perioperative Specialist Practisioner (PSP), was needed to fill a gap when junior doctors work hours was forced to be lowered. The PHPs needed to be taught new skills rather rapidly. Each new PSP was assigned to a surgical team where they were supposed to be trained by the others in the team. Mobile information was also available, presented in a PDA, to the users in the project to accelerate their training. Wiredu and Sörensen joined the project team to study how they worked with mobile information. The project team´s main goal was to train the PSPs, so they needed to provide tools and support to optimize the PSPs learning. The PSP, on the other hand, did work in a surgical team and their main goal was, of course, to help the surgical patient. Having two teams and two goals created a conflict of interests for the PSP. And that's when the authority issue comes to play, Wiredu and Sörensen discovered that the PSP where more influenced by the surgical team leader then the project team considering that the authority was present during work. This made it difficult for the project team to reach their goal to train the PSP as fast as possible. These kinds of strong influences present where the knowledge is to be consumed needs to be addressed during my study.

Tetra Pak´s goal is to support their customers with stationary and mobile knowledge, making sure that information is available everywhere. Making the information ubiquitous is key and it is therefore crucial to understand how others have worked with these issues. Anderson and Lindgren (2005) studied a number of Swedish road haulage firms, where mobile systems where in the vehicles. They found three managerial implications

that were key for success. I like to present two of these that are crucial for Tetra Pak. First, when using ubiquitous solutions, the stationary workers could get a new view on how and where the mobile users work. This is one of the reasons to use the system and could be used to gain value, but it could also create a big brother scenario making the mobile user uncomfortable. Anderson and Lindgren suggest that the use of the contextual information but also how it should be interpret needs to be negotiated within the organization before use. Second, by using systems to support the mobile users, less interaction with the stationary users are needed. This could create problems when the social connection between the mobile and stationary user diminish. The solution, according to Anderson and Lindgren, is to make interaction possible with more than one media.

3. Research Methodology

My research has focused on a number of groups within the organization, groups that will provide and receive knowledge through the knowledge management system. I try to understanding how they work and what knowledge they use and need, based on this can I suggest how the system should be designed to support the organization. I have approached this task by conducting an interpretive case study (Klein and Myers, 1999; Walsham, 1995). My selection of research methodology was based on the need for me to gain knowledge about a phenomenon in a real life context. Interpretive case studies allowed me to gain this understanding.

3.1 Scope

The scope of a paper is important, choosing a too wide scope may result in a paper that fails to answer its research question. A too focused scope may overlook important facts. In neither of these scenarios will the result reflect the reality. I have limited my research to focus on how knowledge is used when Tetra Pak AB:s packaging machines are used and supported. I have found three groups that all work with some of three parts of the study. These three groups are;

- The customers operators, these work with the machines everyday, they have knowledge about how the machines work and behave
- The customers technicians, this group support the operators when the machines malfunction
- Tetra Pak AB:s technicians, supporting the customer through service and support when machines malfunction

Other groups have been identified during the work of this paper, for example does Tetra Pak AB have a department that train new support technicians. I argue that they could use knowledge from the knowledge management system with good results, nevertheless have I left this group outside my scope. The groups that I focused on will all both use knowledge from and contribute with knowledge to the final system.

3.2 Conducting the Interpretive Case Study

I have used an interpretive case study to learn more about the three groups in my scope. I primary wanted to know how they worked, what kind of knowledge they used, and how they obtained that knowledge.

To succeed did I contact Arla Foods AB in Gothenburg, they currently use 8 machines from Tetra Pak AB. A manager at Arla Foods AB did pick out five operators that had time to be interviewed by me. This could have been a possible problem, but the manager was concerned that some production needed to be paused if the selection of respondents was done by chance. I therefore interviewed the respondents that were provided by the manager. The interviews were recorded after I got the respondents concession.

I had prepared open ended questions and some follow up questions. By recording the interview did I get the possibility to concentrate on follow up questions instead of making notes.

I also studied how the operators worked with the machines; I wanted to get an understanding on how they worked an ordinary day. I therefore observed the operators from a room where they could not see me. A downside with this approach was that I could not see details on the machines or on the computer screens. I solved this by asking more detailed questions about their working procedure when I interviewed them.

The second group that I was interested in was the customer's technicians. During my visit at Arla Foods factory in Gothenburg did I interview three technicians. These interviews were not recorded, I followed the technicians when they worked and therefore was it impossible to record. Instead did I ask the technicians to describe how they worked. I also tried to understand how they ranked the operators knowledge level. The selection of which technicians that I interviewed was determined by who had time, I asked every technician I meet during my visit and then they decided if they had time.

