ENHANCING DATA EXCHANGE AND MANAGEMENT SUPERVISION IN A COMPLEX MESH OF SUBCONTRACTORS

A Theoretic Approach to Counter Interface Issues in Micro-, Small- and Medium-sized Enterprises

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Abstract: Modern companies face quickly changing demands of customers, selling conditions, and a high fluctuation of employees because of global competition. Frequently, firms recruit subcontractors and freelancers to handle short-term bottlenecks and to acquire know-how. Because of various interfaces and internal structures and a complex mesh of responsibilities between all participating teams, the exchange of information and data is highly sophisticated. This paper describes the current situation of most small and medium enterprises that co-operate with subcontractors and, hence, face empirical problems. Key features and demands for a possible approach are shown to solve these issues with a minimum effort on existing systems and processes.

1 INTRODUCTION

Modern companies need differentiation against competitors. Customization of products and increased flexibility is essential in order to survive on the market. Because of quickly changing situations, firms have to act and react expeditiously.

Because of short-term commitments, bottlenecks in in-house capacities are generated. It is often necessary to access external expertise and knowledge or a geographical area with growth prospects. Additionally the overall process is slowed down by financial issues (e.g. cost-cutting strategies) or the need of specialized equipmend and skills to manufacture either finished products or unique components (Berry, 1997).

Companies frequently adress these issues by recruiting subcontractors. These sucontractors are mostly freelancers, micro-, small- or medium-sized enterprises, which are directly connected to the companies' processes and interact with various departments simultaneously.

That causes a lot of problems according to the overwhelming amount of information and digitally stored data that has to be managed within those alliances.

This paper describes the current situation of most SMEs (Small and Medium Enterprises) that co-operate with subcontractors to adress empirical problems. A possible approach is presented to solve these issues with a minimum effort on existing systems and processes.

2 INFORMATION DEPLOYMENT

Currently, modern SMEs mostly spread information via proprietary EIS (Enterprise Information Systems). They spend a huge amount of money and time for customization of the processes that are tailored to the overall management tool. The problem is that the subcontractors usually do not have an EIS from the same vendor, which means that they have to customize an interface between the different systems. Because the bottlenecks and commitments are short-term, it usually makes no sense to work on this problem; they simply transfer the needed data and information via FTP-Servers (File Transfer Protocol) or regular e-mails.

Generally, even if an EIS is used, data is stored on local computers or on centralized servers as these modern tools are not always strictly used. Often, no

data management software is used at all and users spend a significant amount of their working hours to search and share information.

Of course, if the mesh of participating team members becomes more complex, this problem becomes more significant to the overall processes and the end results.

The possibility of saving time and money by developing an adequate solution is generally ignored because the current way of data and information exchange does—surprisingly—work. The managers often only realize the tremendous impact of this problem when it is too late.

The fear of managers to implement a sophisticated EIS is grounded in the idea that the outcome of the entire process may not be worth it. Their fears are justified as 44% of projects are late, over budget, or partially successful. Sometimes the results are any combination of these three elements, but data shows that 24% of all implementations fail (Standish, 2009).

2.1 Mesh of Subcontractors

OEMs (Original Equipment Manufacturers) often involve their subcontractors into their supply chain by creating a subcontracting chain as part of the overall manufacturing process on a long-term basis (Lehtinen, 2001). In this case, the subcontractor is highly involved in the contractors' processes. If the subcontractor fulfils a vital part of the supply chain in production, then the EIS for both the subcontractor and the contractor is usually the same. Hence, there are generally no interface issues.

A *Mesh of Subcontractors* is created when various companies are involved in the same project or alliance, as shown in Figure 1. In this case, every company is involved in one overall process but utilizing a different EIS. The small arrows show the connections between the different users. The users' responsibilities can vary during the on-going process. For example, a project leader of the contracting company can be a subordinate team member of the subcontractor's firm for a certain part of a process. As those alliances are usually based on short-term commitments, no expensive interfaces and customizations can be designed.

The subcontractors' position is hard to define as they can be involved in various processes and projects simultaneously. They can act as go-betweens for users and SMEs. One subcontractor can be responsible for a certain task which is bonded to another subcontractor's and user's task at the same time.
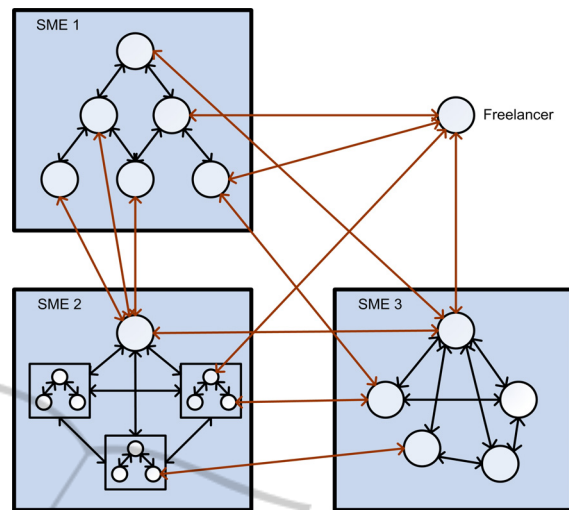

Figure 1: Mesh of Subcontractors.

