

Strategies, Guidelines and Project Level Leadership as Methods for IDDS/BIM Practices in Transition

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Abstract

Construction project forms a multi-disciplinary organization with a goal. Whether that goal is commonly shared or divided and fragmented is a question of management: leadership and shared communication culture as well as design and delivery models with defined roles and authorities. In this paper we discuss the importance of leadership and need for it in project business change in the context of infrastructure development and construction.

We identify and analyse the approaches and concepts to be taken in to consideration for design management for successful IDDS (Integrated Design and Delivery Solutions) and BIM (Building Information Modelling) adoption. Our findings are based on interviews and observations on management and leadership practices as well as assessment of BIM management skills and levels of maturity. The analyses and recommendations describe possible actions in BIM adoption to apply various leadership behaviours and project management roles for desired added-values. The conclusions of this paper highlight the need for managership and leadership in project level integrated practices. Also, management skills and leadership styles and behaviours support BIM adoption.

The purpose of this study is to ensure that relevant approaches and concepts for project level management and leadership are used as point of departure for formulating BIM management guidelines for infrastructure development and construction industry in Finland. Pilot projects and research data originate from the PRE (Process Re-engineering) InfraFINBIM RTD project in Finland.

Keywords: BIM, infrastructure construction, change management, case study.

1. Introduction

1.1 IDDS and BIM adoption issues

In recent years many scholars have brought the change and BIM adoption into discussion from the point of view of understanding the importance of people in the transition. The way forward includes applying strategic and methodological BIM implementation and training

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plans, which are noticed by Smith (2009) and Succar (2009) to be in the core of adaptation strategies in the forerunner companies. Deutsch (2011) argues that when adopting and implementing BIM you are actually adapting to change; it is wise first to adapt and then implement; change is inevitable, but transition is a choice. Kotter (2001) adds that adoption of new approaches is a change situation where strong leadership should be emphasized.

The other relevant issue highlighted is re-engineering, the need to develop a transactional business process models with practical strategies for the purposeful exchange of meaningful information between BIM tools. As BIM matures in steps there are many iterations of re-engineering to be done on project level processes. Succar (2010) introduces a maturity chain starting from ad-hoc maturity, followed by defined, managed and integrated maturity. The chain finally reaches optimized maturity, which often presumes that IDDS based service concepts have been developed and that the whole industry branch has been able to transform their business processes and practices, e.g. all stakeholders share the same level of BIM capabilities and service maturity. This is the premise for successful project performance with desired end user values, leading to BIM based business benefits, which can be formulated as key business indicators (Aranda-Mena et al. 2009).

As the adoption of BIM is on-going, the industry still lacks BIM champions able to implement the technology while understanding the business factors both in their own organization and externally for their clients. The business and technology cases for BIM have already been made and largely accepted. The social case is about to be made for firm culture and project level culture, including working relationship, interaction and intelligence (Deutsch, 2011).

1.2 Procurement model as method of supporting integrated process

Traditional project delivery methods, such as design-bid-build, construction management or design-build, have been widely criticized of being inefficient, too costly and failing to meet quality expectations. In fact, the whole design and construction industry has become increasingly fragmented over the past decades (Lichtig, 2006). Matthews and Howell (2005) identified four major systemic problems with the traditional contractual approach: (1) good ideas are held back; (2) contracting limits cooperation and innovation; (3) inability to coordinate; and (4) pressure for local optimization at the expense of the project as a whole.

Emerging procurement models such as Integrated Project Delivery (IPD) and Project Alliancing are ways to organize projects to achieve lean construction and make integrated design and delivery teams work successfully. With the use of BIM these models provide the industry innovative tools to eliminate waste, cut costs, improve productivity, and create positive outcomes. Key aspirations in developing IPD are to increase collaboration between project team members, align incentives with rewarding high-performing teams, integrate BIM deliveries into contracts and ultimately to increase Value for Money (VfM) for facility owners. IPD is a significant new development in procurement innovation because it integrates design decision making, collaborative contracting and BIM technologies (Raisbeck et al. 2010).