The last group that I needed information about was the Tetra Pak AB's technicians. I visited two representatives from this group interviewed them. These interviews were recorded and I therefore used the same approach as the interviews with the first group.

The information gained through my studies was compared with findings from other authors that have studied knowledge management. The result of this is described in the chapter 4.

3.3 Interpretive Case Studies

I have used interpretive case studies throughout this paper. Klein and Myers (1999) propose a set of principals that could help researchers in their work with interpretive field studies, these principals are:

- The Fundamental Principle of the Hermeneutic Circle
- The Principle of Contextualization
- The Principle of Interaction Between the Researchers and the Subjects

- The Principle of Dialogical Reasoning
- The Principle of Multiple Interpretations
- The Principle of Suspicion

I have used these principles during the work with this paper to optimize my use of an interpretive case study. I also hope that the use of the principles allow me to avoid difficulties that other researchers have faced. The principles allowed me to use experiences gained by numerous researchers making the paper more accurate.

3.3.1 The Hermeneutic Circle

The first principle, and fundamental one, according to Klein and Myers (1999) is the hermeneutic circle. They suggest that it is the foundation of all interpretive work of

hermeneutic nature. The principle requires that the researcher will understand a complex whole by grasping how different parts of that whole works and interact. I compare it with a puzzle where every piece need to be located (by understanding a part of the whole) and then fitted together with the rest of the pieces. Klein and Myers (1999) argues that the researcher needs to examine the parts and the whole alternately. Gadamer (1976, p 117) describes the process:

Thus the movement of understanding is constantly from the whole to the part and back to the whole. Our task is to extend in concentric circles the unity of the understood meaning. The harmony of all the details with the whole is criterion of correct understanding. The failure to achieve this harmony means that understanding has failed.

In this paper have the use of the hermeneutic circle been natural. I have been needed to understand how different small groups work with knowledge to understand the entire process that support the customer's machines. I have also altered my focus between a single group and the whole picture, new information gained when my I focused on a single group has been scrutinized from an overview perspective, and vice versa.

3.3.2 The Principle of Contextualization

The contextualization principle requires that the subject matter is clearly set in its social and historical context when described in the paper. The intended audience needs to see what social and historical context the field study is conducted in (Klein and Myer, 1999). Differences in social and historical context can explain action taken by individuals or the entire organization, thus it is important for a reader to get information regarding possible influences. Gadamer (1976) suggest that there will be differences between the author and the audience in most cases. It is impossible to describe everything that the researcher has learnt during the study. Nevertheless will the researcher need to understand what it is that influence the study and describe that to the audience.

This paper's results are based on studies of three different groups. I will describe any historical and social context that may have affected the results in the chapter, findings. Although, do I see little influence from these contexts except the obvious ones. For a more detailed discussion see e.g. Klein and Myers (1999).

3.3.3 The Principle of Interaction Between the Researcher and the Subjects

An interpretive researcher needs to recognize that the participants, just as much as the researcher, do interpret and analyze the field. In other words could a respondent be affected by a number of different actors, e.g. consultants, vendors, or a researcher (Klein & Myer, 1999). It is therefore crucial to reflect over how the interaction between the respondent and the researcher affect the result. Klein and Myer (1999, p 82) points out:

Clearly, informal contacts, interviews, requests for specific documents, and conversations will affect how the subjects view their own affairs and how they present that to the researcher.

In this paper do the respondents describe how they work and how they would like to work. Other sources may not affect them when they describe how they work. But they certainly influence the respondents when they are asked to reflect upon their situation now and in the future. Although do I argue that I have low or now impact on the respondents, my influence is limited to what kind of questions I ask and that, with my presents, may alter the respondents normal behavior. Other sources influence can I not control and I do not want to do that either. In fact is opinions that are affected by others still interesting information that needs to be analyzed.

3.3.4 The Principle of Abstraction and Generalization

An important question for every paper is, could the results be used elsewhere? This is what Klein and Myer want to acknowledge with these principles.

This question is not entirely easy to answer in this case. I answer to two research questions with this paper. Both are rather specific for the context that I have studied, and I therefore argue that my results could not be used on another context without a new similar study has been undertaken. Nevertheless does this paper contribute with new information to the research that could be generalized. The purpose for this paper is to gain new knowledge about a gap in the existing literature about KM. The question about how mobile knowledge would be managed is important and my results, described in later chapters, do contribute to the field. Although do I suggest that other researchers focus on this issue, if they find similar result could we see these combined result as something that may be used generally within the field. So, to sum up, I suggest that my results could be used within the KM field, but they need to be validated by other studies.

