Masterproef

Modeling knowledge work

Promotor :
Prof. dr. Benoit DEPAIRE

Suha Omeish
*Master Thesis nominated to obtain the degree of Master of Management , specialization*
*Management Information Systems*

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# FACULTY OF BUSINESS ECONOMICS
*Master of Management: Management Information Systems*

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# Preface

On February 2013, Professor Dr. Benoit Depaire proposed various thesis topics. Correspondingly, I, Suha Omeish, chose "Possibility of modeling Knowledge work" to be my thesis topic for partial fulfillment of the requirements for the Master degree at Hasselt University.

Meetings were held with Professor Dr. Benoit Depaire for guidance and support towards the completion of this thesis. Dr. Benoit Depaire ensured that I have adequate grasp of the research topic and supervised my work to better meet the standards required by Hasselt University.

To fulfill the objectives of this thesis I searched, read, and analyzed related articles to the topic at hand. As a novel researcher, I acknowledge that writing this thesis was challenging and required a lot of effort. Yet, writing this thesis increased my knowledge and experience regarding the topic. Moreover, this thesis opened my eyes to new perspectives that I was not aware of while doing my bachelor's degree.

# Acknowledgement

I owe a debt of gratitude to all people who supported me during my journey of writing this thesis. I also wish to express my sincere thanks to Dr. Benoit Depaire. Through his great knowledge and constructive feedback Dr. Benoit Depaire enabled me to complete this thesis. Without Dr. Benoit Depaire's persistent support and my hard work this thesis would not have been possible.

Finally, I would like to thank my parents, family, and friends for encouraging me throughout my stay in Belgium. More specifically I am thankful for their wonderful support and motivation that they provided me with while writing my thesis.

Suha Omeish

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# Executive Summary

Recently, collaborative and knowledge intensive work became an essential asset for organizations. Knowledge workers provide substantial improvement in performing organizational tasks due to their experience and unique intellectual abilities. This field has additionally gained a lot of recent recognition from different scholars due to the implications and constraints of the unclear perspectives that knowledge work imposes. In attempt to help knowledge workers to perform their job, easily and fruitfully, the need arose for modeling their job.

This thesis introduced four existing techniques that can aid in modeling knowledge work and studied whether these techniques provide a convenient approach to model such unstructured work. In order to accomplish the main objectives of this thesis one needed to explore and clarify various concepts.

The findings of this thesis show that modeling knowledge work is a challenging field. Knowledge work is an unstructured form of work that obliges knowledge workers to exploit their skills and experience while dealing with such type of work. The thesis finds that to model a knowledge work, modellers have to design a flexible model that takes in to account the versatile aspects of knowledge work complexity.

The thesis also investigates that though the existing modeling techniques might aid in modeling knowledge work, these techniques are still in capable of performing a holistic picture of a knowledge work model.

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## 1.1 The Need for the Study

The need for this study was justified by elaborating on three main concepts. The concepts explored in this study are: a) the importance of gaining an insight into how the workers' means of working, including their working activities, can benefit the organization. b) The advantages of modeling the workers' working activities. c) The economic change resulting in increased number of knowledge workers, which brings an added importance to the study at hand.

**Concept (a): The importance of gaining an insight into how the workers' means of Working, including their working activities, can benefit the organization.** A business success is based on its employees' performance. Therefore, it is important to understand how people work and perform their working activities. This insight will enable the organization to bridge the gap between its strategic theoretical vision and practical perspective of the working environment. (Nagy & Axner, 2013) Furthermore, it is essential for an organization to figure out how its employees are performing their job; this understanding will allow the organization to react appropriately to changes in the practical working environment and the economic market. Reacting thoughtfully by gaining insight into employees' working activities will bring about an improved organizational performance in both financial and production aspects. (Harter, Schmidt & Hayes, 2002)

Furthermore, by formalizing the criteria for employees' task performance, organizations will improve their employees' motivation, engagement, and dedication to their job. Once motivation, engagement, and dedication are achieved an increase in productivity leading to higher returns and profits can be accomplished. Alam et al. (2013) stated, in agreement to what

is mentioned above, that *"If businesses are to grow their way out of the current economic malaise, they will have to get more productivity out of their people—not by cutting and slashing, but by nurturing, engaging and recognizing."*

Moreover, by understanding the employee's behaviour in performing tasks an organization will be better able to work on a collaborative group level. Collaborative efforts will enable workers to share their knowledge resulting in fruitful outcomes that can aid in achieving organizational goals. (Nagy & Axner, 2013)

**Concept (b): The advantages of modeling the workers' working activities.** Modeling working activities is considered to be a vital method that simplifies the management process and aids in understanding how workers perform their tasks. Modeling allows organizations to screen implemented systems from different perspectives. Tracing a model allows employees to specify the errors implemented in their systems; this consequently allows them to reduce the deficiency in their modeled systems resulting in improvements. Additionally, modeling working activities will enable the modeller to specify the weaknesses and strengths of that model and use this knowledge to imply modifications or find alternative solutions accordingly. Modeling is also used to trivialize complexity of tasks; therefore, modeling working activities will smoothen the progress of work. (ElFarr, 2009; Ford, 1999)

Furthermore, modeling activities in an organization will aid in maintaining knowledge. In other words a model is like a warehouse preserving part of knowledge attained by employees. This warehouse facilitates the current employees' mission and will also be beneficial in aiding the understanding of newly recruited employees regarding the organization's criteria. Apart from the crucial role modeling has in guiding employees, modeling also reduces the amount of money and time consumed by an organization in setting up a new project. When an enterprise starts up a new project it can refer to the exiting information and knowledge stored, warehouse analogy, and reuse it. (White & Miers, 2008)

**Concept (c): The economic change resulting in increased number of knowledge workers.** Considering the evolution of the economic system it is evident that it has

evolved from an industrial to a knowledge economic system. Drucker (1999) suggested that in order to achieve advanced positions in contemporary knowledge-based economies, organizations must increase their numbers of qualified employees who can exploit experience and skills in achieving the organizational goals. According to many scholars, this category of employees is often referred to as 'knowledge workers' and they contribute strongly to the production of newly customized services and products that help organizations in achieving high profits (Drucker, 1999; ElFarr, 2009; Davenport, 2005). The numbers of knowledge workers are found to be increasing in the developed economies. According to Davenport et al. (2002), knowledge workers "are undoubtedly a major component — perhaps a majority— of the U.S. and other advanced economies". Moreover, Drucker (2002) stated that knowledge workers constitute around 40 percent of the US workforce. Simultaneously, the number of knowledge workers in Europe is also increasing to constitute one third of the European market as indicated by Rudiger and McVerry (2007).

The key of a firm's profitability and success is within the knowledge workers' hands. According to Guthridge, Komm et al. (2008), a single knowledge worker's participation in the organizational profit is three times more than other workers. Moreover, a report by Rüdiger and McVerry (2007), for the Knowledge Economy Programme of the European Union, "suggested that knowledge workers could be classified as the top three occupational categories, assigned by the organizational hierarchy, or as university graduates."

Knowledge workers are unable to get all needed knowledge to perform their tasks. Knowledge workers need aid of "processes, workflows, identified tasks, learning systems and accessible; updated; and contextualized information and knowledge management systems."(ELFarr, 2009). Additionally, Kinsey (2007) stated that, stress is one of the obstacles that might face knowledge workers due to the alternating and changeable nature of knowledge

work. Thus, in order to reduce the potential stress of a knowledge worker, it is essential to find ways to model such type of work (Kinsey, 2007).

Finally, by demonstrating the importance of knowledge work in today's economy and highlighting the role that knowledge workers play, this study emphasizes the need for supporting methods that can aid knowledge workers in performing their work. Given the current increase in the numbers of knowledge workers provides an added importance to study how knowledge workers perform their tasks and signifies the need for modeling techniques that can aid them in performing their tasks adequately.

## 1.2 Research Questions.

The primary goal of this thesis is to explore the possibility for modeling knowledge work using existing modeling techniques. In the need analysis of the study one concluded that modeling knowledge work is a challenging task. However, the main aim of this thesis is to explore possible ways that can be used to model knowledge work. This brings us to the main research question:

> **"How existing modeling approaches can model knowledge work?"**

In order to answer the main research question some sub questions were derived.

**Sub-question 1.** Defining knowledge work and knowledge workers is a challenging task that has a lot of obstacles. Knowledge work is a term that has many definitions throughout the literature (Ramirez, 2006); scholars and researchers couldn't agree on a unified precise meaning that describes knowledge work due to its complex nature. Moreover, Ramirez (2006) stated that knowledge workers are considered to be vital asset in advanced economies. Therefore, the first sub question attempts to understand the meaning of knowledge work and tries to formalize an idea of knowledge workers' role within an organization.

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The first sub question is:

> **"What do we mean by knowledge work and knowledge worker?"**

**Sub-question 2.** Given the aim of this thesis it is essential to explore what a model means and why it is important when it comes to model knowledge work. Further, the second part of this sub question aims to explore the right steps that a modeller should take when designing a good model.

The second sub question is divided in to two parts:

> **"What do we mean by a model and why it is important?**
>
> **"What are the steps a modeller should take to build a good model?"**

**Sub-question 3.** It is essential to portray the existing modeling techniques and theories that might aid in futuristic modeling knowledge work.

The third sub question is:

> **"What are the existing modeling techniques and theories that might aid in modeling knowledge work?"**

**1.3 Methodological Approaches**

In order to fulfill the objective of the thesis a thorough literature review was made. Quotes, facts, arguments, claims and models were abstracted from articles written by well-established authors and scholars. Hasselt University and Princess Sumaya University provided unlimited access to scientific databases. In this study four scientific databases were used; EBSCOhost, Academic Search Elite, and eBray which were used to search for articles and ProQuest which was used to find previous dissertations and theses related to the subject at hand. The majority of the articles referred to in this study were found using 'Google Scholar' which offered a simple and easy access for current research. Moreover, some of the articles were provided by the promoter, Professor Benoit Depaire, as the main topic of this thesis was proposed by him to his students at the beginning of the semester.

In attempt to answer the first sub-question, articles about knowledge work and knowledge workers were found using following terms: Knowledge work, knowledge worker, manual work, knowledge, complex work. The most important resources used intensively in chapter two was Ramirez's dissertation (2006) that defined measures for the intensity of knowledge work in tasks and workers. This dissertation contained a lot of basic information that assisted in understanding the concept of knowledge work and knowledge workers.

Articles about the second sub question concerning models and means to build a good model were found using following terms: model, model characteristics, building a model, modeling, and process. The most significant article in answering this sub-question was written by Maier (2005); this article discussed the meaning of a model. Another important resource is a book called "Modeling the Environment" written by Ford that introduced basic steps to build a good model.

