

Lectio praecursoria: The Interaction of Organisational Structure and Humans in Knowledge Integration

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Resting on the postulate that the process of Requirements Engineering is a process of Knowledge Integration among project members originating in different functions/ departments/ domains of an organisation, impediments to the smooth development of large scale applications that have domain spanning character are examined. Enterprise Resource Planning (ERP) and Management Information System (MIS) applications are representations of these kinds of applications; their development is studied here.

FRAMEWORK ELEMENTS

During the late eighties as reaction to the increasing competition originating in globalisation and the related need for western-industrialised nations to move from production of goods and services to creation of innovation. In due course of this, it became apparent that innovations are rather hard to develop and that there are many impediments.

One set of impediments is originating in the ubiquitous division of labour, as it common since the early days of industrialisation. Another set of impediments is identified in the very mode of project organisation and management. Innovation projects (but not only these) are prone to 1) lack of communication among sub-projects due to the project organisation style, 2) missing interaction among sub-projects, even if they are interdependent to each other, and 3) problems of Knowledge Sharing and understanding. As a result of weaknesses of project management it has been suggested that a coherent approach to these obstacles is required: **Knowledge Integration** (KI).

On a more abstract level, KI is defined as the "generation of disciplinary independent knowledge that is resting on the capability of project members to express knowledge in disciplinary independent ways". Some authors have suggested that Knowledge Integration is a process of "learning" based on this characteristic. On the level of project management KI sets out a program of close interactions among the different sub-projects, thus also the intra-organisational boundaries become more fluent.

Requirements Engineering is part of the overall process that guides to the development of Software applications in general. It comprises the elements of elicitation, modelling and analysing, communication, and agreement of requirements. This interactive process is dependent on knowledge from the project contributors originating in the different domains. Research results of the last six decades indicate that exactly this knowledge communication and understanding is the right "Achilles heel" of Software development. The left "Achilles heel" is identified in the problem of how employees cope with these ERP and MIS applications. ERP are improving, from a managerial point of view, organisational task execution.

Innovations are considered as "[...] a social transformation in a community" a strategy for analysis is required, that starts at the end of the innovation cycle. As projects are agreed to be organisational activities, it has to be recognised that they are not happening in a "vacuum". Thus the question has to be asked: Are result expectations and organisational structure negative impacting on Knowledge Integration?

Organisational structure is defined as a frame that informs how the different domains

in an organisation are interacting. Organisation is understood as body set-up to execute a given task on a continuous basis to achieve a given (organisation internally defined) goal. Organisation is the frame within in which a certain activity is performed.

Different forms of organisations are known. Each of them has dedicated, standardised rules how the different domains interact to achieve goal attainment. Organisations are distinguished into the horizontal and vertical division of labour. Within the forms, domains perform their tasks almost independent from each other. Intention is the achievement of domain oriented maximum performance under minimisation of interfaces and -actions.

Parallel to this division of labour it can be observed that organisations are subjected to different knowledge sets, which coincide with vocational and academic secondary socialisation. But if this is the case, the question is coming up: What is happening in innovation development? - The root for the question of how the innovation process can be improved. Dedicated sets of behaviour seem to include the definition of "in-" and "out-groups".

ERP applications are means by which process autonomy is taken away from domains in favour of closer process integration with others; the transparency of the overall process is increasing. This transparency is achieved by the logic of a "workflow-machine" that is integral part of this type of software. ERP applications represent "toolboxes" that are partially open for changes defined in the process of Requirements Engineering. These applications require during development interactions of previously almost autonomous domains. ERP applications can reduce levels of autonomy of staff, too. This happens often in order to achieve economies of scale in respect to supervision, and better control of the different domains. From a managerial point of view ERP are innovations, because they guide to "a social transformation in a community".

METHOD

RE is analysed as a process that it is similar to Knowledge Integration.

The empirical case is based on data that was gathered with "mixed- method- approach".

Methods used are quantitative questionnaire and semi-structured interviews. These two tools encompass questions resulting from a content analysis of literature streams as they pertain to Knowledge Integration -they form the framework. Developed methods are applied in organisations of the public and private sector in Finland and Germany.

The methods reflect the second research question, which asked: Can general models- a framework/ theory- be developed that explain the occurrence of difficulties in Requirements Engineering and Knowledge Integration?

DATA

In the *Finnish case* due to cultural effects, Requirements Engineering seems to be less affected by organisational structure than expected. This finding holds true for both sectors, and this even though that the organisations examined are structured in a line/ functional manner with a typical top-down decision making process. Projects are managed by modes that reflect the overall division of labour that is structuring the organisations. Requirements Engineering is subject to constrains in its quality that originate in the division of labour. Evidence for dedicated knowledge and language sets specific to each domain can be found. The mode of coordination of the ERP project has effects on the quality of the design. Employees report delays and rework as result of missed alterations of scope or design decisions that were made in other sub-projects. The exchange of information and knowledge across sub-projects seems to happen, because work results are perceived to be owned by the employing organisation. This does not mean that all information and knowledge is shared; rather respondents' information and knowledge exchange behaviour is oriented to expectations of understanding on the side of the recipient. This behaviour is shared across both sectors.

Employees' in the project do not necessarily understand the aims that are attached to ERP and MIS applications from a managerial perspective. A base line of resistance can be detected. The openness of the information exchange across domains and hierarchies seems to lower the pressure onto RE process. It is an interesting

phenomenon that the co-representation of the ICT domain on the board of either organisation with other domains, on the one hand seems to increase information and knowledge shared across domains. On the other hand, this co-representation seems to foster exclusionary tendencies of certain domains.