3.3.5 The Principle of Dialogical Reasoning

Researchers have preconceptions, according to Klein and Meyer (1999), which affect the research in some ways. The researcher's preconceptions may lead him or her to jump to

conclusions or focusing on the wrong things. The principal of dialogical reasoning require that a researcher confronts his or hers original research design with the data that is found during the research.
I acknowledge that my own preconditions affected me in a way, I had an unspoken hypothesis when I began this paper. This hypothesis did origin from earlier work with a paper that focused on a similar topic. My early hypothesis was rather negative, I did not believe that any system could support the knowledge transferees needed. But I confront my own preconceptions when I started the work with this paper and tried to have an open mind. And although the two papers focused on similar topics did the results differ greatly, hence proving why the principle of dialogical reasoning is important to follow in any research work.

3.3.6 The Principle of Multiple Interpretations

The principle of multiple interpretations requires the researcher to examine the influences that the social context has upon the actions under study by seeking out and documenting multiple viewpoints along with the reason for them (Klein & Myer, 1999). When different viewpoints are found do the researcher need to confront the different viewpoints with each other and then be willing to revise his or hers understanding accordingly. This principle is similar to the principle of dialogical reasoning, although there is a vital difference. The principle of multiple interpretations suggests a confrontation of conflicted interpretations of the participants in the field. And the principle of dialogical reasoning suggests that the researcher's preconditions needs to be confronted. During my studies in the field have I different groups communicated different opinions on the same subject. When it happens have I tried to find other sources that may confirm either opinion, I also find it interesting when different groups have different opinions and try to find how these differences origin.

3.3.7 The Principle of Suspicion

Any source in an interpretive study could give you false statements, they could either be misinformed or they could deliberately try to trick the researcher. Therefore should a researcher always remain critical to information obtained, and try to validate it. In this paper do I use Forester's (1992) systematic way to question the information that I obtain through interviews. Forrester suggest that information obtained could be tainted in four different ways, the information could be:
- believes that are more or less true
- consent that are more or less appropriate
- trust that are earned more or less deserved
- attention that are more or less focused

These four layers are shaped by interaction between people in the organization, the influences could be both social and political, according to Forester (1992). I will not, in this paper, try to pinpoint what may have influenced a respondent; it would be to time consuming. I have, on the other hand, used these four layers during my research. I have always tried to validate information from different sources. Primarily have I used sources from different groups and positions hoping that they are influenced by different sources. This is no guarantee that all the information is true, but I have tried to minimize the risk with tainted information.

4. Findings

The focus of this paper is on understanding how knowledge that is possessed by mobile users could be optimized. The mobile users support stationary operators with knowledge by traveling to different sites where their knowledge is needed. I have studied the stationary groups and the mobile ones to find what kind of problems that the mobile users' knowledge solves and if it may be solved in a different, and better, way.

4.1 Problem: Downtime Caused by Time-consuming Search for Knowledge

The main issue for most of the customers is downtime, a machine that stands still do not create profit to the customer or Tetra Pak AB, it just cost resources. A customer that sells everything that is produces may lose huge sums of money if a machine malfunctions. And other customers, that are affected less by downtime, do not welcome downtime either, it makes it hard to plan the production. The customers that I have interviewed do all describe downtime as their main problem.

Excerpt 1: In the morning do we need to produce most of the day's production, if a machine goes down during these critical hours it will affect our customers directly. When it happens we try to move the production to another machine or another dairy. And try to fix the problem as fast as possible, of course.

When a machine malfunctions the operator will try to solve the problem. If the operator fails then he or she contacts a supervisor that examines the machine more closely. If more knowledge it needed, the supervisor contacts a technician. Simultaneously will the operator write down the symptoms on a paper that is used for every machine in the dairy. This paper do work as a work list, the technicians solves problems noted on the list from the top down.

Excerpt 2: A technician has a rather large responsibility area and it can take some time before he arrives to my machine. The time varies from a couple of minutes to a number of hours. Q: What do you do during that time? I switch off the machine and wait.

Excerpt 3: It usually takes a long time for a technician to arrive to a machine that malfunctions. The exact time is impossible to predict but I usually tries to study the work list when I write down my problem. If the list is long then I know it will take some time before I get help.

If the technicians have a lot to do it could result in a rather long wait forn the operator. But a technician is not always needed. The operators usually solve between 30 and 50 percent of problems on the machines, according to themselves. Some operators try actively to learn from the

technicians when they solve problems on the operator's machine, if the problem reapers will the operator try to solve it without help. The technicians also try to teach the operators some solutions to frequently appearing problems.