In regards to the third sub-question, articles about existing modeling techniques and theories that might aid in modeling knowledge work were found using the following terms: models, existing models process, activity theory, business process modeling, and modeling

knowledge work.  The most important resource for this sub-question was "BPMN modeling and reference guide" a book written by (White & Miers, 2008).

Finally, articles concerning the last sub-question were found using following terms: knowledge stance, modeling knowledge work, integrating knowledge models. Various articles were used in this section .The most important articles were written by Davenport (2005), Maier (2005), and Blackler (1995).

**Chapters outline.** The second chapter in this study introduces definitions for knowledge work and worker concepts. Chapter three describes what is meant by a model and the importance of a model in real life tasks. Whereas, chapter four discusses the existing modeling techniques and theories related to knowledge work; it also elaborates on the ways these techniques and theories are used to implement knowledge work.

**Chapter 2**

**Knowledge work and Knowledge worker definitions**

**Literature review**

**2.1 Introduction**:

This chapter aims to introduce the meaning of two main concepts: knowledge work and knowledge workers. Knowledge work and knowledge workers are interconnected terms. This chapter begins by giving an introduction to the meaning of knowledge work and progresses to giving a brief description of knowledge workers. This chapter also demonstrates the characteristics of knowledge work and specifically portrays the traits that differentiate it from the manual work. Moreover, it includes a brief summary of the implications and problems faced in the process of modeling knowledge work.

**2.2 Knowledge work**

Many scholars attempted to define knowledge work in unified manner, but struggled to do so since "knowledge work "is a wide general concept that covers various domains. Nonetheless, a few scholars' mutually agree that 'knowledge work' ,often times, is a kind of work that deals with non- materialistic objects during the input phase, and is concerned with production of intangible products. Many scholars suggested that knowledge work depends on information as a form of input and output which leads to the intangibility of knowledge work. ( Ramirez, 2006; Davenport, 2002; Drucker, 1999; Ray & Shou, 1989; Licker & Hancock, 1984) .Supporting that, Ramirez (2006)claimed that knowledge work "entails significant amount of cognitive ability as opposed to skill based activities, it rarely produces a tangible output and generally it is not considered to be effectively decomposable".

Moreover, scholars proposed various definitions that emphasized the complexity and the unclarity in the structure of knowledge work. The complexity of knowledge work arises partially from the need for the worker to have a sufficient level of education and skills to be better able to deal with the sophisticated tasks. Lewis (2004) stated that "knowledge work tasks

are complex, ambiguous, and require specialized knowledge gained through format education and experience." Moreover, Thompson et al. (2001) indicates that workers' creativity, intellectuality, and communicative relationships are essential in performing knowledge work.

 After examining the previous definitions of knowledge work a new definition was deduced by researcher; knowledge work comes in multifaceted form due to its ambiguous and intangible nature; it requires sufficient degree of creativity and intellectual abilities because it entails a combination of complex tasks; it requires working on a collaborative group level to overcome its complexity. Considering this deduced definition one can say that knowledge doesn't follow a specific pattern; in support of that Okunoye ( 2003) stated that "The core of knowledge work remains that of non-routine work that requires some kind of formal education, constant retraining and continuous learning." The complexity and unclear structure, referred to in the definition above, requires the worker to have adequate degree of experience and skills that enable him/her to deal with these difficulties. According to Sulek and Marucheck (1994) knowledge work "refers to cognitive skills such as planning, problem solving and decision making."

 All in all, knowledge work is considered to be one of the most valuable assets that firms have. Trying to exploit the workers' skills and experience in order to convert the theoretical knowledge into practical action will enable firms to both discover and improve knowledge embedded in the workers' brains. Therefore, the next section will explore who are knowledge workers and what role they play in the sophisticated innovation.

## 2.3 Knowledge workers

 Given that the key of the firm profitability and success lie within the workers' hands, it is essential to know the three main groups of workers: manual workers, technologists and knowledge workers (Drucker, 1999). Distinguishing between these three types of workers and knowing their characteristics will enable organizations to select an appropriate group of knowledge workers that can aid in modeling the knowledge work. Moreover, recognizing the

identity of knowledge workers will enable the organization to meet their needs and provide them with a suitable environment to optimize their job performance.

**Manual workers.** Those workers use materialistic equipment and follow particular steps in order to produce a tangible concrete product. In other words, manual workers are a group of workers that use their physical bodily abilities to perform their work (Ducker, 1999).

**Technologist workers.** Those workers perform tasks that require both the physical bodily abilities and the knowledge. These workers have the ability to merge the tasks of manual and knowledge work (Ducker ,1999).

**Knowledge workers.** The economic changes underlined the conversion of the economy from an industrial based to knowledge based giving rise to the term "Knowledge worker" which invaded the 21st century. Drucker (1999) was the first to introduce this term when stating that "The most valuable assets of the 20th-century company were its production equipment. The most valuable asset of a 21st-century institution, whether business or non-business, will be its knowledge workers and their productivity." (Drucker, 1999)

Consequently, knowledge workers can be defined as a group of highly qualified workers that use their intellectual abilities and skills gained through experience to solve unusual problems they might face. Being highly qualified will facilitate knowledge workers' mission when dealing with complex tasks. (Ramirez & Steudel, 2006) Davenport described knowledge workers to be "horses that pull the plow of economic progress". Knowledge workers are the key factor for developed, innovative, and improved economies. It is believed that the most flourishing and profitable companies in United States of America are those companies with a high percentage of knowledge workers. (Davenport, 2005)

Despres and Hiltrop (1995) stated, that communication skill, sufficient level of education, and the way a knowledge worker deal with the external environment plays a vital role in performing knowledge work adequately. (ElFarr, 2009;Despres& Hiltrop, 1995). Also, Despres and Hiltrop (1995) stated that the nature of knowledge work implies the dedication of the

knowledge worker to his peers in both the external and internal environments. Aiming for customer satisfaction, and taking his problems into consideration, knowledge work is done most of the time at a group level .Additionally, building a fruitful relationship with the surrounding environment will aid in the improvement of knowledge work, as it is dependent on learning, sharing, determining conflicts, figuring solutions, and finally building awareness. (El Farr, 2009)

## 2.4 Characteristics of Knowledge work

To gain a holistic idea of knowledge work and before proceeding to modeling it, it is vital to demonstrate its characteristics. As mentioned in section 2.2 modeling knowledge work is considered to be complex. This complexity obliges the modeller to understand the characteristics of knowledge work prior to modeling it. Maier (2005) stated that the main goal of knowledge work is dealing with unusual problems in various ways depending on the case circumstances. Therefore, one can imply that knowledge work tends to be alternating and changeable depending on the situation.

Also, knowledge work is an innovative artistic work, which implies performing knowledge on data and information available. Being innovative and creative is done through merging what has been learned through past experiences and what has to be done in the present. ( Ramirez , 2006) Given that knowledge work assigns employees with multiple tasks while working in a team environment, the need for a flexible convenient information communication technology becomes a must. Information communication technology permits the easiest way of work flow and thus is an essential component of any organization. Implementing an adequate information communication technology is essential in facilitating the procedures of communication and cooperation between the employees in an organization, given the collaborative nature of knowledge work. (Ramirez , 2006)

## 2.5 Difference between manual and knowledge work

After exploring knowledge work, it is important to portray the difference between knowledge and manual work. Knowing the difference between these two types of work will enable organizations to notice the requirements for modeling knowledge work and will also

enable modellers to formalize an idea about the potential obstacles faced when modeling knowledge work.

In attempt to explore the difference between manual and knowledge work, seven scopes will be discussed in this section.

1.  Degree of autonomy needed in each type of work.
2.  Tangibility of each work in terms of inputs and outputs.
3.  Creativity needed to perform each type of work.
4.  Complexity degree of both knowledge and manual work.
5.  Degree of experience needed to perform each type of work.
6.  Physical ability needed to perform each type of work.
7.  Repetitiveness that each type of work implies.

1.  **Degree of autonomy needed in each type of work.** Knowledge work tends to require a higher degree of autonomy than manual work. Knowledge work is not limited by certain procedures; it tends to be no consistent work that mainly depends on the individual's autonomy. Being non consistent will introduce a difficulty for modeling such type of work since, having a good model design entails the must of defining and having a structured predefined flow of process . Moreover, this kind of work involves a lot of thinking, collaboration, and mystiques of understanding resulting in the difficulty to be structured. (Davenport, 2005) Most knowledge workers tend to prefer doing their tasks autonomously freeing themselves from any constraint a rule or a model can impose on them. Usually, knowledge workers like to be in control and they exploit their skills and experience in performing their tasks. Ramirez (2006) supported this argument by introducing the autonomous scope, as one of the scopes that differentiate knowledge work from manual one. By mentioning autonomy scope Ramirez (2006) wanted to clarify the degree to which a worker is capable to control the way tasks are done.

2.  **Tangibility of each work in terms of inputs and outputs.** Additionally, Ramirez (2006) proposed the tangibility to be one of the scopes that helps in demonstrating difference between knowledge and manual work .As for tangibility, many scholars agreed that knowledge work is an intangible form of work. According to Lind and Sulek (2000) knowledge work is intangible since it deals mainly with intangible form of inputs and outputs.

3.  **Creativity needed to perform each type of work.** Creativity is a vital aspect that distinguishes the knowledge work from the manual traditional one.  Mainly, manual work lacks creativity and innovation when compared with knowledge work. On the contrary, thinking outside the box and being innovative is a must when it comes to knowledge work. (Davenport, 2005; Ramirez &  Steudel, 2006) Even though knowledge work requires creativity this doesn't mean that knowledge workers can work freely without following procedures and rules enacted by their organizations. Therefore, according to Ramirez (2006) it is essential that both manual and knowledge workers consider the structure of regulations and procedures.

