A FIRST APPLICATION OF A COLLABORATION MATURITY MODEL IN THE AUTOMOTIVE INDUSTRY

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Abstract: Trends like globalization and increased product and service complexity have pushed organizations to use more distributed, cross-disciplinary, cross-cultural, virtual teams. In this context, the quality of collaboration directly affects the quality of an organization's outcomes and performance. This paper reports on the first field application of a Collaboration Maturity Model (Col-MM) through an automotive industry field study. This model was empirically developed during a series of Focus Group meetings with professional collaboration experts to maximize its relevance and practical applicability. Col-MM is intended to be sufficiently generic to be applied to any type of collaboration and useable to assess the collaboration maturity of a given team holistically through self-assessments performed by practitioners. The purpose of the study reported in this paper was to apply and evaluate the use of the Col-MM in practice. The results should be of interest to academic researchers and information systems practitioners interested in collaboration maturity assessment. The research contributes to the collaboration performance and (IT) project management literature, theory and practice through a detailed case study that develops artefacts that provide evidence of proof of value and proof of use in the field.

1 INTRODUCTION

Organizations form to create value and products that individuals cannot create alone (Mintzberg 1979). To ensure their organizational performance and competitive advantage it is thus critical for organizations to achieve successful collaboration (Clark and Fujimoto, 1991; Hansen and Nohria, 2004). In today's increasingly unstable and competitive socio-economic environment, trends like globalization and increased product and service complexity have pushed organizations to use more distributed, cross-disciplinary, cross-culture, virtual teams (Chudoba et al., 2005). In this context, the quality of collaboration directly affects the quality of an organization's outcomes and performance (Jordan et al., 2002; Banker et al., 2006). This means that the disposition and capabilities of an organization's work force to collaborate will directly affect organizational performance, productivity and profitability (Frost and Sullivan, 2007; Hansen and Nohria, 2004).

It is important for organizations to assess the quality of the collaboration in their teams. This will enable them to identify measures to improve collaboration by better selecting and designing the appropriate collaboration technologies (IT/IS) and therefore to improve the management of their virtual teams and projects. This requires organizations to answer questions such as: Under what conditions do teams collaborate better? Are there different levels of collaboration quality that can be recognized and that teams should aim for? To what extent should management styles be taken into account? Which role should collaboration technologies play to foster effective collaboration? How can we measure the impact of collaboration on organizational performance?

Several studies propose models and methods for collaboration assessment from different points of view: collaboration processes (see e.g. Pinsonneault and Kraemer, 1997; Den Hengst et al., 2006) or collaboration technologies and their usage (see e.g. Damianos et al., 1999; Pinelle and Gutwin, 2003;

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Herskovic et al., 2007). One way to assess the overall collaboration quality of teams is through maturity model approaches used extensively in quality assurance for product development (Fraser et al., 2002). Using these types of models as an assessment instrument helps an organization to identify best practices and trouble spots, and to stimulate discussion among practitioners to initiate activities for continuous improvement (Fraser et al., 2003). However, few efforts have been reported on using maturity models to assess collaboration. Those that have are limited in that they apply only to certain domains or just cover a few phases of the project life cycle (Daoudi and Bourgault, 2007).

This paper reports on the first field application and evaluation of a Collaboration Maturity Model (Col-MM) in an automotive industry for assessing a virtual team distributed in two European countries. The purpose of the study reported in this paper was to apply and evaluate the use of the Col-MM in practice. Col-MM was empirically developed through a Design Science perspective approach (Hevner et al., 2004) during a series of Focus Group meetings with professional collaboration experts to maximize its relevance and practical applicability (Boughzala & Vreede, 2012). It was intended to be sufficiently generic to be applied to any type of collaboration, virtual or not (e.g. project teams, organizational teams, cross functional/organizational teams, inter-organizational team, or communities of practice) and useable to assess the collaboration maturity of a given team holistically by practitioners for conducting self-assessments.

The remainder of this paper is structured as follows. We first introduce the methodological background related to maturity models in general and the Col-MM in particular. Next, we report on the application and the evaluation of the Col-MM in a field study in the automotive industry. Last, we discuss the appropriateness and usefulness of Col-MM, followed by our conclusions which summarize the limitations of this study and present future research directions.