Every user in Figure 1 can be a contractor and subcontractor simultaneously. Hence, a mesh of subcontracting parties is created. Often, this situation has to be addressed by complex processes were a continuous exchange of data and information is required.

Mesh of Subcontractors will be used as a new definition for this work. Previous studies defined the relationship between one company and another company as subcontracting. For this approach, each single connection between one user and another is considered subcontracting.

The definition of the connections can vary during the on-going processes and steps of the product lifecycle. For example, frequently the subcontractors' positions cannot be rigidly defined. Therefore a flexible process is created.

2.2 Current Problems in SMEs

The following subchapters show current problems within subcontracting alliances as a basis for a new approach which were analysed based on previous surveys and interviews with SMEs that address the mentioned issues.

2.2.1 No Data-management

Currently, required data is often pushed from one to another via e-mail or FTP-Servers. There is often no encryption used as the users have neither the understanding of the risk to data security nor the specific knowledge to implement protection.

2.2.2 Missing Responsibilities

Every involved company has its own hierarchy. The diverse responsibilities of integrated subcontractors are often not obvious and can lead to several problems. Often, employees without a leading position can be in charge for a subtask of a certain area within the process. Hence, non-leading employees can be contractors in this specific case.

2.2.3 Sophisticated Task-allocation

Because of various niche areas of complex processes, tasks need to be shifted to subcontractors in order to obtain solutions and results.

Single subtasks can get lost due to short-term employment relationships and a mismanagement of subcontractors. The missing data-management hampers the task-allocation to the needed experts.

2.2.4 Slow Management Interaction

Due to a lack of time and overview of the on-going processes, managers often do not have the needed insight to determine the current state of the project.

Another reason for the lack of management interaction is the increasing amount of involved people and data.

For this reason, the supervision of processes is getting ever more complicated. Subordinate staff have to deal with situations were improvisation can lead to a loss of quality.

2.2.5 Data Safety

Large enterprises make extensive efforts to ensure data safety. These companies purchase expensive and complex tools with effective encryption capabilities to protect sensitive data. Employees then participate in mandatory training on how to use and apply these tools.

Unfortunately, SMEs frequently disregard this issue because of extra costs to the company and a general lack of knowledge about the consequences of compromised data.

2.2.6 Costs of Tools

The direct comparison of license proposals is challenging because the models are so different that it is difficult to distinguish common aspects between the tools to assist in making an effective comparison (Adelsberger, 1995); (Zarnekow, 2006).

That frequently leads to license-sharing.

2.2.7 Overall Time Schedule, Management

Time schedules involve a high risk potential. If milestones in roadmaps are not met, a sub-process can emerge to a tremendous issue of the overall process. Subcontractors frequently get short-term delivery dates, several days in advance of the milestone to avoid time issues.

The lack of time leads to careless mistakes often due to poor time management. The worst case scenario, for example, may be when a one-week milestone is a one-day job for the last subcontractor, as the superordinate levels need several steps within the process to edit the results.

2.2.8 Proprietary Tools and Interfaces

Communication and data exchange via a variety of proprietary tools is still not easy to handle. Adjusted solutions, which are often based on out-dated operating systems and databases, are not designed for easy communication and interaction with other software.

As the customization of EIS interfaces seems to be insuperable for short-term alliances, widespread files are used to exchange information and to work on corporate processes associated with the aforementioned problems.

3 EMPIRICAL METHODOLOGY

The analysis is based on previous surveys from Bramorski (2008), and Al-Hammad (2000), and publications within the EIS industry about the corresponding problems on realized projects.

As the focus of previous research was on the overall EIS and general interfaces among the companies rather than the single connections on the spanning mesh, the obtained conclusions had to be expanded and interpreted from a new perspective, combined with personal experience adding support to the interpretation.

The mentioned problems in a *Mesh of Subcontractors* were discussed and analysed in a variety of companies that try to handle those issues without a big investment on complex EIS.

4 RESULTS

The key results of the research were analysed to determine if a deviation would allow for the needed interfaces to be created for the *Mesh of*

Subcontractors. In order for such a new tool to serve the function for which it was created, it must meet the following criteria to enhance the management of data exchange and security:

- simple and secure,
- affordable,
- implementable,
- non-complex communication,
- clear responsibilities,
- unsophisticated task-allocation, and
- quick interaction of management.