1.3 Leadership as method of supporting people

Leadership and management are two distinct and complementary systems of action, both necessary for success in an increasingly complex and volatile business environment. Good management brings a degree of order and consistency to key dimensions like the quality and profitability of products. Management is about coping with complexity while leadership is coping with change, which makes them complementary to each other (Kotter 2001).

Like Kotter, also Gill (2002, 2012) agrees on the importance of leadership in any organisational change situation. Further, he proposes an integrative model of leadership for change, reflecting its cognitive, spiritual, emotional and behavioural dimensions and requirements. The model comprises vision, values, strategy, empowerment, and motivation and inspiration and can be applied in varied strategic change situations. Leadership focuses on vision, values, strategy, empowerment, and is more focused on supporting people through motivation and inspiration. Pearce (2004) argues that shared leadership is crucial in order to transform knowledge work. Pearce et al. (2003) introduced four types of leadership and their relevant behavioural sets. (1) Directive leadership: issuing instructions and commands; assigning goals; contingent reprimand. (2) Transactional leadership: dispensing contingent material rewards; dispensing contingent personal rewards. (3) Transformational leadership: providing a sense of vision; challenging the status quo; engaging in idealism; providing stimulation and inspiration. (4) Empowering leadership: encouraging opportunity thinking; encouraging self-rewards; encouraging self-leadership; engaging in participative goal setting; encouraging teamwork.

1.4 Research statement

The infrastructure property owners in Finland have described their objectives for using BIM and information technologies through desired impacts: high level of efficiency and safety during design and delivery process and quality of end product (roads, railroads, waterways), as well as generating more innovations. It is also realized that ICT enables changing the nature of the whole procurement process; in planning and design it is possible to improve communication and interaction with citizens and other stakeholder groups (Tiehallinto 2002).

In 2010 the InfraFINBIM project was launched to accelerate the development and adoption of BIM by re-engineering the processes. Common vision of the owners, designers and contractors is that *by year 2014 major infra-sector clients procure only BIM based services, in all project phases from early planning and design to maintenance and operation*. In order to support reaching the vision a set of common BIM guidelines are to be developed for harmonizing BIM based project delivery. One of the guidelines will describe the essence of IDDS/BIM project management.

The pilot projects and the studies in InfraFINBIM project are aimed at process re-engineering, with a clear goal to implement IDDS/BIM in the field of infrastructure construction and development. Development tasks in pilots vary from drafting and testing of BIM guidelines and assessing the feasibility of integrated BIM processes. BIM Guidelines are important tools in design and construction procurement as they identify models to be

delivered and define modelling principals. In the newest set of guidelines for building sector in Finland (BuildingSMART Finland, 2012) also managerial principals are defined; the stakeholders in infrastructure sector are preparing their set of guidelines by the end of 2013. In order to understand the whole picture of management and leadership in IDDS/BIM this study was started, considering project level management and leadership in design phases.

Based on (a) reasoning on IDDS/BIM adoption challenges introduced above, (b) our observations about BIM implementation within building and real estate industry as well as infrastructure development and construction sector and (c) key arguments of leadership thinkers, we argue that in strategic transition situations project organizational leadership actions are critical and should be part of implementation of new approaches.

2. Concepts and approaches for IDDS/BIM management

In this chapter we introduce some relevant concepts and approaches noticed for IDDS/ BIM management in the project business. They are shown as IDDS management pyramid (Fig. 1) where identified key approaches to define BIM management and leadership guidelines are illustrated, with development path to realisation of vision as steps of strategies and actions. We try to limit the approaches to those that have a clear effect on project level actions, but we are aware that most of them are linked to organisational level business strategies at the same time. Also, we do not focus on changing business environments or trends from the society. We try to describe the approaches from an angle that opens their connection to leaders' and managers' behaviours.

