# Knowledge Management in Project-Based Organizations: The Interplay of Time Orientations and Knowledge Interventions

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**Abstract**

The common perception is that all types of work and work organizations appear to involve knowledge: knowledge intensive work, knowledge workers, knowledge products, customer-related knowledge and knowledge intensive organizations. Therefore, as organizations increasingly organize their activities in the form of projects, effective ways of knowledge management are needed to deliver successful and timely outcomes. However, little research has been done in the area that integrates time orientations into the process of knowledge management. Using the approach of grounded theory, this paper investigates the interplay between time orientations and knowledge interventions through interviews with international project managers drawn from different types of project-based organizations in Sweden and Italy. The perceptions and experiences of the managers are used to construct a model of time orientation and knowledge interventions in project-based organizations. Time orientations are shown to play a critical role in the success or failure of projects. The model integrates time orientations into the project life cycle and illustrates how effectively knowledge interventions can be used to achieve project milestones and meet overall deadlines.

**Key words**

Project-based organizations, knowledge interventions, time orientations, knowledge management

## Introduction

In today's New Economy, all types of work and work organizations appear to involve knowledge: knowledge intensive work, knowledge workers and knowledge intensive firms (Quinn 1992; Drucker 1993; Alvesson 2001). Accordingly, projects have become an important milieu for widespread use of knowledge (Jyrki et al. 2003) and important vehicles and mechanisms in many organization's operative and strategic business activities (Söderlund 2002). Project basing facilitates the achievement of economies of resource allocation, knowledge management, and quality (Hobday 2000). It is not surprising, therefore, that much has been written to assist organizations to understand knowledge issues and knowledge processes (Turner et al. 1990; Nonaka and Takeuchi 1995; Liu et al. 2005) and explore their knowledge inventory (Van Donk and Riezebos 2005). Nevertheless, existing evidence suggests that it is quite challenging to find a starting point to manage knowledge in organizations (Shapiro and Varian 1999). Knowledge management here refers to '*purposeful*

*interventions of knowledge development to realize sufficient knowledge availability at the time and place where the organization needs it'* (Smits and de Moor 2004, 4).

Söderlund (2002) argues that, to understand important aspects of knowledge management in project-based organizations (PBOs) one must focus on time-based control mechanisms. This, according to him, is because; many development projects are carried out under the light of an overall negotiable deadline. According to Blackburn (2002), the changing and unpredictable nature of project-based activities makes it difficult for organizations to know how early they should initiate a project and the project manager is often brought in late. In addition, projects are often complex (Hobday 2000) involving a synchronization of several knowledge bases (Van Donk and Riezebos 2005) and a manifold unsettling of knowledge workers with different time orientations (Söderlund 2002). Given these observations, the question arises as to how effectively time orientations[1] and knowledge interventions can be integrated into the project life cycle to ensure efficient outcome.

The main objective of this paper is to discuss the topic of knowledge management in PBOs focusing on the interplay of time orientations and knowledge interventions. Although this subject has lately been acknowledged by a variety of different studies (Hameri and Heikkilä 2002; Clark and Fujimoto 1991; Nonaka and Takeuchi 1995), little research has been conducted that integrates time aspects and knowledge processes (Söderlund 2002, Reinmoeller and Chong 2002). For example, Reinmoeller and Chong (2002) show that time orientations enable knowledge processes and provide a complementary framework to manage knowledge in organizations. Time is important because projects are interdependent, temporal and each project has a new management (Söderlund 2002). However, these studies focus on a few cases in complex development projects and may not provide any general pattern applicable to many types of project-based organizations.

As a reaction to this deficiency, this paper proposes a grounded theory-informed empirical research (Glaser 1992) on the interplay of time orientations and knowledge interventions when managing knowledge in PBOs. The theoretical framework integrates knowledge-based theory of the firm and theories of time orientation in organizations (Reinmoeller and Chong 2002; Söderlund 2002). The knowledge-based view defines knowledge as '*the most strategically significant resource of the firm'* (Grant 1996, 375), while theories of time orientations define different time contexts and explain their organizational implications (Ancona et al. 2001). The empirical research consists of interviews with international project managers in Sweden and Italy. The perceptions and experiences of the managers are used to generate a model of time orientations and knowledge interventions in project-based organizations. The paper illustrates how time orientations and knowledge interventions can be integrated into the project life cycle to assist any PBO to find competence for initiating and completing project milestones and meeting overall deadlines. Section two presents an overview of knowledge management in PBOs emphasising the importance of time orientations. The research study is presented in section three while the emergent empirical model is analyzed in section four. Conclusions and suggestions are presented in section six.