Excerpt 4: We are often called to machines with trivial problems; I believe that about 80 percent of our cases could be solved by the operator without our help. We often try to explain how they could solve the issue themselves and some of them are quick learners, but at the same time it would be easier to talk to a wall in some cases.
Excerpt 5: Q: How is the workload?
A: We have a lot to do, many machines to take care of and they tend to malfunction rather often. We solve the problems as fast we can. But we often have a hard time keeping up with scheduled maintenance, we would like to do more but we just do not have the time.

The technicians agree that downtime probably would be reduced if they had more time to do proper maintenance. Although they also claim that the machines are old and they therefore malfunction on a regular basis even if they are maintained as planned.

4.1.1 Solution: Downtime will be reduced if operators solve more problems themselves

Excerpt 6: Q: Do you think that the operators could have solved some problems that you are called out to deal with? Yes I do, in fact the most cases should the operator solve the problem without my help.
Excerpt 4: We are often called to machines with trivial problems; I believe that about 80 percent of our cases could be solved by the operator without our help.

According to the operators do they solve about 30 to 50 % of the problems themselves. The technicians suggest that the operators could solve 80 % of the problems that they need help for today. If the operators solve half of these 80 % will downtime be reduced drastically and the technicians may focus on other tasks.
But why do the operators ask for help even if they could solve the problem themselves? There are many reasons:

- Some operators do not see repairing the machines as a part of their primary tasks
- Some operators is not interested in learning new skills, depending on:
  - That they see their work as a temporary one
  - They see no personal gain in learning new skills
- When they learn how to solve a problem may it take months before a situation occurs and they could use the particular solution. During this time may they forget the solution.

The motivation to solve problem is an important issue for the customers to solve, they need to communicate how important it is that the operators learn how to solve problems themselves. And the customers also need to offer the operators some kind of incentive to gain new knowledge and use it. This is issues that are important to solve, although they are outside the scope of this paper and I will not discuss them more closely than this.
The last issue, on the other hand, is one of the essential reasons that cause downtime. The operators do not get access to information that supports them when they try to solve problems with the machines; they need to rely on their own memory. The only information available to the operators today is explanations that they get from technicians and other operators. Some operators have attended training sessions to gain a better understanding about how the machines work, but not everyone, it is based on interest. All knowledge about how to repair the machines origin from mobile sources, i.e. the customer's technicians and Tetra Pak AB's technicians. These two groups can support the operators but it takes time, one group is not on site and the other have a lot to do. A solution would be if these two groups knowledge could be available to the operators instantly when a problem occurs. I suggest that a KMS could decrease the impact of problems leading to downtime by systemize the mobile knowledge. The problem today is that a small part of the customer's employees have the needed knowledge to fix problems that cause downtime. If they had access to the knowledge needed in an effective way would downtime be reduced. I suggest that when an error occurs should the operator get access to the most common solutions instantly. Every malfunction render an error code, this code could be used to present the right solution to the operator. Considering their wide knowledge about the machines could they probably solve a number of problems that they need to call technicians for today, if they get the right information. Hence, a KMS could reduce the impact of the problem with downtime drastically.

4.2 Problem: Low Support When Learning to Use a New Machine

A new operator will be trained to work on one machine; they are trained by their colleagues and are expected to work independently after two weeks. After a while will they be encouraged to try to learn new machines, making the workgroup more flexible. The ideal, for the customer would be if every operator could work on every machine, which is not the case today. Both the ideal state and the beginning knowledge level required to work with the machines are hard to reach without any kind of knowledge support, other then the colleagues. This is a problem that a KMS could solve.
Excerpt 7: When I started to work here did I get two weeks to learn a machine, after that was I supposed to know how everything worked. *Q: Did you?* Well, yes I had no problem with that. But new employees seem to have some problems, but I think it is because they have less time to learn. *Q: Do you have support of any kind?* No, I ask others if I forget anything, but we have no instructions or anything like that. *Q: No manuals?* Well, there are some manuals but the technicians have them.

4.2.1 Solution: Providing Instructions "On Site"

A KMS would solve this problem by providing information to the operator on site. The manual for a machine is a bulky volume that would be easier to handle for the operators

if it was digitalized. More importantly could the KMS provide supporting information when it is needed, e.g. when the machines is stopped for the day could instructions about how it should be cleaned be displayed on the TPOP (a terminal that is attached on every machine and is used to interact with the machine).