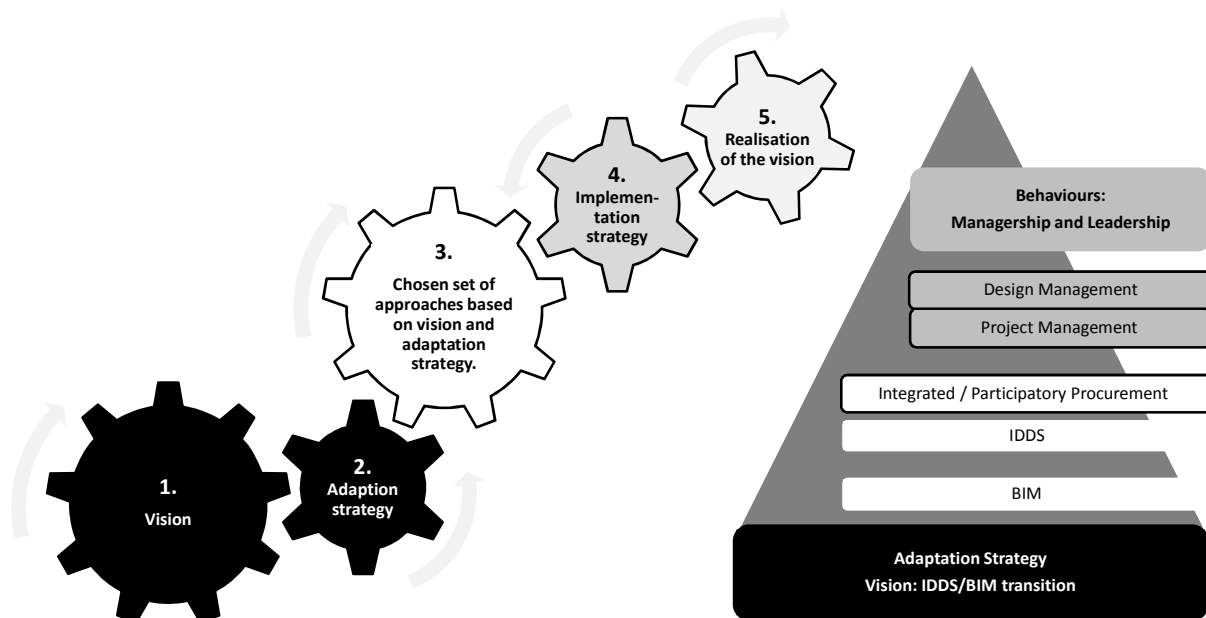


Figure 1: IDDS Management pyramid illustrating key concepts and approaches

2.1 Adaption strategy and BIM transition

The foundation of the pyramid is formed by the adaption strategy that is based on the vision of IDDS/BIM transition and on the principle that it is to be lead, not just followed. Companies

need to recognize their potential BIM benefits and develop relevant business processes and invest in learning and knowledge management. They need to decide whether they implement BIM as a system for data automation, information and collaboration or a key to transform and develop new integrated business models and BIM enabled service concepts. BIM management is a part of service concept and BIM organisational level strategies exist in the forerunner companies.

As BIM matures in steps it is challenging to implement it on project level, with many stakeholders in diverse stages in their own BIM adoption. When reaching for the higher levels of BIM maturity the potential benefits increases. On one hand, BIM is seen as an instrument for valuable and accurate information (starting from the planning phase) as well as leaner processes and smooth workflow with full interoperability. On the other hand, BIM is an enabler for more user-oriented and integrated design concept as well as new service concepts using leadership actions instead of (or in addition to) more traditional management actions. High capabilities of BIM for visualization lead to better understanding and transparency of the project actions, promoting these changes in practices.

We argue that high level of integration is a process level tendency reflecting the growing BIM transition, whereas collaboration and communication are tendencies of growing co-creation between stakeholders (people). Strong interoperability is a tendency of growing need for data transfer technologies and standards.