1 Time contexts, conceptions of time, time orientations and time lens are used interchangeably to refer to different ways that researchers conceptualize and discuses time.

## Knowledge Management in PBOs – the importance of time orientations

### Brief overview of project-based organizations

Classical management theory classified companies according to organizational structure (Mintzberg 1979; Hatch 1997), the nature of products to be developed (Wheelwright and Clark 1992) or the nature of projects undertaken (Hatch 1997; Turner et al. 1990; Hobday 2000). Due to uncertainty in the business world, difficulties in task specification and sub-system partitioning at the end of 20th century companies increasingly began to organize their activities in the form of projects – project-based organizations (Ekstedt et al. 1999; Hobday 1998). Turner and Huemann (2000) identify three organizational objectives of PBO: decentralized management from top management to project managers, transfer of knowledge between projects and project-based organizations, emphasis on goal orientation and personal development. In PBOs, co-ordination takes place between the different projects, each of which consists of four phases (see Figure 1. below) and represent the primary mechanism for production, organization, coordination and integrating all the key business functions in the organization (Wheelwright and Clark, (1992); Hobday 2000). Young (1998, 347) defines a project as: '*a collection of linked activities, carried out in an organized manner with clearly defined starting and finish points, to achieve some specific results that satisfy the needs of an organization as derived from the current business plans.'* Knowledge, capabilities and resources are built up during the execution phase (Hobday 2000) since project members and their team members devote most of their time to the project (Wheelwright and Clark 1992).

Time, task, team and transition are four concepts that illustrate how a project differs from other types of organizational forms (Lundin and Söderholm, 1995). Apart from being a scarce resource, the importance of time lies in the fact that each project is temporal (Lundin and Söderholm 1995) and many high quality projects are delivered too late (Field and Keller 1998). According to Lundin and Söderholm (1995), task, whether unique or repetitive, represents an organization's devotion to goals, relates the individual to the team through sharing and exchange of expectations and experiences (Dixon 2000), establishes the basis for commitment, motivation, communication and leadership, and connects the project team to the environment. Finally, transition is either the transformation process to fulfil specific organizational purpose or transformation among individual project participants on how to proceed from project definition to project closure (Lundin and Söderholm 1995).

### Knowledge management in project-based organizations

According to the knowledge-based theory of the firm, knowledge is '*the most strategically significant resource of the firm'* (Grant 1996, 375). It defines the firm's capacity to efficiently convert its inputs into outputs (Nelson and Winter 1982, 59-60). Davenport and Prusak (2000, ix) define knowledge as: ' items that the organization knows or could know: skills and experiences of people, archives, documents, relations with clients, suppliers and other persons and materials often contained in electronic databases". Two dimensions of knowledge form the basis for knowledge creation and utilization. Firstly, knowledge can be tacit or explicit (Polanyi 1966; Nonaka 1991). Secondly, knowledge can be objective or subjective knowledge (Popper 1972). There is need to minimise the cost of converting tacit knowledge to explicit knowledge while maximising the trade-offs between an organization's need to share/transfer knowledge vis-à-vis that of protecting its knowledge base (Alavi 2001). Nonaka and Takeuchi (1995) argue that knowledge is created through a conversion process between tacit and

explicit knowledge. All of the above point to the importance of organizational learning and the knowledge library in the development of formalised knowledge management.

One of the biggest challenges in achieving formalised knowledge management is to match knowledge to organizational needs and get people to share their knowledge (Fagrell 1999; Ruuska and Vartiainen 2005). PBOs facilitate this matching process through intra-project learning (problem solving within a single project) and inter-project learning (Kotnour 1999). Juran (1988) postulates a model of intra-project learning consisting of pre-project and post-project learning respectively (see Exhibit 2 below). He argues that learning occurs within the phases of a project life cycle through interaction between project team members and occasional reviews and/or audits supported by management. Pre-project evaluation occurs during project work between the manager and the team members (Plan, Do, Study and Act phases). Post-project evaluation takes place at closure when the project is delivered to its owner and valuable lessons and experiences documented and distributed to team members working in future projects (Young 1998).