4.3 How should the KMS work?

I have located two situations where mobile knowledge solves problems at Tetra Pak AB's customers. I argue that the problems that the mobile knowledge solves could be solved more effectively with a KMS. The problems could be solved if correct knowledge would be available where and when a person needs it. Considering the located problems and the suggested solutions do we need to transfer knowledge from numerous sources to different receivers. A KMS makes it possible, although it requires a number of steps:

- The right knowledge need to be located
- That knowledge need to be converted to information
- The information need to be transferred to everyone that need it
- The receiver need to understand the information, hence creating new knowledge
- The receiver need to use the new knowledge in a productive way

These five steps should be compared with Alavi and Leidner's (1999) four steps described in chapter 1. I define these five new steps and have used them in this paper for one reason, they are created souly for this particular case. I could just as well use Alavi and Leidner's suggested steps, they are fairly similar, but they have not focused on mobile knowledge.

The remaining of this chapter is dedicated to discussing and suggesting how the KMS needs to work to solve the problems located. Each of the five steps are explained more closely and then do I describe how the different steps work together.

4.3.1 The right knowledge need to be located

The knowledge that is needed to solve the located problems is possessed by different groups at both Tetra Pak AB and their customers. These different sources needs to be located, sources that may provide qualitative knowledge.

4.3.1.1 Different Sources of Knowledge

My studies have located three different sources that possess knowledge that may solve problems with the machines. Two of these are mobile and one is stationary. Understanding the differences between the groups is important when a KMS are implemented.

The first group is the technicians at Tetra Pak AB. The group consists of a number of individuals that have extensive expertise about one type of machines. Each individual are focused on their area and are contacted by customers when a machine within their area of expertise have a problem. This group have the most qualitative knowledge, although the knowledge is rather spread within the group making it difficult to access effectively. The group are highly mobile, moving to sites where problems occurs if they can not solve it through the telephone. The second group is the customers own technicians, they can solve a large number of errors and they know exactly what kind of settings the specific machine have and what kind of problems the machine usually have. This group is also "on site" making there knowledge crucial in the constant fight to reduce downtime. Nevertheless, it is impossible for this group to learn everything about every machine that the customer uses, they therefore try to learn the most common problems on each machine-type. I refer to this group as a semi-mobile group, they are "on site" although can they seldom start to work on a problem immediately. They have to be called on by the operators, and they may be working on other tasks.

The third source of knowledge is the operators; they solve the majority of problems that occurs on the machine that they work on themselves. They learn the most common solutions from the technicians and try to use them when similar problems reappear. Their knowledge is primary spread within the group. I see them as none-mobile, a operator is always present when a problem occur.

To summarize do I see three different groups that possess knowledge that could be used in a KMS. And I see all three groups as important sources to be used in a KMS, not only the most qualitative source (Tetra Pak AB's technicians) but all of them. I have three reasons for using all three groups: First, it is impossible for Tetra Pak AB's technicians to understand every machine at every customer. The machines will be constantly altered by the customers, settings will be changed and the machines will be run with different speed at different customers. Hence do the KMS need to use some knowledge that has origin from people "on site".

Second, time is also an issue; it would take years for Tetra Pak AB's technicians to solve and describe every single problem that a machine may produce. If all three sources work together could solutions added to the KMS be based on what the operators need help with. And the issues that the operators may have could be solved by any of the three groups, spreading the responsibility.

Third, the process of solving and describing solutions that are going to be used in the KMS could also be a learning process that the customer's technicians and operators should be a part of.

4.3.2 Possible problems with different groups´ objectives

Wiredu and Sörensen (2006) compare the influences from local and distant authorities by researching a project where a mobile device is used to help train the user. They suggest that, even though the mobile device is a strong artifact, it is difficult to stay clear of influence from local authorities with different objectives. In a similar way, Tetra Pak may have to be prepared to take into consideration the customers objectives when an individual are using the KMS for guidance. In this case, an operator could well

be more motivated to take a break when a machine malfunction not using instructions from the KMS. And the local authority, the customer´s engineer, may want to use one of his old workarounds instead of the best practice proposed. Therefore, the KMS will need to be supported by the customer´s organization in such a way that it will be viewed as a strong artifact providing an authority over distance. Figure 4.1 show different scenarios that will come into play. Although, my interviews clearly showed that Tetra Pak´s technicians had a strong authority even on a distance, when talking with the customer on the phone etc. If Tetra Pak is able to convert that authority to the system, many of these possible problems could be avoided.