2 BACKGROUND

Maturity, literally meaning ‘ripeness’, describes the transition from an initial to a more advanced state, possibly through a number of intermediate states (Fraser et al., 2002). The fundamental underlying assumption of maturity models is that a higher level of maturity will result in higher performance. Maturity models reflect the degree to which key processes or activities are defined, managed, measured, and executed effectively. They typically describe the characteristics of an activity at a number of different levels of performance (Fraser et al., 2003). “*At the lowest level, the performance of an activity may be rather ad hoc or depend on the initiative of an individual, so that the outcome is unlikely to be predictable or reproducible. As the level increases, activities are performed more systematically and are well defined and managed. At the highest level, ‘best practices’ are adopted where appropriate and are subject to a continuous improvement process*” (Fraser et al., 2003 p.1500).

2.1 Maturity Models

Approaches to determine process or capability maturity are increasingly applied to various aspects of product development, both as an assessment instrument and as part of an improvement framework (Dooley et al., 2001). Most maturity models define an organization’s typical behaviour for several key processes or activities at various levels of ‘maturity’ (Fraser et al., 2003). Maturity models provide an instantaneous snapshot of a situation and a framework for defining and prioritizing improvement measures. The key strengths of maturity models include:

- They are simple to use and often require simple quantitative analysis.
- They can be applied from both functional and cross-functional perspectives.
- They provide opportunities for consensus and team building around a common language and a shared understanding and perception.
- They can be performed by external auditors or through self-assessment.

One of the earliest maturity models is Crosby’s Quality Management Maturity Grid (QMMG) (Crosby, 1979), which was developed to evaluate the status and evolution of a firm’s approach to quality management. Subsequently, other maturity models have been proposed for a range of activities including quality assurance (Crosby, 1979), software development (Paulk et al., 1993), supplier relationships (Macbeth and Ferguson, 1994), innovation (Chiesa et al., 1996), product design (Fraser et al., 2001), R&D effectiveness (McGrath, 1996), product reliability (Sander and Brombacher, 2000), and knowledge management (Hsieh et al., 2009). One of the best-known maturity models is the Capability Maturity Model (CMM) for software engineering (based on the Process Maturity

Framework of Watts Humphrey, quoted in Paulk et al., 1993), developed at the Software Engineering Institute (SEI). Unlike the other maturity models, CMM is a more extensive framework in which each maturity level contains a number of key process areas (KPAs) containing common features and key practices to achieve stated goals. A number of studies of the software CMM have shown links between maturity and software quality (e.g. Harter et al., 2000). This model (with multiple variations) is widely used in the software industry as part of quality certification (SEI Certification).

Nowadays several maturity models have been proposed that aim at clearly identifying the organizational competences associated with best practices (Fraser et al., 2002). In practice, however, many maturity models are intended to be used as part of an improvement process, and not primarily as absolute measures of performance (Fraser et al., 2002). Few maturity models have been validated in the way of performance assessment. An exception is Dooley et al.'s (2001) study that demonstrated a positive correlation between New Product Development (NPD) process maturity and outcome.

A few maturity models related to collaboration have been proposed. Lebrun et al.'s (1998) model defined maturity levels of concurrent engineering in a virtual company. Their model emphasizes the management of new products and processes in temporary collaborative projects. Fraser et al.'s (2003) model is intended to apply to all product development activities; it is not restricted to software products. Their model gives particular importance to organizational-level collaboration between partners in a product development network. Finally, the model by Ramasubbu et al. (2005) focuses on distributed software development. It represents an effort to fill the gap in models like CMM by introducing several dimensions related to collaboration in distributed development settings.

Each of the above collaboration maturity models is founded on the assumption that the quality of a product is related to the quality of the collaboration process. The value of each of the models is that they emphasize and raise awareness on the issue of collaboration maturity in an organizational setting. Notwithstanding the individual strengths of each of the above models, a number of key limitations exist. First, few applications have been reported (limited information on their model in practice) and reported ones have not been validated empirically (Daoudi and Bourgault, 2007). Second, their application is specific for only certain types of collaboration (e.g. inter-organizational, virtual organizations, or distributed projects), for certain application domains, or for certain project life cycle phases. Third, most models are descriptive in nature, helping to identify collaboration-related problems without proposing solutions. Finally, little is known about whether the use of these models leads to actual performance improvements.