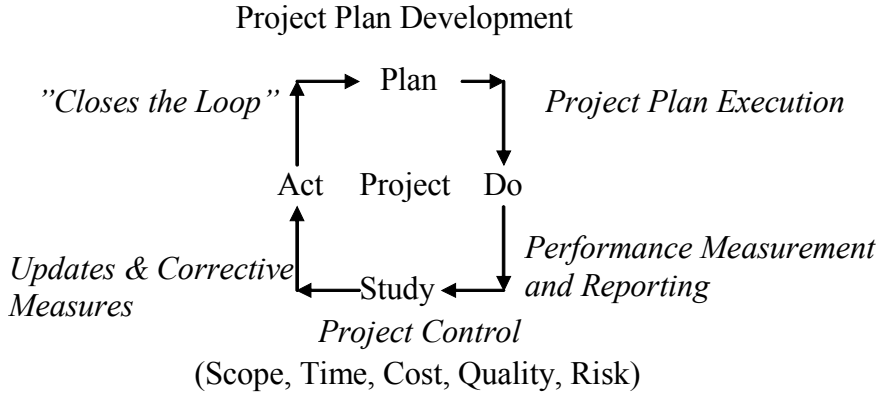


Figure 1. The PDSA View to learning and Project Management (Juran 1988)

Intra-project and inter-project learning also occurs through three interactive "ways of knowing" – *knowing-why, know how and know whom* – all of which make up and individual's career capital (Arthur et al., 2001). The recruitment of a person into a project team is based on knowing-how while knowing-why determines how best the individual participates in the project and knowing-whom affects his/her interaction with other members of the project team. Similarly, three areas of corporate non-financial competencies: *cultural, human capital* and *social capital* respectively, illustrate the shared individual and organizational capabilities, values, beliefs and relationships that facilitates the use of joint experiences during teamwork. For efficient long-term learning to be achieved both intra-project leaning (learning within project) and inter-project learning (learning between projects) must be satisfactorily attended (Antoni and Sense 2001).

The preceding discussions highlight the importance of the project manager: a hero whose skills and actions determine whether a project will be delivered successfully (Petersen 1991; Cleland 1995; Field and Keller 1998). The project manager draws human, natural and technological resources into the project (Turner 1993), considers whether the project goals are clear to self and team members, accumulates and protects valuable knowledge within the project (Cleland 1995; Blackburn 2002). The discussions also suggests that continuous building of organizational capabilities depends firstly, on the ability to identify and

distinguish different types of knowledge and, secondly, to find the vital elements in project management work and relate those elements to the types of knowledge needed to perform them. Nevertheless, while time factor is identified as an essential aspect of project management, no detailed analysis is done to inform the possibility that time inhibit or enable knowledge creation and utilization. The next section introduces time constraints that can enable the establishment of a clear link where the organization can obtain and manage knowledge (Alavi 2001).

**Time orientations in organizations**

Theories of time orientation in organizations generally focus on defining different time contexts and explaining their organizational implications. Ancona et al. (2001) assert that time is an important research lens used to understand how organizations function, such as explaining the interdependency and temporal nature of projects, and the fact that each project has a new management. They provide a category *Conceptions of Time* that explains the many different ways that humans have conceptualized time: clock time, timing, pace, rhythm, and cultural meanings of time. This recognition has led to the role of time in organizations forming an important part of project management research.

In the description of a project in section 2 above, time is defined mostly in terms of ordinary usage (the time to initiate and close a project). In this case, time is a physical constant that can be measured with precision using, for example, clocks, watches, and calendars. Bluedorn and Denhardt (1998, 315) argue otherwise, that *"time is a variable not a constant"* since different cultures perceive and use time differently. Levine (1988) explains that pace – how fast or how slow people do things – is one way to differentiate between cultures. According to him, differences in perceptions and attributes to pace could lead to grave misunderstandings, for example, where slower paced individual is considered as lazy, and a faster paced individual as frenzied and out of control. Palmer and Schoorman (1999) distinguish time orientations and time horizon, referring to the former as individual or a culture's focus on the past, present, or future and the latter as either a short-term or a long-term perspective. These suggest that, apart from clock time, there are also a number of other time-related variables that are relevant for understanding the role of time in organizations.

From an organizational point of view, Schriber and Gutek (1987, 642) define time as "*a basic dimension of organizations"* and develop a scale that measures different components of time: schedules and deadlines, punctuality, future orientation, time boundaries between work and non-work, quality vs. speed, synchronization and coordination, awareness of time use, work pace, allocation of time, sequencing of tasks through time, intra-organizational time boundaries, autonomy of time use, and variety vs. routine. Ancona et al. (2001) argue that relevant time concepts for the study of (organizational) processes that involve tacit and explicit knowledge include measured, forward moving clock time and subjective interpretations of experiences. These suggest that different time orientations need to be considered to understand timing norms, temporal relationships (time lags) and temporal leadership in organizations.