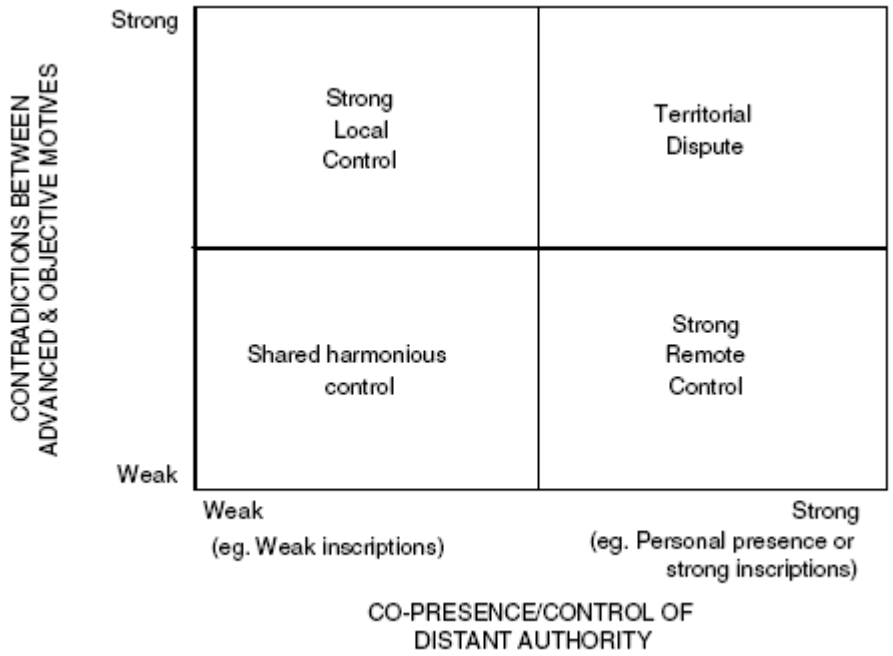


Figure 4.1 source: Wiredu et al (2006) European Journal of Information Systems, p 316

4.3.2.1 Knowledge Supporting New Employees

Supporting new users is less complex, the KMS should be able to describe the most common maneuvers and suggest when they are needed. This could support the operator after he or she have gone through training. These descriptions should be created by Tetra Pak AB's technicians when they create the machines; I also suggest that these instructions should be in the form of a film. That would give the operators an alternative to the manual. Films are already used today to describe how to use the machines, although the use is limited to the training sessions. With a working KMS could the films be viewed on the machines TPOP. The customer's technicians and operators may also produce video films and use them in the KMS, if they choice to do so will new employees learn quickly how the customer's routines work.

4.4 Converting Knowledge to Information

Knowledge that the three groups possess needs to be converted to information. When the knowledge is converted, then it is possible to be transferred to other individuals and groups that are using the system. Nonaka and Konno (1999) describe four processes where knowledge could be shared, amplified, enlarged, and justified by the receiver. All four processes may not be used in this case, but those available should be supported by the KMS.

4.4.1 Socialization and Externalization of Tacit Knowledge

Socialization requires that the knowledge owner and the receiver spend time together (Nonaka and Konno, 1999). When they work in the same environment, solving problems that requires tacit knowledge could the receiver create new tacit knowledge. This is unfortunately difficult to do when the receiver and the knowledge owner are located on different geographic locations. Although may a Socialization process start and work when a technician from the customer work closely with an operator. But I do not believe that it is possible to create a working Socialization process through the KMS. ´ Nevertheless could tacit knowledge be converted to explicit, if that is successful could the explicit knowledge be used in the KMS. The process is called Externalization by Nonaka and Konno (1999). They suggest that the process requires extensive dialogue and is rather time consuming. I do not see this process being a part of the KMS per se, groups using the KMS may work with externalization between themselves. If they are able to start a working Externalization process, could the resulting explicit knowledge be used in the KMS.

4.4.2 Combination and Internalization of Explicit Knowledge

The combination process do not just convert explicit knowledge to information, the

process leads to more accurate knowledge when different sources are combined (Nonaka & Konno, 1999). In this case do we have three different sources that provide explicit knowledge that could be combined and used.
The combination process has three important parts (Nonaka & Konno, 1999). First, knowledge needs to be found, every source should be used and actively encouraged. I have already located three main knowledge sources, these sources needs to be encouraged and supported. Second, the explicit knowledge that is found needs to be spread rapidly to persons that could use it. Explicit knowledge are rather simple to convert, instructions or manuals will give the receiver the information required. It is therefore vital that the explicit knowledge is spread to operators and technicians fast and effectively, this will be done by the KMS. Third, editing the information that is converted is a major part of the combination process. The KMS will make it easy to present the information in a structured way. The knowledge owner needs to convert the knowledge to structured and understandable information.
Nonaka and Konno (1999) suggest that the combination process is best practiced in a *Cyber Ba*, where different explicit knowledge sources could provide knowledge. Using my suggestion on how the KMS should work will create a *Cyber Ba* between Tetra Pak AB and its customers. The *Cyber Ba* will spread the information rapidly, but it is still important that the receiver refine information that is invalid or hard to understand, hence working with a combining process.
The last process, Internalization, will convert explicit knowledge that the user receives from the KMS to tacit knowledge that they use without reflecting on it. When the KMS is used as a natural tool by the operators may the Internalization process begin, if successful will the user be more effective when using the knowledge originated from the system.