4.  **Complexity degree of both knowledge and manual work.** The knowledge worker can use his intellectual and experiential skills while performing his job. However, the unstructured nature that creativity imposes will result in the complexity of knowledge work .Therefore; knowledge work is considered to be more complex than traditional work because knowledge work tends to follow undefined patterns that can to be changeable under different circumstances. ( Ramirez , 2006)

5.  **Degree of experience needed to perform each type of work.** In order to overcome complexity of knowledge work, a worker should have a sufficient degree of knowledge and experience.  When it comes to knowledge work, knowledge scope is also important to show the difference between knowledge and manual work. Knowledge scope presents "the degree to which having previous knowledge, executing cognitive actions and executing cognitive processes are part of the task." Knowledge work requires high level of knowledge

and experience than manual work. This argument can be supported by the fact that knowledge work is "a form of complex combination of different processes around knowledge, information, learning, thinking, reflecting, creativity and communication." (Ramirez , 2006)

6. **Physical ability needed to perform each type of work.** Physical effort in this case portrays the bodily effort a worker has to perform. (Ramirez & Steudel, 2006). Physical effort needed to perform a manual work tends to be higher than that of a knowledge work .This argument can be concluded from the skillful techniques and mental abilities a worker should have in order to accomplish his/her knowledge work. ( Ramirez , 2006)

According to Drucker (1999) manual workers are those who use their physical abilities in order to produce tangible products with the aid of operating machines and materialistic equipments whereas, knowledge workers utilize their experience, competency and knowledge in order to deal with the knowledge work tasks. (Drucker, 1999)

7. **Repetitiveness that each type of work implies.** The routine and repetitiveness scope describes the "degree to which a task is part of a regular or established procedure characterized by habitual or mechanical performance of tasks", can show that knowledge work has a dynamical changeable nature with no certain pattern when compared to manual work.

Considering the previous seven scopes we can conclude that manual work is characterized to follow bureaucratic approaches in order to produce tangible products using physical abilities. Supporting that and  in attempt to find a fine definition of what is lower level knowledge work, Davenport et al. (2002) stated that these are "jobs that are relatively structured, linear and repetitive, such as order fulfillment, benefits administration, and invoicing and accounts management."  On the other hand, knowledge work is considered to be complex and non-repetitive kind of work that requires creativity and sophisticated procedures to be modeled.

**2.6 Implications facing process modeling of knowledge work**

Before going into the modeling details it is important to know that in order to improve and innovate the way work is performed especially , when it comes to knowledge work , two main concepts should be taken into consideration .First , the process aspect that emphasize the way work should be performed . Second, is the practice aspect that constitutes the basic orientation for a worker to understand the surrounding environment and aid him/her to perform his job. According to Davenport (2005) practice aspect is "an understanding of how workers respond to the real world of work and accomplish their assigned tasks." (Davenport, 2005)

The main purpose of process aspect is to introduce suitable designed models. Though when it comes to the way the work is performed and done, practice aspect should be used. It is suggested that some tasks can be modeled using process orientation as these tasks involves a clear structure that can be simply implemented . On the other hand, some types of tasks that involve knowledgeable structure and require a vast experience should be modeled using practice orientation .(Davenport,2005)

According to Davenport et al. (2002), "A time-honored way of improving any form of work is to treat it as a process ".Therefore, modeling knowledge work is very important yet, according to Davenport and Prusak, knowledge work is not easily recognizable (Davenport& Prusak, 2000).  Modeling this type of work is a challenging task that has great implications due to many factors. Many scholars sought to process knowledge work and tried to understand the criteria that this work follows. Unfortunately scholars who did so were faced with lots of obstacles as this kind of work tends to vary every day, and demands wisdom to address its less foreseeable vague nature. (Ramirez & Steudel, 2006; Davenport, 2005). Therefore, the unstructured nature and consistency leakage of knowledge work, created a fundamental challenge in trying to find various ways to model this kind of work.

Apart from the unstructured nature that knowledge work imposes, modeling knowledge work as a form of process has both supporters and opponents. Opponents to modeling knowledge work prefer to have a high level of autonomy with no limiting procedures that minimize their freedom Furthermore, others oppose the idea of taking instructions from others

telling them how they should perform their work given the complexity and unique tasks they deal with. Also, some knowledge workers antipathies the idea of modeling knowledge tasks as a form of process because it will form annoyance load that prevent them from being innovative and creative when working on a task.(Davenport,2005)

On the other hand, many researchers studied the perspective of process orientation of software developers and found that a right thorough modeling for knowledge work is beneficial and enhances the productivity. Furthermore, some knowledge workers see that it is beneficial to model such tasks, as modeling these tasks will make it easier for workers to analyze and to benefit from the discipline that a process portrays. (Alder, 2005)

## Chapter 3
## Model concept
## Literature review

### 3.1 Introduction:

Given the main aim of this study and after establishing what knowledge work is, it is essential to know what is meant by a model. This chapter will provide a basic idea of what a model is and what characteristics constitutes a good model. Also, this chapter will clarify the importance of modeling when it comes to knowledge work and will demonstrate various types of models. Then, it will discuss the basic steps a modeler should follow to build an adequate model. After that, the chapter will discuss the perspectives a modeler should take to build knowledge work model. Finally, considering knowledge work traits the researcher deduced a list of elements that people should consider when modeling knowledge work.

### 3.2 What is a model?

Many of us have built models in his/her childhood. When we were young we used to construct LEGO models or build paper airplanes. These constructions conveyed the transformation of our intangible thoughts into tangible/materialistic models. Building these physical models enabled us as children to think logically and aided in the development of our cognitive skills.( Magretta,2002) However, modeling continues to play a role past our childhood and into our practical working environment. An architect design for a building is considered to be a model that reflects the partial idea of the building's infrastructure. Though the model will not reflect the entire idea of the real system, it will help in understanding its general concept.(Ford,1999)

In order to build a strong, adequate, and flexible model manager need to understand what the precise meaning of a model is. According to Osterwalder (2004) a model is considered to be an important tool that helps managers to understand and evaluate the criteria their organizations' follow. Building a model that represents the work flow of an organization will permit employees to predict how things will work. Models will allow employees to modify,

improve, or even change the model according to the market needs since dealing with models is simpler than dealing with the actual real systems. Furthermore, Maier (2005) identifies the model as a "representation of a selected portion of the perceived reality of an individual or a group of observers."

Ford (1999) believed that a model cannot be perfect and it is a form of repetitious process that includes both trial and error. Also, in attempt to bridge the gap between complicated practical tasks and theoretical modeled process, Goldsmith (1993) suggested that modeling is the process of dividing the tasks into simplified subtasks in order to understand the real process an organization passes through. One can conclude that a model is a mirror that reflects a partial part of complex real tasks that an individual faces while performing the job. Though it's not fully reflective of the real practical tasks, a model is considered to be useful for understanding the work flow in an organization.

Building a model is not a simple task. Therefore a modeller should deeply understand and specify characteristics that constitute a good model.


## 3.3 Characteristics of a good model:

To construct a model a modeler should be able to setup standards for the characteristics of the model he/she wants to build. The first characteristic that contributes to formalizing a good model is accuracy. A model should represent the flow of the processes related to the task in an accurate, precise, and direct way by focusing on the remarkable and noteworthy events. In other words, a good model should be salient. Simplicity and inclusiveness are also key factors in depicting models, the simpler the model and the more inclusive it is regarding aspects of the problem the better it is. Also, familiarity contributes significantly in building a good model. Moreover, a model should be perceptible, which means a model should portray the flow of the processes in reliable ways, enabling the user to thoroughly understand the flow of the model, recognize the idea, and the goal of modeling. Additionally, a good model should be understandable; being understandable implies that a model must be predictive about what might happen in the future. A good model designed by a modeler is like a piece of art integrating

both style and content; thus a good model should be inspiring and reflective of the environmental aspects aligned with the task to be modeled. (Clemens, 2002-2007)

Furthermore, it is beneficial to make a model memorable. By being memorable a model lends itself to be utilized daily by employees and aids the organization in reaching its goals. However, organizational needs might change and develop through time. Therefore, it is important to build a flexible model that can be modified according to the evolving needs of the organization. Also, since models are considered to be a part of interlocking systems, it is crucial for a model to be coherent with other correlated models in the system. Finally, productivity is another property of a good model. A good model identifies the main goals of the organization and then interprets this vision into productive actions. (Clemens, 2002-2007)

A combination of all of the above traits with a substantial portion of each one will create a useful and effective model. According to Clemens (2002-2007) "All models are incomplete. All models are a compromise. The model maker's art lies in making those shrewd trade-offs that will render the model most useful to the problem at hand."

### 3.4 Importance of modeling

Building an adequate model that covers the holistic aspects of the organization's work is an important element in the organization's success.  A deep understanding of what a model is, and a good flexible design will enable organizations to gain a high returns in terms of profits (Magretta, 2002). From White and Miers (2008) perspective modeling is considered to be crucial in supporting the various changes an organization goes through, since a good model consists of organizational goals, strategies, and rules.

Given the reality of the complexities and difficulties associated with tasks within an organization Goldsmith (1993) recommended splitting complex tasks into smaller simpler ones. Dividing complex tasks into simpler subtasks will enable the workers to accomplish their job easily (Goldsmith, 1993). Moreover, models will aid in the communication inside organizations. Better communication will enable employees to have a clear vision of the organization's ambitions and goals. Models act as a communication tool and allows for knowledge exchange

between workers. It is worth mentioning that constructing models in small organizations is easier than that in larger ones due to the fact that small organization's employees tend to have a more common and shared culture relative to those in bigger organizations. (White & Miers, 2008)

## 3.5 Different types of models

Literature introduces various types of models that can be used differently depending on the situation. In this section the four main types of models are explored to assess whether they are suitable to model knowledge work or not. The four main types of models are: physical model, mathematical model, conceptual model, and statistical model.

(1) **The physical model.** This model is considered to be one of the simplest models to be utilized. The paper airplane model is an example of this model. Physical models enable the user to learn and explore facts about the model by experimentation given their materialistic and tangible nature (Ford, 1999). However, looking back at the characteristics of knowledge work mentioned in chapter two it is clear that knowledge work is an intangible form of work; with that being said physical models cannot be used to model such type of work.

(2) **The mathematical model.** This model revolves mainly around mathematical equations. Moreover, some mathematical models are done with the aid of software simulation; such models are called 'computer simulation models' (Ford, 1999). Given that mathematical models are used to model precise equations and programs and considering the changeable dynamic nature of knowledge work it can be concluded that mathematical models are not suitable to model such type of work.

(3) **The conceptual model.** In order to build a conceptual model, the modeler has to invent, plan, and formulate a structured idea of the model. Moreover, this kind of model can convey the human purposes and intentions (Duan & Cruz, 2011). Even though knowledge work model represents knowledge workers ideas and perspectives conceptual models cannot be used to model knowledge work; this is so because knowledge work is an unstructured form of work that tends to change daily.

(4) **The statistical model.** This model deals with pure mathematical equations. This type of model connects various variables through an explicit mathematical equation (Mccullagh, 2002). It is clear that these kinds of models are not suitable for modeling knowledge work due to their rigid nature.

However, the next section will introduce some perspectives that a modeller can use in order to model knowledge work.

## 3.6 The Steps of Modeling

In attempt to know the steps to be taken to model knowledge work this section portrays the general steps associated with building a model. After that we specify which of these steps are relevant vs. irrelevant to modeling knowledge work.