**Integrating time orientations and knowledge interventions**

Reinmoeller and Chong (2002) develop a model of time contexts that enable knowledge processes and provide a complementary framework to manage knowledge in organizations. They integrate a time lens onto a general model of knowledge processes to better understand

the contexts and enabling conditions for successful knowledge management. Their argument is that *strategic use of time contexts, that is, timing of interventions, enables organizations to create and exploit knowledge effectively*" (2002, 166). Firstly, different time concepts are characterised with the aim of reducing the number of hours of resources employed (see Figure 2 below). Secondly, ideal temporal contexts that support knowledge conversion processes are identified. By facilitating the accumulation and sharing of knowledge, creative leisure (the effective experience of time as source of tacit knowledge) enables socialization, while defining moments (periods in time of particular importance) enables externalization. Velocity (occasions that evoke experience of speed and acceleration) enables combination and minimizes time through organizational structure, efficient processes, and support systems or methods, while; seasonality (chronological flow of time) enables internalization.

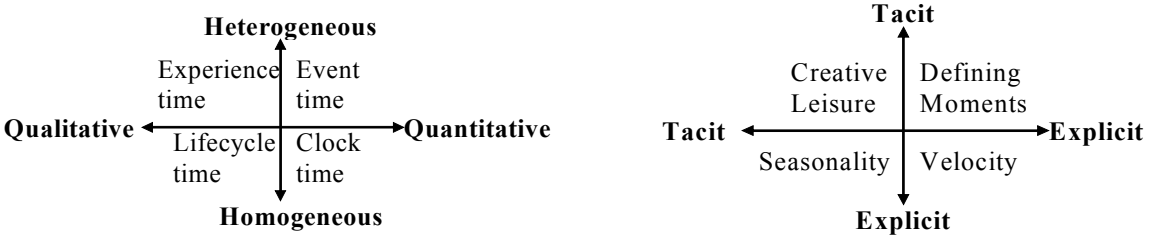


Figure 2. Time concepts and occassions for knowledge interventions (Reinmoeller and Chong 2002)

Söderlund (2002) uses two in-debt case studies of project management in complex product development contexts to develop a grounded theory on how time orientation and knowledge processes are handled. The study identifies two primary aspects of time limits that have implications for project management: the overall deadline and the synchronization of activities within a project. He argues that the overall deadline serves as a control mechanism that alters the calculations of actors and function as a trigger for acting and rethinking. Moreover, time schedules are shown to provide opportunities to introduce new ways of organization, which improve the collaborative spirit of the project.

Reinmoeller and Chong's (2002) note that the propositions and concepts built in their model need empirical testing. In addition, the grounded theory developed by Söderlund (2002) uses only two case studies in very complex development project, and may not apply to many types of PBOs. The current study adds to existing knowledge by proposing an empirical model using case studies from ten PBOs selected from different industries of sectors. The results may therefore be applicable different types of PBOs.

## The Research Study

### The research method

This paper is based on grounded theory, consisting of *generating concepts and their relationships that explain, account for and interpret the variation in behaviours in substantive area understudy, which behaviour is most hinged around processing a problem for the subjects* (Glaser 1992, 19). Primary data was collected through interviews with ten project managers in different types of international PBOs in Sweden and Italy. Three criteria were used to select participants: firstly, the participant has to be a project manager with relevant academic and professional experiences in at least two countries; secondly, the projects or

project-based organization must be international; and thirdly, the projects/project-based organizations should come from different industries or sectors of the economy. The initial study identified sixty-one project-based organizations in Sweden and Italy – since the authors had easy reach to these countries. This number was reduced to twenty-six when we applied the third criteria. Ten of these accepted to participate in the interview: public works, e-business/IT, educational institution, military, construction, sewage and water management, speleological, customer research, telecommunications, and innovation systems development. A strict rule of introduction was used, and ethical consent was sought from the participants for recording oral data on tapes. Secondary data on the participants were also used in the interview and recording process. This selection obviously ensures appreciable accuracy and trustworthiness of the data collected.

The interview consisted of semi-structured open-ended questions to allow the respondents to freely discuss their different experiences and ideologies, to clarify background and reasons behind decisions and management styles, and to allow the interviewer to ask questions within a wide area of issues (Yin 2003). This wide coverage was necessary to obtain results that can be generalized for other PBOs. The interviews took place in Spring 2005 with eight conducted face-to-face and two over the telephone. To ensure generality in the responses, the details of the specific projects and project managers studied have been kept anonymous. Secondary materials supplemented analysis of the verbal transcripts and interview notes.