In the *German case* two extremes of the Requirements Engineering process become apparent. Representations of different knowledge and languages sets per domains are discovered, too, and affect the project work. A functional oriented project management style is applied in the private sector. There not only information and aims given by management are open for interpretation, but also those received from colleagues in similar ranks originating in different domains. While all domains are included in the Requirements Engineering process, these outputs are not checked for integrity and interdependencies among the contributors. Respondents in the public sector report fewer difficulties with incoherent requirements, and rich interaction among interdependent sub-projects due to an integrated management approach. They agree that knowledge and language differences exist, but these are not affecting the communication within the project, because a "neutral language" is used. This language does not allow for communication with project outsiders, if information and knowledge has to be obtained from there. In both sectors information and knowledge is possessed by the organisation, and has to be exchanged within the overall organisation. However, respondents in either sector subject this exchange to implicit rules of doing so. These rules consider the rank and domain belonging of the recipient. Respondents are dissatisfied with the information they obtain a) because management is not to happy if domain specific information is circling in the overall organisation, and b) in the private sector on top the information exchange is oriented to peers and how these perform the information exchange. In the public sector the information exchange is oriented in line with modes of internal coordination of the domain of origin. Project members subjected to top-down decision-making and low information exchange department internally, will show the same behaviour in the project.

The negative impact of ERP onto Knowledge

Integration in Requirements Engineering becomes more apparent in the private sector. Data indicate that resistance to domain spanning applications is originating in the fear of operational staff to use an application that contains errors. In the public sector respondents in general do not report about a dedicated resistance form when interviewed. However, some respondents see staff negative affected by the implementation, and ask how these members can be motivated to take part actively in the design. Design is considered as a pioneer work in the municipal sector of the land (Bundesland), so a high cohesiveness of staff can be achieved, and seemingly minimise resistance.

ANSWERING RESEARCH QUESTIONS

Over viewing the total data, and answering the question whether Requirements Engineering is a similar activity as Knowledge Integration for innovation development, ample evidence can be seen. The framework developed, and operationalised via the questionnaire and interview questions, allows showing that both project settings are affected by domain specific knowledge and language sets. These sets are reinforced when projects are managed with division of labour reinforcing means.

Considering the second part of the third research question "Whether organisational structure has a negative impact onto Knowledge Integration" the answer should be a yes in principle, but there are varying degrees.

In the Finnish data project members can circumvent the expected negative outcomes. This seem to happen based on a general proximity of knowledge and language sets held by project peers of similar ranks on the vertical division of labour. They hold themselves accountable against a project aim that is shared among them, and used as a device for deriving sanction power over each other. Respondents report about consciously withheld information etc. This mode of behaviour is reminiscent of domain specific attitudes. These findings are reinforced by the German data, in particular from the private sector. Domain specific languages and knowledge sets are transported into the project setting. Information exchange within the project is oriented towards rank and domain

belonging of the recipient. On top it is based on the anticipation of how much information about the domain can be given to "outsiders". Management is afraid that too much information "flows" in the overall organisation about "their" domain. The public sector in Germany is a special case as there the integrated project management style is applied. This mode of coordination seems to ensure that information is trickling from project management to the sub-projects, and is there coordinated for its meaning and impact. Problems of communication are overcome by relying on the artificial language of the application that is designed- partially a knowledge integrative activity. In either country the information exchange happens as result of a implied moral obligation.

A negative impact of result expectations onto Knowledge Integration in the projects can be faintly discovered. It seems as if the data gathering tools were here not sufficient detailed. However, in the Finish data and German private sector data, there are chains of evidence that suggest that lack of information about the expected outcome impacts on employees acceptance of these applications. In the German case, this chain could be said to be prototypical worked out. Project staff that is behaving in line with domain standards, and rather inexperienced in multidisciplinary work tries to communicate its knowledge to others but is incapable to do so. In turn an application is developed, which is characterised by error, which increases operation staff's resistance to use this application.

CONCLUSIONS

Taking the overall Finnish data as a benchmark for conclusions to be drawn, three main ones are lined out:

Management guides with its behaviour in respect to information sharing. If an open information exchange and interactions among project members is desired, management has to act as role model. Employees' orient their behaviour to them. Furthermore, the way in which management of a domain speaks about "others" will affect employees' behaviour.

Employees in innovation projects seem to be subjected to conflicting work tasks. On the one hand they are part of their domain, thus have to seek to keep in contact with their peers. On

the other hand they have a responsibility to the overall organisation, as they are working in the project. Seemingly employees have to balance themselves as person between two very different sets of expectations. This balancing process seems to be a part of the actions that are happening in due course of Knowledge Integration on an individual level. It adduces evidence to the notion that Knowledge Integration is a process of learning. Shared aims seem to support this balancing process.

Requirements Engineering is not just about the process itself and how well information and knowledge is communicated. Data indicate that RE is subjected to two very different push effects. One push seems to originate in the knowledge that is held in a society in general, and in domains as result of the division of labour in particular - cultural values are coming into effect. Another push taking its root in culture, defines how management, as a cultural output, thinks that organisations should be designed.

This study as a contribution to Administrative Sciences goes well beyond traditional boundaries of the discipline. While it considers the key terms of Administrative Sciences: Structure, Processes and Humans it sets-out linkages to topics like innovation generation and Software development. By appreciating the individual human, in its interdependency with its environment, as the sole source of actions in organisational settings the study shows, that structures have consequences which are not always in line with expectations. Structures and organisational aims seem to be in need to be re-evaluated every now and then against each other, by looking critically at the expectation management has and how all three elements are aligned to each other.

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