2.2 IDDS and Integrated/Participatory Procurement

IDDS support collaborative project delivery approaches in construction and seem to lead to smart business strategies. The more focused use of BIM in order to receive benefits and create value is leading to transparent design processes and supporting lean construction and risk management. Both approaches rely on actors in the design and delivery processes and their upgraded skills, as well as motivation and shared aspiration to execute work in a more value adding, efficient and profitable ways. Implementing BIM as a systemic innovation and turning the business focus on IDDS is a strategic change action. The issue of leadership and management rises when project level design and delivery solutions are under adaption to integrated approaches. Integration of the process is happening both in design teams, in project teams and in the interactions with clients and users.

The IPD approach integrates better than the traditional delivery methods all team members to form a collaborative that acts as the core group to manage the integrated project delivery process. However, the formation of project organisation and consistency of leadership are crucial when using IPD (or Alliancing) procurement models. Owner's representatives have to be actively involved in project leadership for the whole project life-cycle. The link to the customer is also very important. Integrated project delivery is supported with the use of relational contracts that recognise the reality of what needs to happen for successful project delivery. An integrated project delivery team shares decision making, pools contingencies, and provides incentives for team performance. Having such contracts in place creates an environment where all team members share risks and rewards based on reaching targets.

The organizational design of integrated/lean project delivery is based on demand, value and flow; open, collaborative and integrated team of key players formed at the outset and added to as the stakeholder group grows. The management/leadership ethos of IPD is from outside-in: act on the system to improve it for customers (helped by those working in it), unlike traditional top-down: manage the contract, manage the programme, manage budgets and manage people (AIA, 2007).

2.3 Project management and Design management

The project manager is essential for the successful delivery of a construction project and has the overall responsibility for the planning, co-ordination and control of a project from conception to completion. The project manager takes on multiple roles in projects. Project management has several sub management layers like value management and team management. Risk management and information management have a straight relation to the IDDS approach as has been discussed in previous articles (Azhar 2011).

The key idea for BIM enabled design process is to produce valuable information for decision making. This is done with help of BIM functions: BIM based analyses, simulations and visualizations, and it is a key task of design management. The whole design workflow will actually be managed with help of information. This leads to adapting the key theories of knowledge management for the project level, for change management and using BIM as instrument rather than a tool (Mäkeläinen et al. 2012).

The design manager takes multiple roles as well as. The essence is not only to track the design tasks but to use means and mechanisms available to create social interaction, influencing and stimulating the team members, even challenge them to create innovative solutions (Rekola et al. 2012). Tatum (2009) argues that leading and implementing integration requires a collaborative approach and special skills. The three levels of champions needed are (1) executive champion (typically project managers) who creates the supportive organization culture and structure; (2) commercial champion (business managers) and (3) technical champion (project engineers). All of them foster integration by providing active advocacy, obviating potential problems, solving those that occur, and always insisting on increased integration when it helps satisfying project objectives.

In addition to project organisational roles, one way to understand design management is through design concepts. In order to answer to the trends and objectives of the society general design concepts have been developed. These concepts can be upgraded to service concepts, which normally highlight several values of design and delivery.

2.4 Managership and Leadership Behaviours

The present leadership and management responsibilities in the infrastructure sector are based on generally proven and known practices, organizational hierarchies and professionalism. Actual formal management and leadership roles, practices or task lists have not been recognized as a general guide for the business. The responsibilities of designers are described loosely in the building regulations. In our study we have raised the issue of

leadership both as behaviour of a leader and as a competence to be held in IDDS transition process in order to achieve understanding of use of BIM. Leadership behaviours are structured by typologies (Pearce et al. 2003), but in practice they are used also together.

In our study we are interested in leadership behaviours and actions and their output in two ways: firstly, in relation to a certain project action situation and to managers' roles; secondly, in relation to industry wide BIM adoption and implementation strategies.