**The process of knowledge management in project-based organizations**

The participants discussed their perceptions and experiences dealing with projects and project-based organizations and knowledge and knowledge management. An overview of what these terms mean and how they are applied in practice is useful in understanding the usage of time in project work and how knowledge interventions take place. Since some of the views of the participant reflect existing literature, there is constant reconciliation illustration of similarities in concepts and patterns with previous research (Glaser 1992).

**Project and project-based organization** The participants shared the same view concerning the definition of a project and a description of its life cycle, but presented different perspectives concerning a project-based organization and pros and cons of working with projects. A project could be defined as a whole of activities performed to achieve a pre-stated objective within a given time and budget. A successful project involves the project manager coordinating three critical variables: goal, time and costs. The project goal defines why the project should be undertaken (see Table 1. below). Cost constraints determine the quality of the project. Time limits are discussed at a later sub section.

| **PBO** | **Project** | **Project Goal** |
|---|---|---|
| IT Company | IT-services | Provide high-technological services and assistance |
| Software company | Software systems | Supply operative systems, software and assistance |
| University | Business School | Create a competitive international business school |
| Speleological organization | Speleological program | Develop scientific research project on cultural goods and cultural circulation. |
| State Agency | R & D | Long-term growth and sustainable development |
| Sewage company | Construction | Construct a sewage management plant |
| Defence Ministry | Military operation | Prevent territorial occupation by enemy forces |

Table 1. Types of project goals from some PBOs selected for this study

Although the respondents allotted different names to each phase of the project life cycle**,** their descriptions point to Juran's (1998) four phases: introduction or initiation, planning, implementation and closure. However, a project life cycle consists of phases to be accomplished simultaneously rather than step-by-step. In the initiation phase feasibility studies are carried out to create the project idea and preparations made for take off.

*'The initiation phase is the visionary stage.... for any project the vision must be so concrete such that people understand what you want and at the same time feel that they can influence your vision'* Project manager, construction project

The planning phase, consisting in designing and setting milestones for achieving different project tasks, emerged as that most important phase. This is because it contains most problems that can affect regular evaluation of the project. The third or implementation phase involves operation, maintenance, rehabilitation, monitoring and preparation for the delivery of the project to its owner at the final stage (closure/delivery).

The project owner can be an individual (sole proprietorship) or a PBO. A PBO can be defined as an organization in which the processes are structured into projects with the goal of accomplishing a sequence of activities to meet organizational objectives. This suggests that any organization can be project-based even if it has a different organizational structure.

*'The project-based organization tries to reduce the levels between the professionals to avoid a hierarchic organization and guarantee flexibility ... our organization has a matrix structure yet we do many of our operations through projects. So any organization can be project-base'* Project manager, IT-project

Some advantages of working with project, according to the respondents, include: the orientation to a clear and defined goal, reliability on good practices to improve the quality of products, easy performance measurement, the possibility to do many processes at the same time. In addition, projects are easy to evaluate since the project team actually performs the various tasks and do the evaluation. Despite these advantages, the requirements of meeting the pre-stated objective given the time and costs surfaced more frequently among the respondents as critical problem. Other problems include management of conflicts during inter-project coordination, understanding the level of personal motivation and common spirit among the team members, maintaining accountability of costs, getting the customer to understand the value of the final product, and getting understanding from people outside the project team.

**Knowledge and knowledge management** The respondents presented similar definitions of knowledge, identified different holders of knowledge and discussed knowledge management challenges. Knowledge is the whole lot of education and experiences of an individual and also the individual's personal way of working in a group. In addition, the sum of knowledge in a project team is bigger than the sum of knowledge of individual team members. This supports the argument that projects are highly knowledge-intensive (Jyrki et al., 2003) and require effective ways to spread and share knowledge (Nonaka and Takeuchi 1995). According to the respondents, the capacity to create new consumer demands, transform technologies into new products and maintain the image and reputation of the company necessitate constant learning and updating of knowledge to increase effective knowledge management. Three knowledge levels were identified: individual (own experiences and level of specificity in the field of

expertise), team (integration and coordination of individual knowledge in the project team) and organization (skills and mentality for managing and working defined in the organization's manifesto) knowledge respectively. A clear identification and definition of these three levels of knowledge, the respondents stressed, guarantee a logical connection in the project knowledge acquired, facilitates conversion from tacit to explicit knowledge and enhances the sharing of to enrich project management.