2.2 The Design and Structure of the Collaboration Maturity Model

In the literature, collaboration has been defined in different ways (Levan, 2004; Briggs et al., 2006; Boughzala, 2007). In the context of this study, we define collaboration as a process in which two or more agents (individuals or organizations) share resources and skills to solve problems so that they can jointly accomplish one or more activities. During this process, the agents communicate with each other to coordinate their tasks. Based on this definition of collaboration, we define collaboration maturity as a team's current maximum capability to collaborate where team members effectively communicate, reach shared understanding, and adjust their tasks and behaviours to produce high quality outcomes.

The main objective of our research is to introduce a new collaboration maturity model that addresses some of the limitations described above. This model aims to holistically assess the collaboration maturity of a (virtual) team that uses several collaboration technologies. However, its applicability is not limited to a particular form of collaboration and the model can be used for different settings. Further, it supports the development of recommendations in form of an action plan to reach improved project management, collaboration performance and quality of collaboration outcomes.

The Col-MM was designed during a design science study in which we cooperated with a Focus Group consisting of professional collaboration experts. These experts included 15 Chief Knowledge Management Officers (CKMOs) from companies of different sizes in different sectors, holding at least a master-level degree from different areas, and having at least 15-19 years of work experience with 50% of them having 5-9 years as a CKMO. Their average age was 48 and 73% of them were male. They were accustomed to meet in the context of a business association to share their best practices regarding methods, techniques and tools in the collaboration and knowledge management area. The involvement of the experts group enabled us to combine relevance and rigor by meeting a business need with applicable knowledge and so to maximize the resulting artefacts' relevance and applicability. The experts expressed the following critical requirements for the Col-MM:

- **Resource Efficient:** The Col-MM should be fast to complete.
- **Rich Data:** The Col-MM should report on different points of view and concerns from the workplace, using both quantitative and qualitative data.
- **Limited need for Further advanced Data analysis:** The supporting tool should provide integrated support for results interpretation.
- **Self-assessment:** Practitioners should be able to apply the Col-MM themselves.
- **Constructive Learning:** The Col-MM should promote team building and organizational learning rather than control and sanction.

After a series of meetings with the Focus Group in which several initial versions of the Col-MM were presented and pilot results were shared, the first full version of Col-MM was completed (Boughzala and Vreede 2012). The Col-MM consisted of a number of artefacts including: The Col-MM structure that describes the collaboration areas of concerns (topics) and their related criteria; The Col-MM questionnaire that includes questions, levels of rating and mathematical equations for analysis; The Col-MM method that (a) defines the steps and provides guidance on how to run the Col-MM questionnaire in the field, and (b) supports the development of recommendations; and the Col-MM tool which is a customized MS Excel application that represents the implementation of the above artefacts, and enables the execution of a concrete assessment by enabling the collection and analysis of quantitatively and qualitatively questionnaire data. It provides different presentations of results (e.g. individual and team spider diagrams, comparison curves, and cloud matrices) and the results' report generation.

The Col-MM distinguishes between four maturity levels: Ad-hoc, Exploring, Managing, and Optimizing. At the Ad-hoc level, teams are collaboratively immature. Individuals have many difficulties to communicate effectively, to reach shared understanding, and to adjust their tasks and behaviours to produce high quality outcomes together. At the Exploring level, teams are well aware of their weaknesses in terms of collaboration quality. Individuals try work together to produce valuable outcomes, but are faced with many collaboration challenges. Some initiatives to address these are attempted but without major impacts. At the Managing level, individuals are able to produce collaborative outcomes of good quality. They have overcome many challenges to collaborate productively, but there still is room for improvement. At the Optimizing level, teams are collaboratively mature. Teams work together optimally and accomplish high quality collaborative outcomes. Furthermore, they engage in critical self-reflection and continuous improvement efforts.