Though Ford (1999) was basically interested in introducing mathematical models of the environmental systems, he introduced an interesting flow of steps that aided in the modeling process. The list below shows the eight main steps knowledge workers must follow to have a good basic model of their work.

**Table 3.1: Basic steps to build a model (Ford, 1999)**

| Step1. A is for Acquainted | get acquainted with the system and the problem |
|---|---|
| Step 2. B is for Be specific | be specific about the dynamic problem |
| Step 3. C is for Construct | construct the stock and flow diagram |
| Step 4. D is for Draw | draw the causal loop diagram |
| Step 5. E is for Estimate | estimate the parameter values |
| Step 6. R is for Run | run the model to get the reference mode |
| Step 7. S is for Sensitivity | conduct sensitivity analysis |
| Step 8. T is for Test | test the impact of policies |

To clarify how these theoretical stated steps can be transformed into a practical example that can aid modeling knowledge work these steps will be applied to the process of teaching in the educational field. Educational field is considered to be knowledge-based industry; supporting

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that Brinkley et al.(2009) stated that knowledge based industries are "These industries include high- to medium-technology manufacturing and knowledge intensive services such as financial and business services, telecommunications and health and education". Teachers are considered to be knowledge workers since their job implies that they have a sufficient level of experience in a particular subject. Moreover, their job obliges them to interact with the students collaboratively to convince them with a certain type of information. The convincing process and the way teachers deliver information to their students require adequate level of skills.

According to that, our example will discuss the steps teachers should follow so that they will be able to model their knowledge. Considering the first step, mentioned in table 3.1, a knowledge worker, which is the teacher in this situation, must know what the problem is. Relating this to knowledge work knowing turns out to be half of the battle; identifying the problem and analyzing it well to find out the points of conflict is the first essential step a teacher should take into consideration. This particular step can be applied to model knowledge work. In our example the problem is delivering a holistic approach of the knowledge a teacher has about a certain topic for students with special needs. If the teacher was able to be acquainted with that problem by analyzing its aspects, then he/she will be able to accomplish the first step identified in table 3.1.

After having a clear idea of the problem and its implications, knowledge workers have to know the exact dynamical aspects of the problem. In reality problems are not isolated they are, in fact, affected by external and internal factors. In order to model knowledge work, this step is considered to be a vital but still a complicated one. As it was mentioned in section 2.2 knowledge work is an unpredictable type of work hence, a knowledge worker might specify the internal aspects that influence the problem yet, he/she will not be able to control external factors that influence the problem even if he/she was able to specify its sources. In the above example a teacher might be able to control the type of knowledge he/she wants to deliver to his/her students however, the teacher will not be able to know whether this knowledge is transferred to students in an effective manner or not. Therefore, this step can be partially applied to the process of modeling knowledge work.

Furthermore, the knowledge worker has to act by constructing/drawing a model. In the above example if the teacher wants to deliver his/her knowledge about a certain topic for students with special needs , it will be beneficial to construct a model that conveys the way and skills a teacher followed to deal with those students aiming at delivering his/her knowledge about a certain topic. By constructing a model the teacher will be able to experiment the details of work performance and will be able to specify the holistic aspects of this knowledge work including its flow and implications. Therefore, steps three and four, from table 3.1, could be used to model knowledge work in its practical form. Given that these steps were abstracted from a book concerned with mathematical models in environmental systems, step five will be excluded from our discussion due to its irrelevance to the topic of modeling knowledge work.

Moreover, the model should be executed to test its effectiveness in solving the problem which is a difficult step to do. Despres and Hiltrop (1995) suggested that one of obstacles that impede modeling knowledge work is the difficulty in measuring its effectiveness. (ElFarr, 2009; Despres & Hiltrop , 1995). Relating this to the above example, a teacher might deliver her/his knowledge to the students but he/she cannot know to which extent the student benefited from her/his knowledge work. Finally, the sensitiveness of a model and the impact of the surrounding policies are also vital points to be considered (Ford, 1999). This step can be hardly applied in modeling knowledge work due to its dynamic nature.

## 3.7 Knowledge work model

Knowledge work model is a model that aims to depict an overview of the approaches worker applies on the exiting valuable knowledge to achieve organization's goals. The main purpose of a knowledge work model is to portray the criteria of how knowledge worker uses his/her experience and skills to solve unstructured knowledge work processes. Contrary to other models, knowledge work model is neither constructed nor executed with a set of predefined and structured tasks due to its changeable nature.

Knowledge work model constitutes a pivotal role in the organization due to various reasons. First, a knowledge work model will decrease the time knowledge workers consume on

their searches, thus knowledge workers will be able to utilize their time efficiently. Second, knowledge work model will allow organizations to increase its productivity, as this work model will enable workers to formalize holistic concepts of knowledge applied and the knowledge needed to achieve organizations goals. Finally, as a result of consuming time efficiently and increase in productivity, organization will gain high profits. In support of these three reason and according to a report conducted in IDC/Xerox "knowledge workers spend 15-30% of their time at work conducting searches for information, but up to 50% of these searches are unsuccessful". However, setting up a knowledge work model will aid knowledge workers to understand how processes flow, reducing the 50% of unsuccessful searches. ( Spinuzzi et al.,2004 ; Ley et al,2008)

## 3.8 Modeling knowledge work

Throughout the literature there are various modeling techniques, each one of them focuses on specific issues. Consequently, we focus on three common techniques. First, entity relationship modeling which mainly concentrates on databases implemented in an organization. Second, object-oriented modeling which is focuses on object and classes in computer programming and finally business process modeling which deal with the flow of the process concerning a specific business. (Balzer et al., 2001)

Modeling knowledge work is not easy and requires a unique modeling techniques that take three main factors into account which are: the content , the user and finally the communicative perspective.(Maier,2005).Upon what we discussed in chapter two ,it can be said that these three factors result in difficulty of modeling knowledge work . The first factor is the unstructured content of knowledge work that cannot be formalized as a form of well-defined structure. Second, users which are knowledge workers .As it was mentioned previously knowledge workers perform their jobs utilizing their mental skills and experience. Therefore, understanding knowledge workers' behavior is considered to be an obstacle while modeling knowledge work. As for the communicative perspective it also, limits modeller from constructing knowledge work model since it is complicated to figure out the criteria of communication aspects between knowledge workers.

In attempt to overcome these obstacles ,Maier (2005) suggested that such techniques should "define meta-data and provide ontologies, user profiles, communication diagrams, knowledge maps and diagrams that show what objects, persons, instruments, roles, communities, rules and outcomes are involved in the main knowledge-related activities. "

Modeling is an essential key that helps to support and improve knowledge work. Before modeling process takes place we should bear in mind five important aspects that constitute the basic concept of modeling knowledge work. Maier (2005) introduced clearly a figure that shows the strong interconnected relationship between these five perspectives.
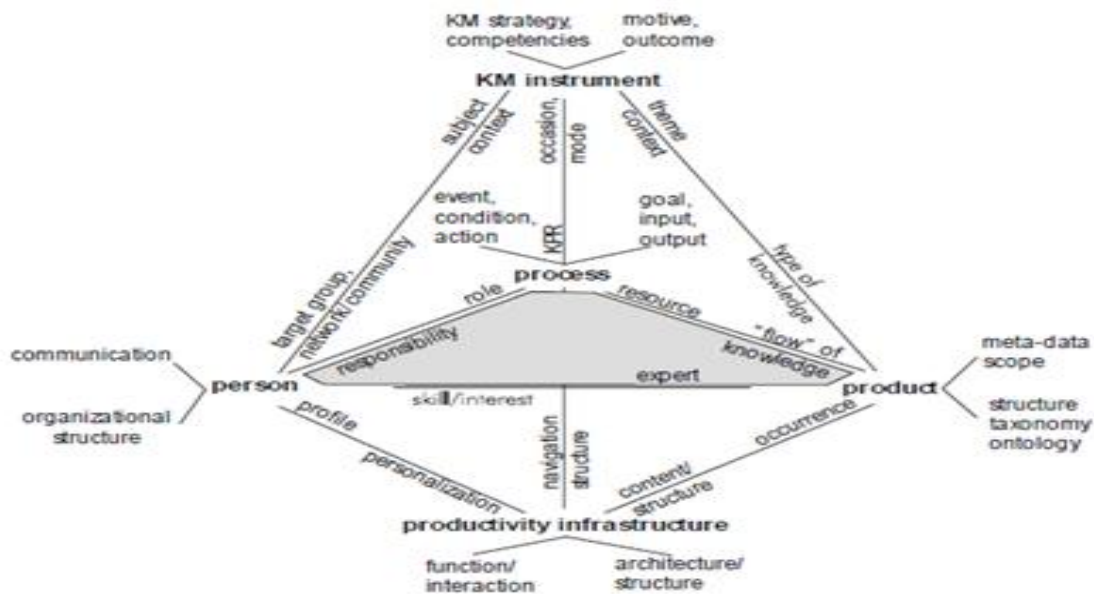


**Figure 3.1: Perspectives for modeling knowledge work**

**(Maier, 2005)**

As it can be seen from figure 3.1, the five perspectives are: Knowledge management instruments, person, process, product and productivity infrastructure. In an attempt to understand how these perspectives play an important role in modeling knowledge work, it is

essential to know what does each perspective mean and then analyze the relationship between them.

First, knowledge management instruments constitute an essential role in supporting "organizational knowledge base" and are classified into three main substantial aligned aspects which are person oriented, product oriented and organizational instruments. These instruments are supported with adequate technical ICT infrastructure.( Peinl,2004 )

1. Person oriented knowledge management instrument reflects knowledge workers experience, skills and abilities. It consists of three main categories:

   - Knowledge mapping:

   - Competence management: A way that facilitates managing knowledge workers competence that enables them to solve complicated cases through managed discipline.

   - Personal experience management: Enables knowledge workers to share their personal experience, which will enhance knowledge sharing inside the organization. (Peinl,2004)

2. Organizational knowledge management instruments:

   These instruments have to deal with social systems in the organization. It consists of three main categories:

   - Communities or Knowledge networks: enable employees to exchange thoughts and opinions about certain topic.

   - Knowledge development: entails representation of how knowledge is applied with in organizational departments

   - Knowledge process reengineering: this category is very important to understand how we can model knowledge work. First, this term is originated from the main concept of Business process modeling that aims to redesign the flow of processes improving the way work is done. Second, the main difference between business process modeling and knowledge process modeling is that, knowledge process modeling aims to reconstruct the design of a model considering knowledge aspects applied within the task.