Knowledge, according to the respondents, can come from three sources: project team, PBO/senior management and/or external sources. However, the primary source of knowledge is the project team coordinated by the project manager. The medium for spreading and enhancing knowledge within the project team include collection of best practices in archives and making them accessible to team members, regular follow-up meetings to answer questions that come up during project work, and informal meetings such as during leisure. Some important constituents of knowledge management were also identified: source of knowledge, spread and share knowledge, team-spirited learning process, and increased competitive advantage. Thus, knowledge management is the identification, spreading, and sharing of knowledge to ensure continuous growth in project knowledge and achieve competitive advantage for the PBO. It gives the possibility to effectively structure the organization's learning process in a way that involves all team members, and reduces the time to achieve pre-stated or superior objectives with available resources.

**Projects and time orientation** The respondents discussed the need to constantly control the timing of events and the responsibility of the project manager to have the right balance and estimation of time orientations. This is because *'most projects fail because the time it takes to accomplish all steps in the project plan is not taken into consideration at the planning phase.'* Manager, Military Project. Time is perceived either in terms of scope or as a resource. In terms of scope there is a starting time when the project is initiated, a middle time during which project work is carried out, and an end time when the project is handed to the owner. Time is also important as a resource because it is used to achieve organizational objectives, the only difference being that it can neither be improved nor defined. Time orientations include start time, life cycle time, requisite time, test time, leisure time and deadlines.

Life cycle time is the time it takes to complete all stages in the project life cycle. Life cycle time is difficult to deal with in a multi-project organization where some members of specific projects are also engaged in other projects within the organization. This inter-project way of working can cause delays in one project at the expense of others (Söderlund, 2002). Start time, that is, the time when the project assignment is handed to the project team, determines the success of the project. If the project assignment is given to the team early enough then the team has an opportunity to construct a good project plan. Requisite time is the time it takes to construct the details to achieving the project goal. In product development, for example, if the requisites dictated by the customer are not clearly stated, the goal of the project as well as the work of the specialist is equally unclear. This necessitates delays in re-working the project idea until the project goal is acceptable. Test time is the period to experiment and evaluate whether the initially completed project is ready for delivery. For example, sewage management projects such as recycling plants have to be tested to determine if the machines work well. Test time enables the team to identify errors, seek and implement corrective measures before delivering the project.

All the respondents identified leisure/free time as a necessary way of to relax and give life to the project team: boat ride, meet at pubs/bars or take a holiday. Apart from relaxation, some managers use leisure time to spread and share knowledge among team members such as brainstorming over issues related to the project during coffee breaks. Free time also exists between the project phases due to more technical reasons such as uncertainty in the customer wish, time between pre-sale and implementation, and general problems of saturation. Thus, the project manager must minimize the effects of free time to avoid unplanned delays in project work that could prevent meeting the deadline. Finally, the deadline is the time that must not elapse without completing the project.

*'Time is very critical…you have to see the end of the project and move backwards to figure out when you should do specific tasks. Since time is not learned in the textbook you have to be creative and flexible to develop the project as you work…the project should not be organized as one process…it should be organized as parallel processes, that is, doing all the phases in the project cycle at the same time.'* Project Manager, Education Project.

Sometimes the project team is confronted with the dilemma of achieving different time orientations and sticking to the managerial procedures set during project planning. The respondents noted that delays and bad management at the beginning of a project could have a multiplier negative effect on the outcome of the project. This is because the use of time in project implementation is often not visible to the implementation team and this makes effective re-planning impossible. This forces the project team to negotiate for time by requesting more time from the project owner or customer.

**Projects and knowledge interventions** According to the respondents, knowledge intervention means additional instruction that supplements the project plan and assists the team in meeting the goal of the project. This includes guidance, counseling and specific skills implemented by project manager, team member, PBO or external experts (depending on the phase of the project life cycle) to support improved task performance. Knowledge intervention is implemented by the project manager within and between the different phases of the project life cycle. However, since individual team members possess technical and skilful knowledge needed to perform practical tasks, their intervention is crucial during the implementation phase to detect errors and implement corrective measures even without notifying the project manager. The characteristics of the project during the initiation phase require the project manager to figure out the type, size and scope of the project. This requires knowledge from the project organization (stored in previous project reports, databases and specific programs) and books on project management. External sources of knowledge interventions come into play when the required knowledge does not exist either within the project team or the project organization. In this case, the project team may re-utilize knowledge applied in other projects obtainable from external networks or seek consultants and specialized experts that are better informed about the ongoing project. Although their intervention is specific, direct and limited in time and space, it adds to the store of knowledge available to PBO for use in the future. In terms of effective knowledge interventions, the respondents identified true teamwork as a prerequisite for sharing and spreading knowledge held by single members. The respondents argue that while higher management can define the time and modalities for interventions since it is in a better position to foresee the direction and vision of the project. However, they stressed that it is the task of the project manager to dictate the need and measures for intervention.