4.4.2.1 Converting Knowledge at the Customers

The customers have two sources of knowledge, the operators and the technicians. These two sources integrate when a machine malfunction. More precisely the technicians solve any problem that the operator fail to solve, the ideal is that the technician teach the operator the solution when they work with the machine. But the success of this interaction depends heavily on the operator's interest and the technician's educational skills. That is how it works today.
I suggest that both of these sources should work together to create knowledge and transferring it with the KMS. These two sources could create a working *Integration Ba* together. If successful will both the externalization and socialization process be supported, hence making knowledge transfer possible in two new ways. Nonaka points out that new knowledge could be created in an *Integration Ba*, he argues that different sources of knowledge could be combined to create new, more accurate, knowledge.
To accomplish a working *Integration Ba* in this context should the technician and the operator provide data to the KMS together. Solution instructions could be created together, this would result in better instructions that both groups understand. According to Björgvinsson and Hillgren (2002) could the creation of instruction also be an important learning process. The two authors have studied how video films could support an intensive care unit. The films are created by the same personal that are going to use the solutions described in the film. The authors' description of the process:
The process starts when two colleagues discuss and negotiate how the film should be made. It continues by involving additional colleagues in watching, reflecting and discussing their work practice. (Björgvinsson & Hillgren, 2002. pp 5)

The observed process is similar with what I would like to create at the Tetra Pak AB's customers. Video film as a tool may also be useful in some cases, but pictures combined with text or just text could also be sufficient. Therefore do I suggest that the process of working is introduced at the customers and that the users choice their documentation technique depending on the situation. Considering that both operators and technicians will be involved in the process do they have a great understanding how they should create understanding.
Solution descriptions created should be attached to an error code and be made available in the KMS. This will give the customer a database with custom made solutions for the machines used at the customer. This is my suggestion, although it may be hard for Tetra Pak AB to dictate how the customer's processes should be designed. I will not discuss how this problem should be solved. That discussion is outside the scope of this paper, nevertheless is it important and need to be addressed before a KMS is implemented.

4.5 The information need to be transferred to everyone that needs it

Knowledge converted to information need to be transferred to the receiver. Today is an operator depending on his or hers memory to solve problems with the machines, they have no support other then the customer's technicians.
The suggested system will transfer knowledge from both the customer's and Tetra Pak AB's technicians. Considering that one of these sources is on the same site as the operators and the other source is not do we need to use two different channels. The KMS is one of these channels, more exactly a database that use a TPOP as channel. According to Hotham and Courtney (1998) is a database an impersonal channel that is an effective way to transfer general knowledge that is independent of context. In this case do the impersonal channel transfer instructions for problem solving, this will give the receiver an opportunity to learn a specific solution but not necessary the cause of the problem. The impersonal channel is not the ideal one to use if we wanted the operators to understand how the machine actually works.
Instead do Hotham and Courtney (1998) suggest a personal channel when more complex knowledge needs to be transferred. If the customer wants the operator to understand more

complex issues about how the machines is constructed for example will a personal channel be used. This will give the operator a chance to ask questions more directly, hence making it possible to learn more complex things. Therefore should trainings sessions still be used as a complement to the KMS.

4.6 The receiver needs to understand the information

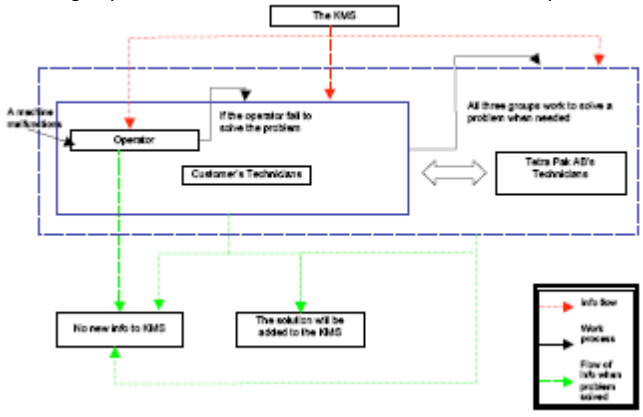
Considering that the operator receives information at the same time as a problem occurs, is it crucial that the operator understand the information promptly and correctly. The information may origin from a number of different knowledge sources, which I described earlier. The knowledge source and the knowledge receiver may have very different background and understanding about the machine. It is therefore extremely important that the knowledge-to-information conversion phase result in information that is easy to interpret by the receiver. On the other hand do I believe that it is naïve to expect that all information produced will be easy to understand. Therefore do I suggest that information that the receiver can not interpret will be altered. Operators and technicians should work together, making new instructions that are easy to understand. This will refine the information in the KMS continually. And when working with creating instructions will the operators learn from the technicians, creating both explicit and tacit knowledge at the same time.
The information could be displayed to the operators through the TPOP. By using a display information can be presented to the operators in different forms:
- Text
- Audio
- Video
- Combination of two or all of the suggested forms