Finally, process warehouse is a concept aligned with knowledge process reengineering. This concept represents the way organization stores unique cases that received attention of knowledge workers. (Peinl, 2004)

3. Product-oriented instruments:

It consists of four main categories:

- Knowledge structure map: It demonstrates how internal and external aspects of an organization are interconnected through documents and data bases.

- Lessons learned; represents the way knowledge workers learn from their mistakes. Learning from his/her mistakes a knowledge worker will improve his/her skills.

- Best practices: represent the most precious and effective practice an organization follow.

- Semantic content management: "refers to managing meaningfully organized content, i.e. documented knowledge embedded in a context."(Maier,2005)

After having an idea about knowledge management instruments we will move to the second perspective, person. Person perspective represents the experience and skills knowledge workers have and use in order to perform the organizational tasks.

As for the product perspective, it has to do with the documented knowledgeable data that the organization has. Usually documented knowledge is integrated by electronically available ontologies and taxonomies.

Moreover, the process perspective which has the centric part in figure 3.1 refers to activities and actions a worker has to perform .Finally; the productivity infrastructure refers to "organization-wide platforms that offer a joint workspace for collaboration, information, knowledge and learning to support knowledge work." (Maier, 2005)

Aiming to increase the productivity of knowledge work, these five perspectives are interconnected to form a wide network .Studying figure 3.1, we can notice the following:

1. Processes are done by person. Persons have the responsibility to accomplish process through actions. A person's role is to transform activities into practical real actions.

2. In order to enhance the performance of the organization, processes are supported by knowledge infrastructure.

3. The main connection between the product and productivity infrastructure is occurrence, which means that products are interpreted into occurrences such as documents.

4. The basic unit of content that an infrastructure contains can be structures, taxonomies and ontologies.

5. Persons' skills and interest will constitute a vital role in producing the product.

6. Flow of knowledge is the main connection between the product and the process perspectives. This connection indicates how organizations run and perform knowledgeable actions and activities.

7. As for the personalization and profile connection between the process and productivity infrastructure process, it indicates the right of worker to utilize data and services stored in infrastructure.

8. The final link in this figure is between knowledge management instruments and three different perspectives which are person, product and process. These connections aim to provide various knowledge oriented tasks.

Looking at the aspects of knowledge work discussed in this chapter the researcher deduced a list of elements that people should consider when modeling knowledge work:

**Table 3.2: elements that people should consider when modeling knowledge work**

| Aspects | |
|---|---|
| User adoption | Models cannot stand by their own. When it comes to knowledge work process cannot be automated without the aid of human intellectual abilities. Therefore, when a modeller needs to construct a knowledge work model he should bear in mind that it's compatible with the knowledge workers need. |
| Communication channels | Knowledge work is usually done on a group level. Knowledge workers share their thoughts and experience aiming to solve a particular case. Hence, providing communication channels in the model will enable them to intensify their collaboration. |
| Flexible structure | It is difficult to determine how knowledge process will be executed because knowledge is not a defined steps or rules but it is a form of abilities and skills gained through education and experience. Therefore, while designing a knowledge work model, the modeller should consider some flexibility in the design that permits knowledge worker to modify the way process flow according to the situation. |
| Documentation facilities | This might seem contradicting aspect since it was mentioned before that knowledge work cannot be defined and structured. However, this aspect means that when constructing a knowledge work model it will be beneficial If there was an option that allow knowledge worker to write his/her comments about a certain task. Writing or let's call |

| | it sharing his/her opinion a knowledge worker will contribute in improving two main aspects. First, he/she will give the chance for other knowledge workers to benefit from his/her experience. Therefore, he /she will foster the level of education in the organization. Second, by documenting his knowledge an opinion he will aid in continuous process improvement. |
|---|---|
| Standardized layout | Knowledge work gives the chance for more than one employee to work together. Hence, it will be beneficial to construct a model with a standardized layout. Standardized layout will smoothen the work process as everyone participating in performing knowledge work task will have the exact same model to work on .By doing this reduce burden of knowledge workers to understand the external layout and we will facilitate communication between knowledge workers. |

# Chapter 4

## Existing modeling techniques

### 4.1 Introduction:

In an attempt to find ways to model knowledge work, it is essential to study some existing modeling techniques and theories that are used intensively by organizations.

Due to the unexpected, collaborative and changeable nature knowledge work imposes; traditional modeling techniques became insufficient in portraying a clear model of the knowledge process. In this chapter we will discuss four existing modeling techniques which are business process modeling technique, case management systems, communication event model and genre ecology model. Moreover, one theory which is called activity theory will be examined thoroughly in order, to figure out the degree of its compatibility to model knowledge work.

### 4.2 Knowledge vs. relationship complexity

In attempt to understand how IT solutions and models can contribute in understanding the knowledgeable , complex and dynamical nature of human work , two variables were set , one of them aims to measure the degree of complexity needed to perform knowledge work and the other one aims to measure the personal and business relationship complexity .( Koehler et.al,2012)

Figure 4.1 depicts the position of various existing modeling techniques according to degree of knowledge and relationship complexity they need. Two of the areas represented in figure 4.1 which are process oriented work and case management will be discussed thoroughly in section 4.3 and 4.6.

Referring to figure 4.1, we can notice that the first area is the process oriented work which explicitly indicates the low degree of both knowledge and relationship complexity. Process oriented work is basically concerned in solving the structured problems that lack sense of creativity. Moreover, the criteria of solving such structured problems can be automated due to

the simplicity of human interaction as their relationship is well defined in this case. (Koehler et.al, 2012)

Moving to the second area, intelligent –problem solving where it is considered to have a high degree of knowledge complexity and a low degree of relationship complexity, this area is mainly concerned in solving the most creative, communication – intensive and difficult problems. (Koehler et.al, 2012)

Third, is the social collaboration area that imposes the need of IT software to simplify the complex, collaborative and unstructured human interconnections. ( Koehler et.al,2012)

Fourth is the case management area that represents "the domain of highly qualified work combined with comprehensive collaboration needs."(Koehler et.al,2012)
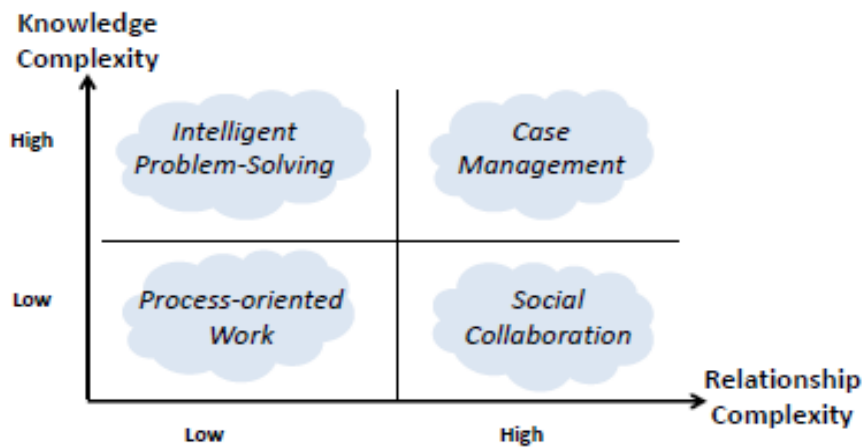


**Figure 4.1 Knowledge vs. Relationship complexity**

**(Koehler et.al, 2012)**

**4.3 Business process modeling technique**:

The first modeling technique that will be examined in this chapter is the business process modeling.

According to Maier (2005)" business process modeling has been established in many organizations as a key task in order to analyze, understand and improve business processes and to support design, implementation and management of process-oriented ICT systems."

Business process modeling enables the organization to interpret its strategy and tactical processes in to operational level. Furthermore, organizations main concern is to develop the way processes is performed, aiming to maximize their profits and satisfy stakeholders and shareholders vision. The longer an organization is in the market, the more mature it will be due to the experience it will gain through long period. Maturity in this case is a result of routinely processes that will be done daily. The repeatable act of performing tasks will make the organization capable to notice its weak points and improve the whole generic method of its modeling aspect especially if it is using business process modeling techniques. (White & Miers, 2008)

Before going into details of business process modeling, it should be clear to the user the difference between a procedure and a practice. Mainly there are two main types of processes. The first type is procedures which tend to be repeatable processes that have a clear structure. On the other hand, there are other types of processes that are changeable and can be unpredictable with a vague structure which are called practices. A banking transaction is considered to be a procedure, whereas developing a marketing strategy is considered to be a practice. Therefore, the main aim when modeling knowledge work is to find significant criteria that will aid in the transformation of knowledge tasks from practice perspective to a procedural one so it will be modeled easily. (White & Miers, 2008)

As for the technical issues concerning business process modeling it is important to note that business process modeling cannot stand still by its own and needs the support of some approaches that aid in the modeling process. Some of these approaches are **ARIS** (Architecture of Integrated Information Systems) and MEMO multi perspective enterprise modeling. Though these approaches are helpful in designing and managing a substantial frame work of process flow they were not able to model knowledge work since these two approaches focus on modeling processes in a rigid well-defined flow.(Maier,2005)

However, attempts to model knowledge work lead to the existence of process model extensions. For example extensions to ARIS and Knowledge MEMO appeared. Model's extensions are made up of two main essential factors that differentiate them from the basic original modeling techniques. These two factors are, object types and additional model types. (Maier, 2005)

Additional object types can involve "knowledge objects" which is made up of knowledge stored in individual's brain, skills a worker have and documented knowledge in an organization. (Maier, 2005).Referring to characteristics of knowledge work mentioned in chapter two it can be said that for a compatible design of a knowledge work model , this model should take in to account both the implicit and explicit knowledge employees have. Taking into account these two perspectives will enable the employee to express his professional skills in performing knowledge work. Therefore, the availability of knowledge objects will aid the worker to find the best approach to perform his/her tasks by mixing the previous documented knowledge with his/her outstanding experience.

Moving to the second factor which is, additional model types these include diagrams that enable the modeller to model knowledge work due to the flexible nature of such diagrams. (Maier, 2005).Knowledge work tends to be dynamic. Therefore since additional model types entail the existence of knowledge maps and diagrams, modeling knowledge work will be easier. The availability of knowledge maps and diagrams will enable knowledge worker to understand

the way tasks are interconnected to each other and allow them to communicate and share different opinions in order to capture sufficient degree of knowledge.

For a while these extensions satisfied the desire of organizations in modeling some and not all the perspectives a knowledge work imposes. ARIS extensions for example concentrate on processes and person perspective because it aims to improve organization's architecture by modifying the construction of information system implemented.(William's et al., 1993). From this example it can be concluded that though these extensions take two perspectives which are person and process into account they neglect the other three which are knowledge infrastructure, knowledge instruments and productivity. Maier (2005) stated that in general these extensions concentrated on the person, product, process and productivity infrastructure perspectives and neglected the most important one, which is the knowledge management instrument.