## Discussion of the Emergent Empirical Model

The goal of this paper is to develop a model of time orientations and knowledge interventions in PBO by analysing the interview data presented above. Figure 3 below represents the emergent model of time orientation and knowledge interventions during project work. The figure represents a single project, with the owner at the top, interacting with the PBO (or the owner of the project) and external networks. The big circle is the life cycle time, that is, the time it takes from initiation to delivery of the project. The direction of project work is clockwise since, life cycle time could be interpreted as clock time. The dotted lines illustrate time flow while the full lines portray knowledge flows. Time is represented by dotted lines because it can stretch beyond limits. This occurs for example, when the project assignment is brought in late (Blackburn, 2002). Since the project managers do not initially know the capacity of the project team's knowledge they may need more time to make adjustments.

The four phases of the project life cycle (introduction, planning, implementation and delivery) are separated by dotted lines that end with black balls stretching from the centre of the circle to its perimeter. These dotted lines and black balls are the milestones and deadlines respectively for accomplishing each phase of the project cycle. For example, the ball in the right represents the deadline to introduce the project and get it ready for planning, while that at the bottom is the deadline to complete the planning phase. The division of the spaces inside the life cycle is not equal. The planning and implementation phases are much more time consuming and knowledge intensive than the introduction and delivery phases. These are therefore are allotted larger spaces on the life cycle. The dotted arrow from project owner into the circle represents start time and leads to the beginning of the life cycle time. The last period is the test time, that is, the time to test and evaluate the project and acceptance by owner. The leisure/free time is identified in the planning and implementation stages. This is because it is not expected to get any significant effects during the introduction and delivery stages.

There are three sources of knowledge available to the project team: team knowledge, organization knowledge and knowledge from external sources. Knowledge from external sources is represented by dotted lines since, as discussed above; it can only be used in special circumstances. During the second and third phases, the team knowledge is more integrated and coordinated than during the introduction and delivery stages. In the implementation phase, the team should have achieved enough knowledge for a successful exploitation of the project. Finally team knowledge is stored in archives, intranet, and databases and shared in the form of best practices learned and case studies with all the members of the organization (see arrow from team knowledge to organization knowledge).

The model describes the relationship between time conditions and knowledge intervention in a single project. The project-based organization can be seen as a sum of many projects each with its own graphical exposition. The organization knowledge is always growing thanks to knowledge management that guarantees efficiency and growth. For this purpose most organizations have developed a "check list" consisting of knowledge inside the organization and those from external sources. In other cases a specialist or external expert may be hired into the project (like outsourcing). Throughout the project life cycle, for example, there are technical and functional problems. Technical problems are associated with the early phases of the project cycle namely initiation and planning/design that require a lot of research and obviously more time to interact with knowledge sources. The functional problems concern those encountered during project implementation.