What form that is used in a specific case will be up to the knowledge owner. Nevertheless will the receiver need to be set in focus, the knowledge owner need to provide information that is understood by the receiver. Anderson and Lindgren (2005) points out the importance of different media to be able to keep the social connection between different users. In this case, could the use of different media keep a connection between Tetra Pak´s and the customers´ technicians. This is key considering two things, first, Tetra Pak will need to keep their authority regarding which solution that should be considered best practice. If the social connection is broken, there will be a risk that the customer start to downgrade the KMS solutions. Second, Tetra Pak needs to keep some connection with their customer to be able to sell new solutions in the future.
I suggest that this is done in an iterative process; if the receiver misunderstands information provided will it need to be revised. In that revision could a switch of forms be included but it is not obligatory. In some cases I do believe that the customer's technicians and Tetra Pak AB's technicians could help each
other to alter misunderstood information. Ones again do all three groups need to work together to produce information that could be used in the KMS.

4.7 Using knowledge

If the operator understands the information that is made available will he or she be able to solve more problems directly. Downtime will be reduced, the customer's technician can work with other tasks, and the production outcome will be more predictable. But all this depends on that the operator uses the system and that it results in that problem gets solved. In other words, the operator needs to be motivated to use the system, and to solve problems. This could be done if the customers work hard on it, they may present rewards for number of problems solved or the quantity/quality number of information that an operator add to the KMS.

Figure 4.1 summarize how I suggest that the KMS would be designed and how the different groups would work with the KMS and each others to optimize the value.



The problem drives all processes in my suggestion, if the operator fails to solve it will he or her seek new knowledge from wither the KMS or from the customer's technicians. Tetra Pak AB's technicians may support the customer if they are needed. The result needs to be recorded in the form of a solution if the operator failed to be helped by the KMS. If a solution is available in the KMS but the operator fail to understand it should a new instruction be constructed with the help from all groups that was needed to solve the problem.

4.8 Possible problems when collaborate cross organizations

Anderson and Lindgren (2005) point out the importance of negotiating how information from the system is used. This is especially true when the system shall work between more than one organization. The customer needs to feel that Tetra Pak doesn´t becomes a big brother that keeps track on everything that the customer does. It´s is equally important that the user understand what tetra Pak does with the information that he or she feeds the system with. Finally, one of the great opportunities for this KMS is to spread new solution rapidly to everyone that uses the same machine. But Tetra Pak´s customers are often competitors, providing information to others is therefore not an obvious solution.
This is something Tetra Pak need to solve if they want an optimal system.

5. Conclusions

Based on the problems that I located with my interpretive case study and the solutions that I discuss in earlier chapter, I suggest that the mobile knowledge may create value for both Tetra Pak AB and their customers if it is transferred through a KMS. I suggest that the main problem for the customers is downtime. The amount of downtime that is created is equivalent with how long time it takes to find a solution to the problem that causes the problem and to implement that solution. Hence, would a system, that minimizes the search for knowledge that is needed to solve the problem, directly affect the amount of downtime in a positive way. I suggest a KMS that provide knowledge to the operators that work with the machines and are triggered by the machines error codes to minimize the search time. Information is easier to transport, after all, then people.
This KMS would be of type Model 1 (Malhotra, 2004) where the aim is to give instructions and try to predict the action taken from the user. Tetra Pak would in this case more or less digitalize a manual, making it easier to use and quick to update. Bobrow et al (2002) found that similar systems didn´t help Xerox technicians, but Tetra Pak is different in a crucial way. Tetra Pak´s customer has operator that is rather technical savvy if compared to Xerox customers. Hence, giving them better tools to solve issues without help would be both economically sound and give Tetra Pak´s technicians more time to create new knowledge about problems not found in the manual. To capitalize on this new possibility, Tetra Pak need to create a second KMS focused on the technicians, similar to Xerox´s solution. This KMS should be more of a Model 2 type (Malhotra, 2004), where the technicians both tacit and more complex explicit knowledge should flow. Tetra Pak needs to facilitate an environment and processes that optimize this knowledge creation/exchange.

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