Moreover, some scholars and modellers tried to add improvements on that technique so that it will be agile and capable to accept changes .Some modifications took place on activities presented in business process model. These modifications according to (Thoenssen et al.) are

1. "Attaching resources"
2. "Commenting on an issue"
3. "Adding problems and solution to an activity or process "

These modifications allowed a modeller to elaborate more on the way a task should be executed and by using these modifications a modeller will be able to represent part of the knowledge he/she used.

Recently, business process modeling is capable to model two types of activities. First, is the normal activities that can be executed immediately, this kind of activities are well defined and ordered by a modeller. On the other hand, a new term KIA is used to describe intensive knowledge activities.  KIA" knowledge intensive activity" is a new concept that intends to bridge

the gap between the rigid nature of business process modeling and flexibility character of knowledge work.

Both of these activities will be modeled. However , while execution KIA will be processed under special circumstances i.e. will be executed according to the case situation .Various types of KIA can be both modeled and executed when needed , an example of KIA " Refer to an expert " or "ask for additional material ".(Thoenssen et al.)

An illustration of how KIA can be used in business process modeling is illustrated in figure 4.2.
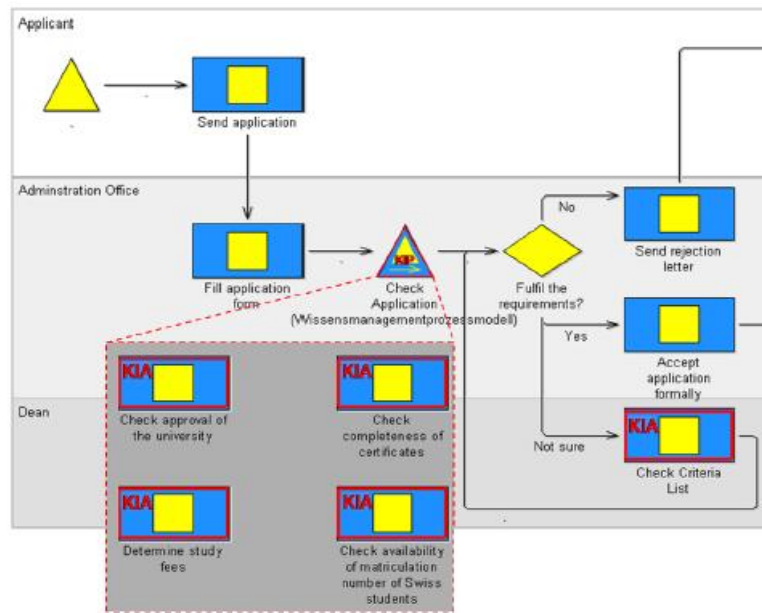


**Figure 4.2: Knowledge intensive activity in business process modeling**

**(Thoenssen et al., 2012)**

Upon what was stated in the literature about KIA and our understanding, it can be said that KIA doesn't help modeling knowledge work directly. As it was mentioned in chapter two that knowledge work is non-materialistic and it cannot be stored. Hence, KIA doesn't contain the

knowledge embedded in knowledge worker brain. Therefore, KIA doesn't automate work flow immediately up on stored knowledge but it refers back to knowledge worker s so that they can start performing their job. So for example, if a certain process need an expert (knowledge worker) opinion, KIA will facilitate such a task by permitting knowledge worker to interfere with his skills and experience for a convenient process flow.

### 4.3.1 Drawbacks of Business process modeling technique:

It is obviously clear from its name that "Business process modeling "is aligned with the process aspect that aims to model structured form of work.

Knowledge work is not a form of rules, instructions or even structured steps. Knowledge work is an intangible asset that is formalized during a sufficient time and is a result of collaborative work. Therefore, since business process modeling requires" defined sequence of events and functions" to be modeled and executed. It is believed that modeling such type of work could be hard when using this technique. (Maier, 2005)

Moreover, in their book BPMN modeling and reference guide, White & Miers (2008), suggested that without being precise of the tasks you want to model, it will be difficult to start modeling and if it happens this model will look like a bunch of boxes and arrows with no use. Furthermore, they stated that business process modeling can be described as a form of model that is concerned in modeling descriptive detailed and rigorous processes. Finally, White & Miers (2008) emphasized that in order for this technique to be functioned and executed correctly it has to capture a well-defined set of sequential activities. Relating these requirements, that the technique needs to knowledge work characteristics, it can be said that knowledge work is not a form of work that can be compatible with such a technique since knowledge cannot be arranged and ordered in form of defined precise tasks. (White & Miers, 2008)

Also, one of the vital properties that business process modeling has is its strictness and inability to model the complete versatile aspects, this property might constitute an obstacle when a modeller intends to model knowledge work. According to White & Miers (2008) "The reality is that, when it comes to modeling multifaceted world of work, all business process

models need a certain degree of rigor. "And since knowledge work cannot be holistically modeled using a rigor technique, critics stated that business process modeling is not the perfect technique for modeling such complicated work. (White & Miers, 2008)

Maier (2005) concluded that knowledge work is characterized to be changeable, blurred and unstructured hence; modeling techniques such as business process modeling lacks the ability to support the process of modeling knowledge work due to its inflexible design that cannot suit the holistic approach of knowledge work. Maier (2005) explained that both, the recent development of the ICT infrastructure and the nature of knowledge work implied the necessity of finding some modeling techniques that can be used to either replace or apply some modifications on the business process modeling structure enabling this model to portray and present an adequate and helpful structure to model knowledge work aspects.

## 4.4 Case management systems

The term case management invaded the business environment to indicate a degree of flexibility which case management systems add to the rigorous nature of business process modeling. Flexibility here means that the usage of case management will allow a modeller to do some modifications on the process modeled in the business process model during execution. (Koehler et.al, 2012.)

The main concept behind case management is that it deals with difficult problems in three main fields which are social work, health care and finally insurance claims. Case management studies the needs of client and based on these needs a bunch of suitable services will be provided. (Koehler et.al, 2012.)

Case management is believed to be one of the approaches that can aid in modeling knowledge work. One of the traits that helps to model knowledge work that these types of systems don't require to predefine the tasks that a modeller wants to execute, alternatively these systems depend mostly on the human actions .Moreover, these kind of systems take into account both the external and internal environment of the task.

It is essential to know that though automated computer systems are considered to be beneficial in various working departments inside the organization, however these systems are incapable of performing the holistic aspects of a certain task without the aid of human abilities. Therefore, case management systems came in order to integrate the intellectual mental abilities of knowledge worker with the facilities that software provides. (Miller,2009)

### 4.4.1 Case management steps

In order to perform a precise case management five steps should be followed:

1. Clearing and intake: Where a case manager decide if the situation needs to be solved using case management systems. This step illustrates the knowledge that a case manager should use so that he can decide whether a certain case is unique and needs a special attention to be solved. (Miller,2009; Koehler et.al, 2012)
2. Assessment: Here the case manager assesses the details and the structure of the case and tries to figure out what services the case management can provide so it will suit the client's desire.
3. Planning: This step is done collaboratively with the client to decide what kind of services can both achieve the goals of the case and suit the client.
4. Linking and Monitoring: This step emphasizes the way services are provided and measure the impact of these services in accomplishing the objective of the case.
5. Evaluation: This step is concerned about the results of performing the case management process. (Koehler et.al, 2012.)

These steps aid in determining various traits that distinguish case management when compared to business process modeling. First, determining the goals of the case management process is done collaboratively between case manager and the client. Also, while setting up the planning phase both the case manager and the client should agree on the offered services taking into account that these services will aid in solving the unstructured problem. The last trait that makes case management unique is the continuous control and assessment on the way services are performed.

Case management systems are considered to be one of the best choices to model knowledge work. This argument can be supported by various facts. First, referring to figure 4.1 we notice that work with a high degree of required knowledge and relationship complexity requires case management (Koehler et.al, 2012). Second, case management systems permitted workers to collaborate effectively due to, case management systems design that considers user adoption. Therefore, knowledge workers will be able to aggregate documents and exchange them easily.

Finally, a case worker is not limited by predefined steps to follow since case management "is strongly client-centered and purely driven by humans." (Koehleret.al, 2012)

### 4.4.2 Case management model

Case management is considered to be a recurring process where its phases can be executed more than once according to the case being solved. Case managers present essential records of steps they followed at each stage of the case management process. ." (Koehleret.al, 2012)

Figure 4.3 is an example of case management system interface that enable the case manager to document all the related information about a certain case. Documenting this information will implicitly portray the criteria case manager followed in solving the case. Hence, if there was a need to solve another case that has similar properties of a previous documented case, a case manager can go back to the documented information and figure out the way of previous skills and experiences used.

**Figure 4.3: Case management system interface**

**Source: http://www.sunridgesystems.com/assets/images/CasePageMOD.jpg**

Relating this to our main goal of modeling knowledge work, we have noticed from chapter two that knowledge work obliges knowledge worker to use his/her intellectual abilities to solve complex problems. Moreover, solving complex knowledgeable cases need worker to use wide knowledge spectrum that provides a holistic overview of both previous and current experiences in the organization. Thus, documenting information about a certain case and providing understandable approach of the way it was solved will enable knowledge worker to deal with various cases by referring to the previous experiences implicitly implemented in case management systems.

Case management system is an approach that integrates business process modeling with knowledge work. Hinkelmann (2012) suggests that one of the techniques that can aid in modeling knowledge work is implementing case as a form of sub process in BPMN.