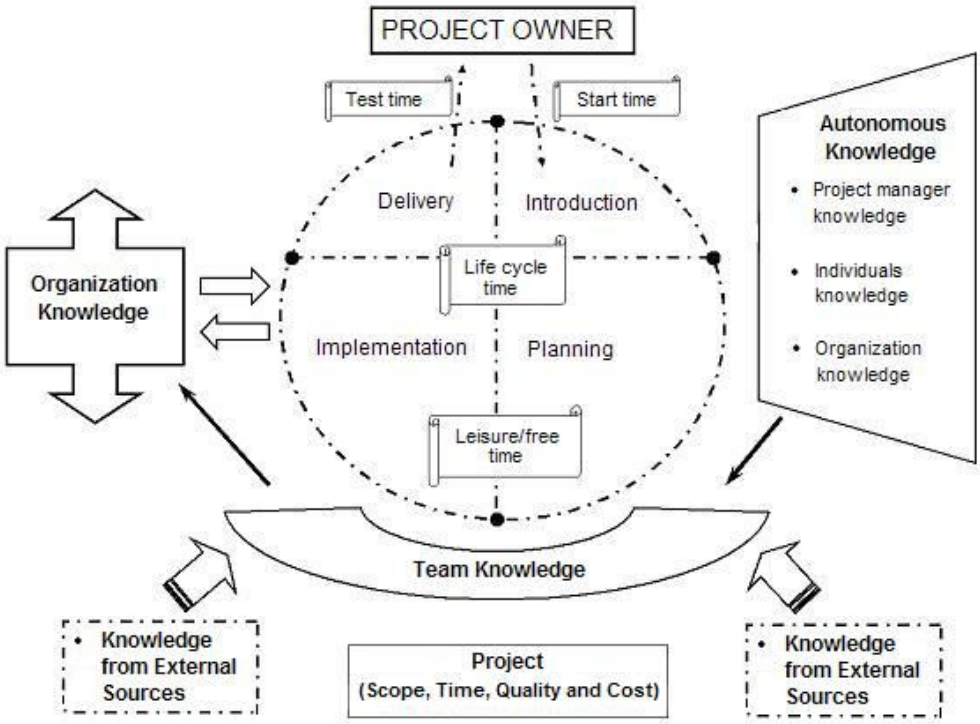


**Figure 3. Model of Time Orientations and Knowledge Interventions**

Although the projects and project organizations investigated are very different in terms of industrial context, type of products and technologies used, the model reveals striking similarities exist among projects that have implications for project management. The first is that all types of projects follow the same project life cycle. Although the phases of the project life cycle are given different names by various project organizations the same task is performed in all phases. However, unlike Juran's (1988) argument that the phases of the project life cycle should be accomplished step-by-step, this study recommends a simultaneous accomplishment of the project phases. Another empirical pattern identified concerns the issue of generating new knowledge within the project team at the time when it is needed. It is argued that, time must be integrated into the project plan by setting deadlines at which each phase of the project cycle should be completed and integrating existing knowledge to achieve each. In addition, the experiences of the managers reveal that things may always happen in the course of project work that the team is unable to resolve. Knowledge intervention is necessary to secure people with specific skills or previous experiences in working with strict deadlines.

## Conclusions

This paper addresses the subject of knowledge management in project-based organizations focusing on how time orientations and knowledge interventions can be integrated to improve project outcome. Existing literature shows that this subject has not been sufficiently explored. While a recent work by Reinmoeller and Chong (2002) presents a similar conclusion by integrating the time lens to a general model of knowledge processes, this paper explains the process by integrating time orientations into the project life cycle and illustrating how effectively knowledge interventions can be used to achieve different milestones and overall deadlines. In addition, while another work by Söderlund (2002) discusses the implication of

achieving different milestones and meeting overall deadlines, the theoretical model in this paper identifies the boundary conditions between and among the phases of the project life cycle and their implications on the requirements for meeting the overall deadline.

The method of integrating time orientations and knowledge interventions consist of four stages: define the project (mission, quality and budget) and project life cycle, identify the knowledge processes, develop ideal types of time orientations that enable these knowledge processes and establish a link between time orientations and knowledge processes in the project life cycle. These facilitate effective structuring of an organization's learning process in a way that involves all team members, and minimize the time to achieve pre-stated or superior objectives with available resources. Time orientations are shown to have a direct non-linear relationship with knowledge interventions, and the extent of this relationship is limited by the budget and scope of the project. Based on the empirical analysis, it is concluded that integrating time orientations and knowledge interventions is an important source of knowledge management in project organizations (Reinmoeller and Chong 2002, Söderlund 2002). The project manager is the architect of success in the outcome of a project. In addition to understanding the implications of time orientations and the limits of wide-range knowledge interactions, the project manager must trust and implement a culture of knowledge sharing and consensus decision making within the project team. Brainstorming, improvisation, support from higher management and the use of external networks are measures that could be used to handle unforeseen events that may prevent successful and timely delivery of project.

During this research a number of issues were encountered where further research could be performed. Interviews were limited to Swedish and Italian project managers who are living and working in Sweden and Italy respectively. Despite their international academic and professional experiences, it is possible that milieu, religion and other national characteristics in their countries might have affected their perceptions and interpretations of working with projects. Therefore a comparative study could be conducted with organizations in different countries. Secondly, during the survey, respondents were not asked to discuss the actual effects of different time orientations and knowledge interventions on the success/failures of projects. An interesting research is therefore to apply the theory to specific projects and project-based organizations to test its applicability. Thirdly, this paper has approached the subject of knowledge management in project organizations from the project manager's point of view. It could be interesting to study the perceptions of subordinates – project team members – on the same subject. Switching perspective in this way can lead to more interesting insights on knowledge management in project-based organizations.

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