The Col-MM explores the maturity of a given team holistically from different perspectives related to collaboration. The following perspectives, or areas of concerns, were considered essential by the participants in the Focus Group meetings (Boughzala and Vreede, 2012):

- **Collaboration Characterizing:** This covers the characteristics of the collaboration.
- **Collaboration Steering:** This covers the way in which collaboration processes and activities are managed.
- **Collaboration Processing:** This covers how actors perform collaboration on a daily basis.
- **Information and Knowledge Integration:** This covers how actors manage the information and knowledge required for productive collaboration.

Table 1: Col-MM areas of concerns and criteria.

Areas of concern	*Criteria*
Collaboration Characterizing	1. Collaboration object 2. Collaboration depth 3. Working mode 4. Interaction intensity 5. Collaboration forms 6. Formalization of relationships 7. Commitment and availability of individuals 8. Collaboration boundaries
Collaboration Steering	9. Collaboration goal 10. Management style 11. Decision-making 12. Leadership endorsement 13. Rewarding 14. Collaboration progress
Collaboration Processing	15. Collaboration framework 16. Resources sharing 17. Awareness 18. Conflicts management 19. Engineering (methods and technologies)
Information and Knowledge Integration	20. Information collection 21. Information structuring 22. Information access 23. Knowledge validation 24. Knowledge reusing 25. Knowledge creation

For each area of concern, a number of criteria were defined (see Table 1). These criteria represent the topics for a questionnaire (Col-MM questionnaire). Each criterion is represented by an item that is evaluated on a 4-point scale. To support the respondents, the levels of each criterion are described briefly, with examples wherever possible. An example of a criterion item is provided in Figure 1. When a respondent cannot answer, no score is recorded. The more often criteria are rated at 4 by the respondents, the higher the collaboration maturity of the community under investigation is.

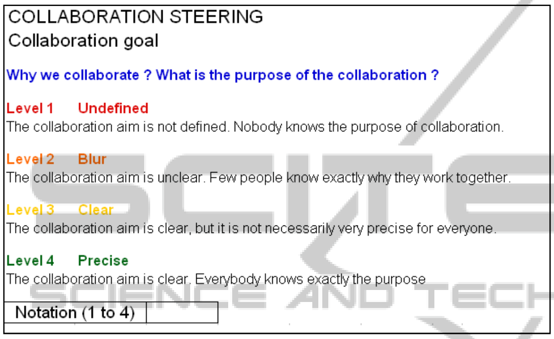

Figure 1: Example of criterion in Col-MM.

In essence, the Col-MM is structured as a library of criteria. Sometimes, not all criteria are relevant. So, an organization can decide which criteria fit its particular context. It can also decide to expand the set of criteria. Also, for some organizations certain criteria may be more important than others. In such situations, it is possible to assign different weights to the criteria.

3 METHOD

The Col-MM was developed following Hevner et al.'s (2004) design science approach. In this paper we will not report on the development of the Col-MM but only on its first field application and evaluation to demonstrate the model's practical feasibility and utility. This study therefore answers Hevner et al.'s Design Evaluation Framework recommendation for the use observational methods (2004 p. 86). Our role as researchers was limited to the organization and execution of (group) interviews, the analysis of collected interview data, and the gathering of participants' feedback regarding Col-MM. Our interventions during the study were only aimed at supporting the organization in achieving its goals in the project. The researchers had no personal stake in the project, neither with the problem situation nor with the solutions that were to be explored. The primary motivation for the client organization to involve the researchers was its desire to assess and improve the collaboration in a number of its key teams.

Research data was collected from both quantitative and qualitative sources to enable a rich understanding of the application of the Col-MM in practice. First, while observing the different activities in the study, we kept notes of incidents, remarks and events that conveyed critical information. Second, the (group) interview results were analyzed to gain insight into (1) the participants' reaction and understanding of the interview questions, and (2) analyze specific feedback regarding the Col-MM. Finally, we invited participants on all levels to share feedback on the Col-MM method and artefacts.