4.1 Simple and Secure

Not every employee is an enthusiastic software user. Because of frequently changing hardware, software, updates, etc., many users are overwhelmed with the technical aspects of their job. Data security must be automated without special software or extra steps.

4.2 Affordable

Because of the overpriced costs of the majority of EIS, firms frequently use only a single license for the entire team or company involved in order to save money. As responsibilities are bonded to various tasks and datasets, this approach is not possible in a *Mesh of Subcontractors*.

4.3 Implementable

Hardware and software compatibility may become a major issue within a *Mesh of Subcontractors*. Short-term relationships often need to be established very quickly when expert knowledge is urgently required. However, arranging these relationships is difficult as implementation of EIS and other data management and exchange tools slows down the overall process.

4.4 Non-complex Communication

No matter which tool is in use, digital firms generally use quasi-standard e-mail software for any kind of communicating and exchanging information. Even the state-of-the-art chat-tools used in some modern companies cannot replace verbal communication (Vintean, 2008).

4.5 Clear Responsibilities

Hierarchies within the overall process are not generally obvious. The development of complex relationships can change an individual's responsibilities in the overall process. Often,

organizational charts are not updated as roles change frequently.

To complicate the issue, every involved company has its own hierarchy as shown in Figure 1. Subcontractors integrated into the company may have diverse responsibilities that make their role in the process opaque. Also, it is not unusual for an employee without a leading position in a company to spearhead a subtask of a specific area.

4.6 Unsophisticated Task-allocation

Involved team members shift tasks back and forth in a not-so fluid process to accomplish the overall goals. Complex processes and products need the input of various experts in niche areas. Frequently, the need for a specialist's advice arises suddenly. New employees and subcontractors need to be incorporated quickly when the need for this specialized knowledge or skill is short-dated.

4.7 Quick Interaction of Management

Frequently, managers and top managers are smothered with paperwork and obligations so that their time schedule has no gaps. There is little time available to troubleshoot big issues and to interact with project leaders.

Due to a lack of time and understanding of the on-going processes, managers often do not have the needed insight on the sub-processes.

Subordinate staff members have to perform in these situations. At times the pressure to perform causes users to improvise solutions to the problems of managing and exchanging data and information. However, this type of improvisation is prone to human error, which often leads to a loss of quality.

5 CONCLUSIONS AND FUTURE RESEARCH

In order to enhance data exchange and management supervision in a complex *Mesh of Subcontractors*, a new tool needs to be simple and secure. For example, it has to be self-explaining in its usage and should not replace regular quasi-standard e-mail software. A user-friendly copy of e-mails to a web address could assure the ability to trace the source of data, information, and errors within the data-exchange process. This improves and addresses the issue of quality assurance without affecting the daily used standard processes.

Micro enterprises, small subcontractors, and freelancers are frequently involved in various projects by different contractors. The goal is to include the communication into the new method. If an extra step, such as to save communications between users or to disseminate new information to users, is necessary, then people will soon start to avoid the tool or use it thriftily. Users need to be able to use the tool without purposefully using it. Plug-ins to the standard e-mail software would solve this issue.

License costs should also be reasonable to implicitly avoid the sharing of accounts.

To address the compatibility issue stemming from the various hardware and software in use at the participating firms, the tool must be independent of operating systems. Hence, a web-based tool would be the fastest available solution without any implementation at all. Interface issues because of proprietary EIS would become obsolete. The main contractor could implement the web-based tool into the used EIS and its databases; the subcontractor could use the web-based software to manage and share information and data for a specific project with the contractor; and files commonly used within a project could be stored within the web-based software for easy retrieval by subcontractors who need access to the information quickly.

Also, overall time schedules need to be accessible through the new tool without confusing Graphical User Interfaces (GUIs). Overall, the responsibility for a task or project needs to be allocated appropriately and clear at any time. For example, if a task is created, then it needs to be assigned to a person, who then is in charge until the task is complete. In addition, the organizational chart for each process must always be up-to-date and clear at any given time.

Tasks, as part of processes always need to be "owned" by somebody in order to avoid mistakes (Burnickl, 2010). For this reason, an unsophisticated task-allocation tool is essential. If a task is processed by a variety of involved team members, there must always be the "task-owner" that leads the management of the single step in the process. This clarifies a user's role and responsibility in the process to all interested parties.

Reports and evaluations are gaining more and more importance for leading personnel. The current state of the projects and processes needs to be present and easy to inspect. Visualized status reports, such as the traffic light principle or status bars, can easily indicate the current standing of tasks and overall projects. This report will support managers and leaders in their supervisory roles. A quick intervention is possible when responsibilities are clear.

As networks are getting more complex and short-dated through the vicissitude of the market, this topic provides sufficient reasons for deeper research. The single connections and interfaces of team members over an overall *Mesh of Subcontractors* need to be considered for future studies, as many issues arise due to sweeping approaches.

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