Figure 4.4 represents an example of a case activity that will be implemented as a form of sub process. This sub process consists of four main components. These four components are mile stones, rules and human activities and content. (Hinkelmann, 2012).From these building

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blocks we can say that case management intensively depends on human judgements and behaviour. Hence, since knowledge work depends on knowledge worker behaviour, case management system is considered to be useful approach to model knowledge work**.**
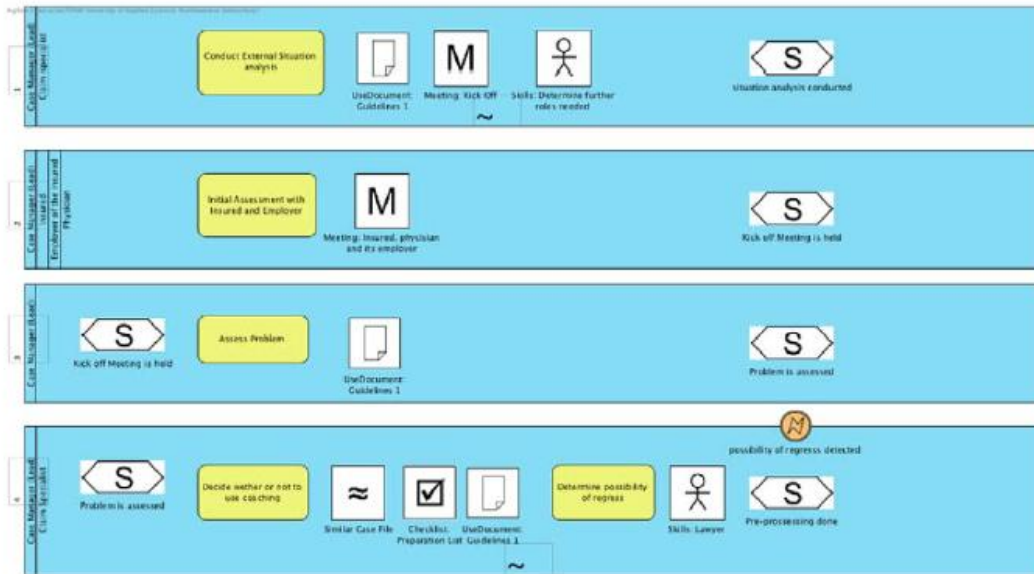


**Figure 4.4 case management systems**

**(Hinkelmann, 2012)**

## 4.5 Activity theory:

Before discussing the remaining two modeling techniques it was essential to introduce the activity theory that simplified and aid the construction of the two remaining modeling techniques. Demonstrating generic aspects of this theory will help in understanding the criteria of how the two remaining modeling techniques work.

Moreover, some authors opposed the idea of modeling knowledge work using the extensions of business process models , since these type of models deal with knowledge as a

form of materialistic object that can be stored and documented neglecting the fact that knowledge can be changeable and applied differently according to the situation (Maier,2005).Therefore, authors suggested that one of the most beneficial theories that aid in understanding knowledge work is the activity theory that treats knowledge work as a form of " knowing and doing ."(Maier,2005). Activity theory treats knowledge as a dynamical action that impacts the worker ability to know and gain more experience. (Blackler, 1995)

Knowledge work is not that type of work that has certain pattern, knowledge work is based upon practices and implications knowledge workers face every day. Hence, the complexity of modeling such type of work is due to its changeable and unstructured form. However, according to Nardi (1996), activity theory main concern is in applied practices rather than theoretical ones.

Activity theory is considered to be a successful framework when it comes to the analysis of knowledge work. Analyzing knowledge work will enable modeller to construct a beneficial model that will aid knowledge workers. This theory is considered to follow practical orientation that aim to present a model for the vague , blurred and unstructured tasks .Practical orientation in this case means that the knowledge worker will be able to enacts his/her own conceptions through his/her activities. Therefore, this facility of enacting concepts, will allow knowledge worker to deal with the unstructured tasks of knowledge work. (Blackler, 1995)

Also, knowledge work is formalized due to the experience and skills an individual gain through his/her working journey relating these traits to what Nardi (1996) stated about activity theory that it "proposes a strong notion of *mediation*—all human experience is shaped by the tools and sign systems we use" it can be said that the social artifacts and knowledge work can be modeled successfully with the aid of activity theory.

Furthermore , it is essential to know that while modeling ,the framework of activity theory takes into account the historical background of a person, role of artifacts and the circumstances of surrounding environment .Taking into account these factors permitted activity theory to present volatile nature of knowledge work tasks successfully.(Maier,2005)

**4.5.1 Hierarchal structure of activity theory :**

In order to understand the way activity theory works it is essential to know its hierarchal structure.

Referring to figure 4.5 it can be noticed, that a knowledge worker will have motivations to solve a certain case, according to activity theory these motivations will be translated into activities. Then, in the aim to achieve goals aligned with these motivations, knowledge worker will start performing his/her job through actions. However, before starting the action, knowledge worker should consider two main perspectives. First, he/she should plan the way action will be done. Second, he/she must study the surrounding conditions. Finally, knowledge worker can start executing actions by performing series of operations. (Engeström, 1999)
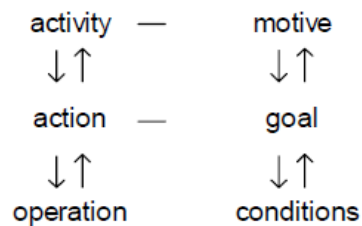
activity — motive
↓↑ ↓↑
action — goal
↓↑ ↓↑
operation conditions

**Figure 4.5: Hierarchal structure of activity theory**

**(Maier,2005)**

Maier (2005) stated that" Elements of higher levels collapse to constructs of lower levels if learning takes place. They unfold to higher levels if changes occur and learning is necessary." Therefore since learning and gaining experience play essential role in knowledge work field, the transformation of higher levels into lower ones in the activity theory is considered to be suitable

approach for learning process aligned with knowledge work. Moreover, the value of activity theory structure is represented in its flexibility. As it was mentioned in chapter three a good model is the flexible model that can be modified easily according to different conditions. Referring to figure 4.5 it can be noticed that elements of lower levels can be unfolded to a higher level if any change occurred.

### 4.5.2 Activity theory model:

Knowledge is not presented as a separate entity in activity theory model rather, as a part embedded in the relations represented in the model. Six elements constitute the formalization of the activity theory. These elements are arranged in inner and outer triangle that is depicted in the figure 4.6 below. First, agent/subject who symbolizes the individuals (actors) involved in the activity and it also demonstrate the way individuals deal with each other. Second, is the object which represents objectivity of activity system. Moreover, the sociable rules and frameworks have an important role to adapt agent thoughts and behavior to his/her community.

Also, Instruments represent the connotation individuals perform while doing their activities. It is important to note that these instruments are not stable and tend to change due to the experience a worker can gain through time and due to the volatile cultural changes that can take place and influence the worker intellectual abilities and thoughts. Finally, sociable rules make a joint relationship between agent and the division of labor. (Maier, 2005)
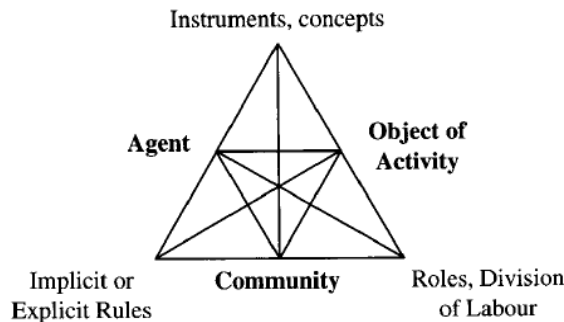


**Figure 4.6: elements that constitute activity theory**

**(Maier, 2005)**

Moreover, referring to figure 4.6 it can be noticed that there is a direct connection between agent (worker) and community element, this connection enables knowledge worker to communicate with the surrounding community, and hence this will permit sharing knowledge and experience. This mechanism will allow knowledge sharing and enhance collaborative work which is considered to be vital factor in modeling knowledge work. (Blackler,1995 )

While presenting a model, activity theory takes into consideration the mental and social perspectives workers perform while doing their tasks. This argument can be supported by the study Engestrom (1999) conducted to understand the behaviour of medical sector in Finland. Figure 4.7 depicts six elements in medical sector. Analyzing the figure Engestrom suggested that the agent who is the individual doctor will be able to enact his own conceptions, skills and knowledge through his/her activities. However if any change occurred in community which is health practice, this change will influence doctor's behaviour and will oblige him to act differently according to the situation. Hence, activity theory is considered to represent compatible framework that aid in modeling knowledge work as this type of work crucially needs intellectual abilities to be utilized and performed. (Blackler, 1995)
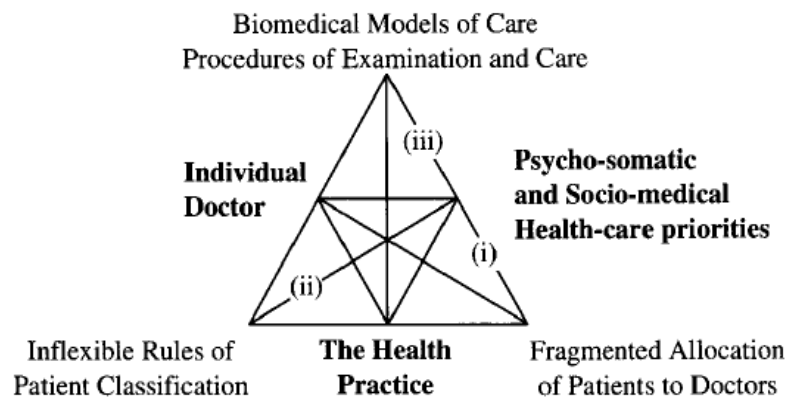


**Figure 4.7 elements that constitute activity theory in medical sector**

**(Blackler, 1995)**

From the previous example it can be concluded that activity theory is concerned about understanding the way worker acts and thinks while performing his job. Activity theory accounts for the holistic aspects of a, worker atmosphere, culture and daily complications.  (Blackler, 1995)

According to Blackler (1995), activity theory main goal is to demonstrate a good analysis of knowledge work. In the support of that, Fjeld et al. (2002) suggested that one of the vital advantages activity theory has, that might aid in modeling knowledge work, is that it introduces methods that enable worker to formalize a sufficient idea about complex phenomenal tasks and gives the worker the ability to find out the criteria that these phenomenal tasks follow.

Also, activity theory aids knowledge workers to improve their abilities, as activity theory enables them to exploit their skills and experience in a situation that is still developing and doesn't have a certain structure.(Blackler 1995 )

Finally, the flexible nature of the activity theory aligned with the collaborative aspects it takes into account made this theory relatively, suitable to present knowledge work. However, looking thoroughly on the elements that constitute activity theory we can conclude that though this theory represents a relatively successful framework to analyze knowledge work ,it neglect the importance of organizational value chain which might cause a deficiency while modeling. (Maier,2005) Though, activity theory seems to be successful approach to understand knowledge work , it cannot be practically applied because it doesn't take into account the organizational value chain perspective that aims in creating customer value.