4 APPLICATION IN AN AUTOMOTIVE INDUSTRY FIELD STUDY

A large multinational automotive firm had a desire to assess the collaboration performance of some of their virtual teams. This company had previously established a new organizational matrix structure, based on the "management by project" principle. To assess the 'fit' of this new structure in the context of a recent merger-acquisition and to see if all the constituent brands work as a one single group, the company decided to assess the overall organizational performance in terms of synergy between the different sites and brands, productivity, quality of the products, and the balance between product diversity and process complexity. The collaboration maturity assessment was part of this larger organizational performance assessment.

As a first step it was decided to apply the Col-MM to measure the collaboration maturity of one virtual team distributed over two European countries (two sites) with different cultures, different work habits, and different management styles. This virtual team was in charge of the "Engine After Treatment System" (EATS) that was part of a larger development project of a new diesel engine that was taking place under the responsibility of a business unit distributed over three countries. The leading site in this project will be referred to as site A below.

4.1 Field Study Steps

The field study was performed over the course of 5

Figure 2: The seven steps in the Col-MM method.

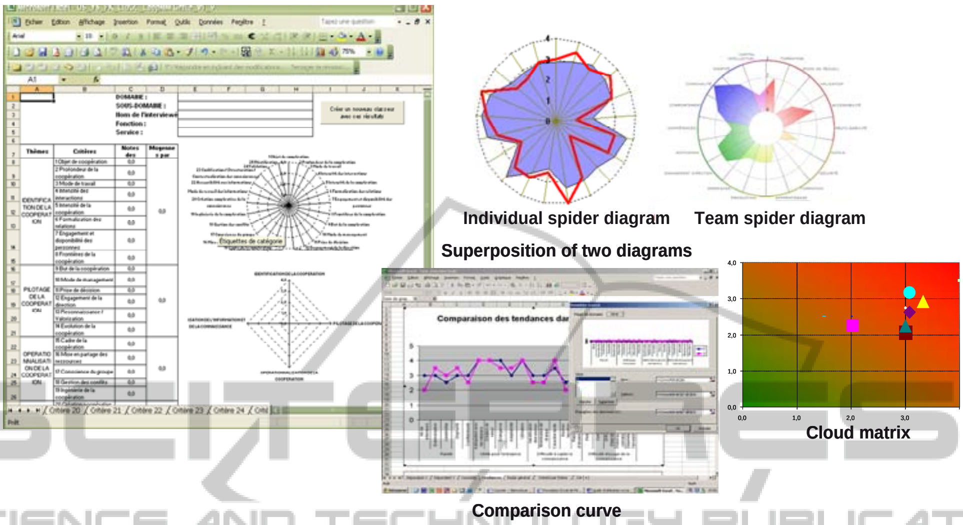

Figure 3: The Col-MM tool data collection and analysis.

months. It was applied and followed the Col-MM method steps (Figure 2).

At the scoping step, the purpose of the Col-MM analysis was defined according to the company's requirements. As presented to the stakeholders, the objectives of the Col-MM analysis were to check:

- If the organization had adequate capabilities to effectively support high quality collaboration.
- If collaboration technologies were well selected and configured.
- If collaboration technologies provided were effectively used.
- If there were critical issues related to cultural differences (national, organizational, technological, etc), given the merger-acquisition context.

The data collection was performed through individual and/or collective interviews based on the Col-MM questionnaire (quantitative data). The selection of respondents was done with the assistance of the firm' CKMO according to criteria such as job position, responsibility, process step intervention, and working experience. All respondents had similar levels of education (MSc degree) but from different engineering fields: mechanical, electronic, electric, and industrial. The Col-MM questionnaire was sent to the respondents before the meeting with an introduction of the company's Col-MM objectives. Anonymity and confidentiality of the treatment of the responses were formally assured. Nine individual interviews were conducted face-to-face in the respondents' native language in the two European countries (3 in the site A and 6 in the site B). Each interview lasted about 90 minutes. During the interviews the Col-MM tool (Figure 3) was used for data collection, followed by a first quantitative data analysis. This analysis presented individual perceptions about the collaboration maturity of the team. It also helped to identify perception differences concerning the different criteria. All interviews were recorded for further qualitative data analysis, consisting of content/thematic analysis. This analysis helped to get a more in-depth understanding of these perception differences for each criterion or group of criteria (area of concern). Two collective interviews (one for each site) were conducted to examine these perception gaps on some criteria. Follow-up discussions and consensus building efforts were carried out for relevant scores, in order to settle on an acceptable assessment. The cross analysis yielded additional interpretations by combining criteria for specific measurements of capabilities according to the focus of the assessment, such as project management, knowledge management, IT adequacy, value creation, and organizational learning.