3. Empirical research

3.1 Case study methodology and results

The partners of on-going InfraFINBIM project form a good target group as they all have personal experience of working with BIM in pilot cases and they share an ambition for BIM enabled re-engineering. InfraFINBIM portfolio of pilot projects forms a favourable innovation platform, where 25 different pilot cases act as development and testing environment. Furthermore, as the use of BIM is in its early stages of an industry-wide adoption, the stakeholders have strong susceptibility to notice details in project level culture and change of practices due to BIM implementation. Therefore the personal statements of the experienced managers interviewed are treated as phronetic intelligence (Flyvbjerg et al. 2012) in the analyses. Seven design managers from six consulting companies and three clients' project managers were involved in the two round interviews, where the objective was to identify management and leadership contents and relevance of the pre-chosen approaches (Fig. 1).

The semi-structured short interviews were performed in two rounds. In the first round the managers were asked four general questions on project level management and leadership. The first two questions were related to identification of the present leadership roles and management tasks and the need for changing those. All the interviewees identified similar roles on project level: project supervision (client), project manager, principal designer, experts of different disciplines, design management etc. Depending on the size of the project usually chief designer takes more tasks and roles especially in small, routine projects.

The interviewees believed that the current management methods and practices will remain unchanged even though the design work itself becomes more BIM based: *"The roles of the various parties do not change (administrative and technical management) but the tasks are developing to support more model based design."* New role of BIM coordinator was expected especially in the projects where the coordination models are necessary. When the BIM based design becomes more common, a BIM quality supervisor's role might arise. The quality controller's role can be performed either as a design task or by an independent auditor. The participants emphasized the importance of the co-ordination of the project consortium as well as general guidelines and supervision to guarantee the continuity of design from one phase to another.

We asked participants how BIM based design and working method have changed the decision-making process. Most of the companies had positive experiences in the use of BIM for visual models during project progress meetings with the client. *"Models play an integral part in the decision-making process in connection to a certain design solution on a practical*

level. The quality of the solutions improves when design issues are considered together." Similarly, the conflicts of the different design disciplines are better detected, commenting between parties is more active and presentations to stakeholder groups like end-users and politicians are better facilitated. The interviewees stressed that although visualization has great importance, the BIM model is not used as visualization model only but as a tool that allows easy access to information and helps co-creating more valuable solutions.

Finally, the interviewees were asked to describe what BIM means to them with four claims: (a) BIM is automating information and data, (b) BIM is communication and information tool, (c) BIM is decision-making tool and (d) BIM is a new design concept. All interviewees agreed that at the moment BIM is a communication tool automating information and data (a and b). The benefits are improved validity and reliability of information. They also agreed that data transfer and compatibility issues can be resolved in time. BIM as a decision-making tool was considered more a target or vision for future which is possible to achieve when the use of BIM-models is part of the daily routine. As emphasised by the owner, models were expected to bring clarity and support to decision-making processes in the infrastructure property management. BIM is not a new concept in construction industry according the interviewees. Most of the participants had noticed that BIM based work will require behavioural changes.

In the second round informal material on leadership practices and methods were delivered to interviewees and they were asked to identify the leadership styles and behaviours in their own working environment and roles. Many of the leadership styles were recognised in their own organisations and in connection to changes in practices. At the moment the project environment does not support any other styles or behaviours than the administrative and technical management roles and directive leadership styles. However, the interviewees were able to separate benefits and disadvantages between different leadership styles and their usage in different situations. In particular, the participants noticed that they were working according to certain management style without questioning or any estimation whether the management method is correct and fits for the purpose. In general the current management practice was rated to be good enough. More innovative and supportive leadership could be exploited in demanding projects in order to achieve better end results.

The last exercise of the study focused on the development and maturity of BIM skills. Four project managers of recent BIM pilot projects, where the target had been to test boundaries of BIM collaborative practises and design model content were interviewed. The project managers were asked to estimate the level of skill maturity of the BIM designer and group design manager of their own company. The results show that neither of the skill maturity levels rise very high (Table 1). Leading companies in BIM based design give clearly better scores themselves than those who have not adopted BIM in their common design practices.