## 4.6 Communication Event Model and Genre Ecology Model

Davidson et al. (2004) stated that the presence of activity theory played a crucial role in understanding the way workers act within their communities while performing their jobs. Formalizing a holistic approach about how activity theory works enabled Davidson et al. (2004)

to introduce two interesting models for modeling knowledge work which are Communication Event Model and Genre Ecology Model. These two models will aid knowledge workers in performing their jobs so that they can examine current work, evaluate past work, and get ready for future work. These two models deal with knowledge work as a form of synchronized communication events, understood as genres. (Davidson et al., 2004)

According Davidson et al. (2004) both techniques aim to "to build a representation of work rather than relying exclusively on more conventional units found in workflow systems: tasks, decisions, and milestones"

Building these two models needed the use of two dimensions that enable collection of data related to worker's communication practices. The first dimension is called "Syntagmatic " and it's main aim is to predict what will be the next communicative event that a worker will use to collaborate with the team members in a certain project. The second dimension is called "Paradigmatic" and it focuses on replacement of certain genres used by workers with other genres, keeping in mind that the flow of work will remain consistent. (Davidson et al. ,2004)

### 4.6.1 Communication Event Models (CEMs)

CEM: Communication event model is a model that presents both written and spoken communication events that took place between employees working on a certain project. Presenting, accumulating and analyzing these communication events permit the organization to specify the certain pattern of a project. (Davidson et al. ,2004)

Modeling and synchronizing communicative activities and events performed by workers will help them to formalize evident understandable pattern of project dynamics. These modeled events are considered to be a reflection of "motivated, explicit, goal-oriented knowledge work." (Davidson et al. ,2004)

In order to understand what we mean by communication event model figure 4.8 represents the kinds of communication events that might take place while developing routine report.
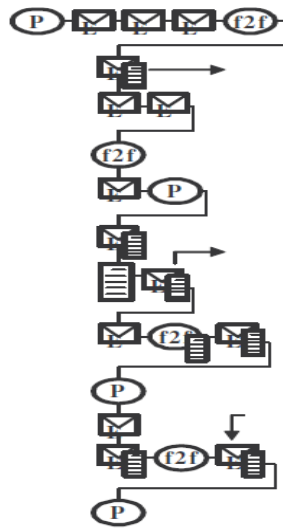
**Figure 4.8 Communication Event Model**

**(Davidson et al. ,2004)**

According to Gunnarsson (1997) elliptical shapes represent the spoken communicative events that knowledge workers perform such as, meetings face to face or doing a phone call. Whereas, rectangular shape represents the written communicative events such as written emails. Using Communication Event Model entails sorting communication events according to the date they occurred in. Further, one of the vital options that communication event model provides is that it stores both information related to a certain project and communication events as a form of "data objects with attribute-value pairs". (Davidson et al. ,2004)

These data objects with attribute-value pairs will enable the worker to add new events on the project and to specify various aspects of a project such as its purpose and date it was added. An example of communication events attributes is shown in figure 4.9.
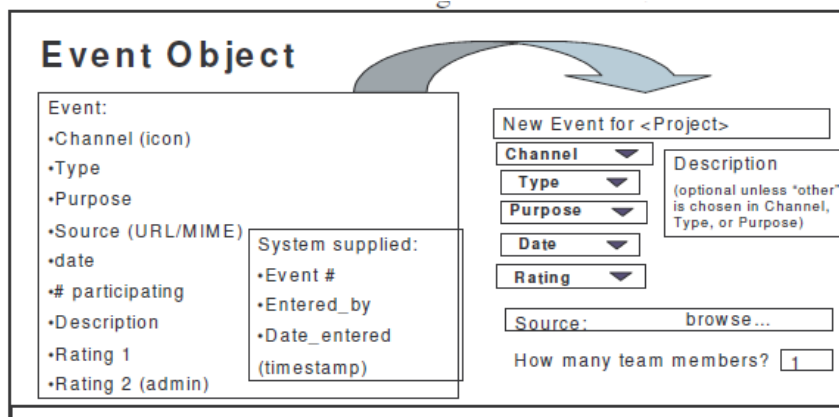
**Figure 4.9 Communication events attribute**

**(Davidson et al. ,2004)**

Finally, it can be said that communication event models used Syntagmatic dimension to gather data and correlate between communication events that took place within the project. This association of communication events will demonstrate the way knowledge workers act. Further, chronological flow of the communicative events will give the chance for workers to reuse current modeled strategies in other projects. Reusing the previous strategies will enhance the way knowledge workers perform their job and will add to their experience. (Davidson et al., 2004)

### 4.6.2 Genre Ecology Models (GEMs)

Genre Ecology Model (GEM): a model that brings together various information objects and illustrates the coordination between those objects .Moreover, it demonstrates the way genres combined with one another. (Spinuzzi, 2003)

Spinuzzi(2003) suggested that, while performing their jobs knowledge workers tend to both bring in new genres and replace old ones with more innovative and practical ones. Yet, most modeling techniques have a tendency to neglect this innovative substitution. However, Genre Ecology models basically use paradigmatic dimension that tends to replace current genres with new ones.

The facility of modifying and replacing existing genres with new ones will enable the organization to perform its job in a stable manner, since genre ecology models will allow workers to understand how genres are interconnected and enable them to use their knowledge to either modify existing genres or create a new ones .Further, genres act as an intermediate that groups work activities. (Davidson et al., 2004)

Genre ecologies" are a way of talking about the material set of interpreted informational resources on which workers draw as they do their work." (Davidson et al., 2004).Figure 4.10 represents an example of genre ecology model.
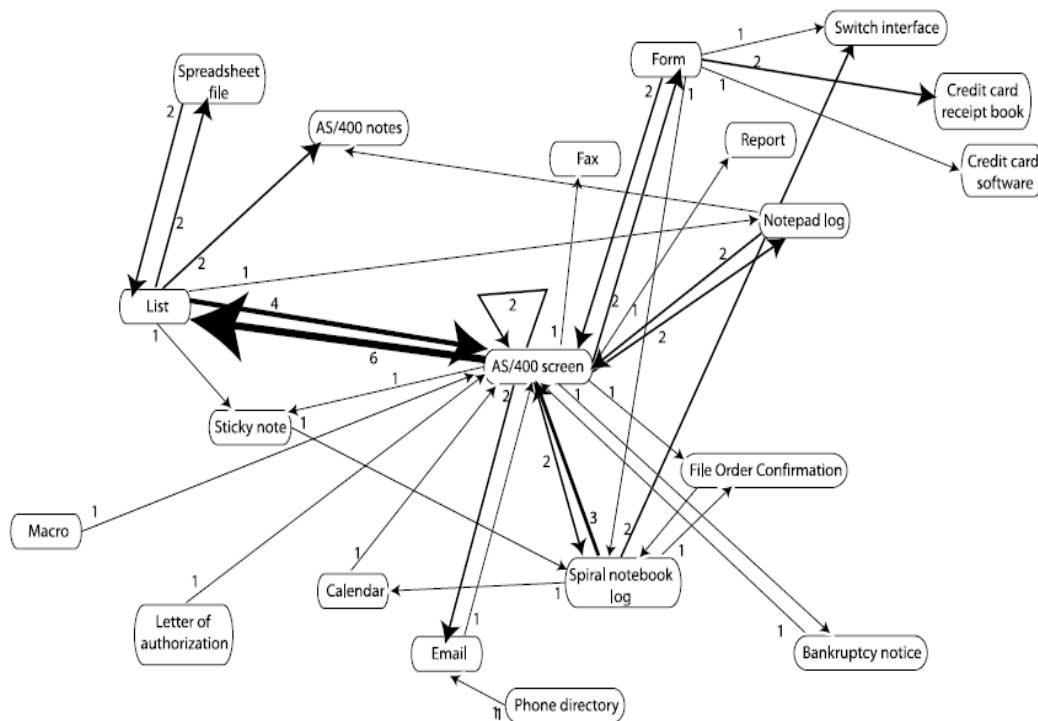


**Figure 4.10: Genre Ecology model**

**(Spinuzzi, 2003)**

Genre Ecology model depicts a cluster of interconnected genres. This ecology model will enable organization to form an idea about how workers unite collection of genres in order to perform their jobs. Further, it permits the organization to figure out how workers replace genres within existing genre's cluster.

Understanding how genres are interconnected and the way workers use them is a representation of the knowledge work performed by workers within the organization. From figure 4.10 we can notice that genre ecology systems permits organization to gain insights of methods and artifacts used by its workers.

**4.7 Evaluation of Existing modeling techniques**

According to the aspects the researcher deduced in table 3.2 we will evaluate the four existing modeling techniques and see whether these techniques are compatible to model knowledge work. Table 4.1 represents this evaluation.

**Table 4.1 Evaluation of the exiting modeling techniques according to aspects researcher deduced**

| | User adoption | Communication Channel | Flexible Structure | Documentation Facilities | Standard layout |
|---|---|---|---|---|---|
| Traditional business process modeling | Yes | No | No | Yes | Yes |
| Extensions of Business process modeling | Yes | No | Yes | Yes | No |
| Case management | Yes | No | Yes | Yes | No |
| Communication Event Model | Yes | Yes | Yes | Yes | No |
| Genre Ecology Model | Yes | No | Yes | No | No |

From table 4.1 we can notice that traditional business process modeling technique is rigid in its structure and requires a set of predefined process to be modeled. Moreover, this technique lacks the communication channels that enable workers to collaborate in order to perform their knowledge work.

As for the extensions of business process techniques, they lack two important aspects. First, standard layout since each extension will have a unique layout. Second, communication channels that are considered to be essential for employees' collaboration. Like, extensions of business process techniques case management systems lacks both communication channels between workers and a standardized lay out.

Communication event models provide a suitable communication channels between workers so that they can communicate and share their knowledge. Also, communication event models permit workers to document the steps they followed during their work.

Finally, Genre Ecology model has a flexible structure and allow knowledge workers to substitute existing genres with new ones. However, this technique lacks the validity of communication channels between workers.

# Chapter 5

## Conclusion

From the previous four chapters we can conclude some vital precious conclusions that can contribute to find some ways in order to model knowledge work.

Though, modeling knowledge work is considered to be a promising field for flourished and developed organizations, this field has a lot of implications.

Looking back at the literature we can see that this field grabbed attention of many scholars and writers, however up to this moment scholars, analysts or even writers couldn't agree on one precise meaning of what is knowledge work. This inability of finding the adequate meaning of knowledge work refers to the complex structure of this work.

Knowledge work is not based on set of predefined structured activities but it is a result of knowledge worker intellectual abilities and skills. Moreover, knowledge work is done collaboratively, and permits knowledge workers to share their knowledge and experience to perform their task appropriately.

Due to the good profits organization can gain from modeling knowledge work, there were a lot of trials that aim to model such type of work.

From our analysis in chapter four we can say that though there are a lot of techniques that aid in modeling knowledge work, still none of them was able to model the holistic approach of knowledge work.

All in all, it can be said that this thesis analyzed the exiting techniques that aid in modeling knowledge work but unfortunately concluded that, still every technique has its weak points when it comes to model knowledge work.

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