The last step of the Col-MM method concerns the definition of an action plan. This plan was included in the report. An initial version of the report was sent to the respondents to solicit any corrections before the final report was prepared. A final presentation to the company's top management reported on the results and provide recommendations in form of a list of suggested future actions.

4.2 Findings

The findings were reported as observations and discussions of the different recorded perceptions related to the Col-MM criteria and topics. Examples of findings reported to top management according to the four Col-MM areas of concern include:

- **Collaboration Characterizing:** There were virtually no differences between the different sites in terms of their perceptions regarding the nature of collaboration. We found similar understandings of collaboration goals and team members' commitment for both sites. This may have been facilitated by the technical subject matter that the team members in the different sites had to collaborate on; this created a common language and hence understanding.
- **Collaboration Steering:** We noticed different perceptions between the two sites with respect to project management style and decision-making (hierarchical management vs. consensual management). Site B respondents felt unfairly rewarded compared to site A. They felt that because site A had the project lead, its employees always had an advantage.
- **Collaboration Processing:** We noticed that site B respondents had less awareness about different collaboration approaches to enhance the team's performance. Because of their positions and responsibilities in the process, they focused more on their individual contribution to the overall process rather than on developing collaborative relationships. We also noticed differences in terms of conflict management by the leadership in each site: Conflict management in the site A was based on consensus while in site B it was based on hierarchical decision making and negotiation.
- **Information and Knowledge Integration:** We found different perceptions regarding information access. For site A respondents, access to information was not organized as well as they wished. Information was very distributed and access should be simplified. We found consistent perceptions between the two sites regarding collaborative knowledge creation; both sites felt this process was well organized.

Through the qualitative data analysis we found that some cultural differences between sites appeared to be related more the organizational culture rather than to the national culture. For example, the balance between private and professional life appeared to be different. Also, there was a different brand identity: Site B respondents felt they were still belonging to their original brand (i.e. from before the merger) rather than to the group of brands. We also found different work attitudes: In site B respondents were more reactive compared to the respondents in site A being more proactive. According to some respondents, this was because of their position in the project. Possible explanations could be related to their contracts type (tenure status) and social protection.

The general findings reported can be summarized as follows:

- Collaboration was mainly based on "individuals' goodwill" as for example related to resource sharing and knowledge management.
- The team was not as collaboratively mature as was expected – they were at the Exploring Level. Because of the asymmetric collaboration awareness between the two sites, their collaboration is mostly of a coordination nature. This makes it difficult to further improve the quality of their outcomes.
- The new matrix structure did not resolve all problems with respect to the imbalance between responsibility and authority.

In the final report, various recommendations were proposed, including:

- Make collaboration a clear strategic goal in all project management initiatives.
- Re-think the management of collaboration (steering) and provide training for managers.
- Nominate full-time facilitators for collaboration.
- Take into account diversity aspects related to culture.
- Make explicit recognitions for the contributions of every actor toward effective collaboration.

After six months, we learned that three of the suggested recommendations were followed up with concrete actions:

- The first recommendation was clearly mentioned in the company's project management standard.
- Following the third recommendation, one full time collaboration facilitator was assigned to each business unit.

- Following the fifth recommendation, a 'collaboration capability' criterion was added to the annual individual performance assessment.

5 DISCUSSION

During the application of the Col-MM during this field study, we gathered various experiences and feedback regarding the appropriateness and usefulness of Col-MM. According to the respondents, the Col-MM analysis was satisfactory and correctly represented their perceptions. It focused on real collaboration problems and allowed traditionally 'unspoken issues' to surface. They were also satisfied with the feedback provided to top management and the subsequent actions that were taken related to the assessment's recommendations. According to the operational managers, the results were relevant. Further, most of them felt able to reuse the Col-MM by themselves in the future. According to the top managers, the study was satisfactory in terms of results and recommendations, as they confirmed and reinforced some of their own perceptions. This allowed them, for example, to focus more on the organizational culture than on national culture and to understand the problems related to the project-based new organizational structure.

We also received feedback and recommendations from the respondents on the Col-MM questionnaire such as the possibility to review some criteria and questions. The respondents stated that some criteria were a little difficult to understand. Also, the nuances between levels of responses were sometimes subjective or difficult to distinguish. In addition, they proposed to add some criteria such as culture, work experience, and practice diversity, and to rename some areas of concern such as "collaboration readiness" instead of "collaboration characterizing" and "collaboration management" instead of "collaboration processing". Finally, they suggested putting a stronger focus on virtualness (i.e. the extent to which a process can be virtualized (Martins et al., 2004)) and collaboration technology rather than on information and knowledge integration. Interestingly, this was contrary to the wishes expressed by the focus group. However, since the Col-MM is developed as a library of criteria, the review of the Col-MM structure according to a specific context is possible and therefore the respondents' suggestions can be easily accommodated. In terms of execution, most respondents expressed that they preferred the use of collective rather than individual interviews as this would enable a faster application of the Col-MM process.

Based on the experiences and feedback from this field study, we observe the following regarding the extent to which Col-MM meets the requirements as proposed by the Focus Group experts:

- Resource efficient: Col-MM appears to be resource efficient. A total of 36 hours were spent: 1.5 hours for the assessment preparation, 16.5 hours for the engineering interviews, 3 hours for the CKMO interviews, 3 hours for the top management interviews and 12 hours for the analysis and report preparation. We feel that this is a modest and reasonable effort in terms of resources spent.
- Rich data: The combined use of quantitative and qualitative data analysis enabled richer findings. We felt that qualitative observations enabled us to better uncover and interpret the various points of views expressed by the respondents through the Col-MM questionnaire.
- Limited need for further advanced data analysis: The analysis needs in the field application were limited and the Col-MM tool provided sufficient support (among others the report generation)..
- Self-assessment: The operational managers expressed confidence that they could perform future applications of the Col-MM themselves.
- Constructive learning: The respondents' feedback shows that when the Col-MM study is carefully communicated, participation can be effective and generate discussions on real problems that further facilitate the acceptance of proposed solutions. In this respect, anonymity and confidentiality seem to be crucial. This was confirmed by feedback from the participants.

6 CONCLUSIONS

In this paper, we report on the first field application and evaluation of an initial version of a new collaboration maturity model, Col-MM, to assist in the assessment of teams' collaboration performance. The Col-MM was developed prescriptively to meet a real business need as expressed by 15 CKMOs and others experts that are regularly confronted with collaboration performance challenges. Our contribution is both theoretical and practical as we propose a model, an application method, a supporting tool, and empirical evidence of their application. Our experiences show that the Col-MM can be applied in a resource-efficient fashion and yields results that are useful for organizations.

However, there are limitations related to this work with respect to the Design Science Evaluation Framework. First, our empirical evidence is based on several pilot studies but only a single field application. Further field studies have to be executed to expand the evaluation of the Col-MM artefacts and to further enhance the Col-MM. Particular care will have to be taken to ensure that Col-MM can take into account all levels of collaboration and all collaboration processes in an organization in different settings. This cannot be achieved by just expanding the number of criteria as this will overly complicate the use of the model. Second, at this stage, the Col-MM cannot yet be used to investigate a correlation between collaboration maturity levels and organizational/team performance. However, it provides a first step into this direction.

We recommend several directions for future research to enhance the current version of Col-MM. First, the model has to be applied in different types of organizations for different types of teams. The experiences from these applications will assist in the further development and evaluation of the Col-MM artefacts. Second, organizational and team performance measures have to be developed to enable an analysis of the relationship between collaboration maturity and organizational productivity. Fourth, from a behavioural science perspective, some further confirmatory studies should be performed using Structural Equation Modelling (Bollen, 1989) to validate the correlation between these variables (i.e. Col-MM constructs and performance).

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