Table 1: Skill levels observed in pilot cases with scale 1 (poor) to 6 (authorised) – skill levels explained in Table 2

Pilot case	Level of BIM designer skills	Level of group design manager
#1	3 (good)	3 (good)
#2	2 (satisfactory)	2 (satisfactory)
#3	3 (good)	2 (satisfactory)
#4	4 (very good)	3 (good)

3.2 Analyses

The final analyses were done by the research group, when the predicted approaches connected to management and leadership was matched to new findings from observations and interviews (Fig. 2). As a summary we conclude that interviewees related management roles and managerial behaviours to most of the levels of IDDS managerial pyramid. The relationship between procurement and management issues was not as clear.

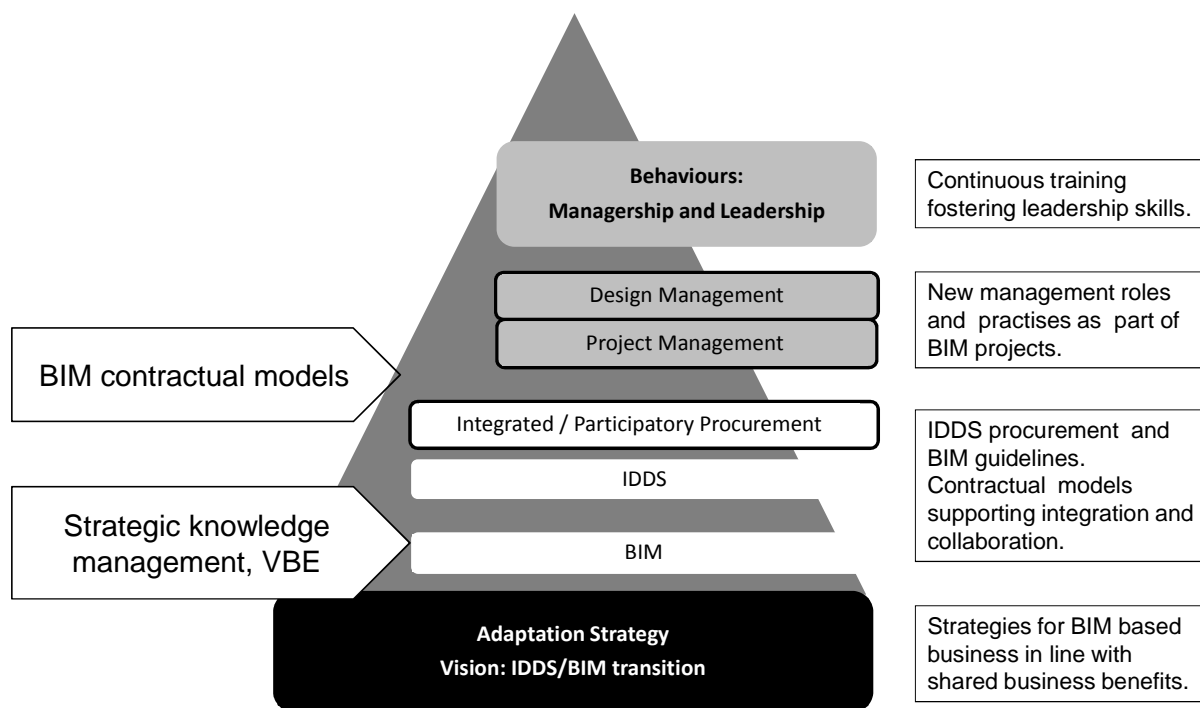


Figure 2: Summary of the interviews and analyses as updated managerial pyramid

Findings from the interviews were expanded with our observations from management styles used in pilot projects. These observations were done by researchers that had followed the pilot projects in the interaction events of design meetings or in public presentation events. The observations were upgraded into management roles and description of the levels of skills as part of BIM project maturity matrix with recommended leadership styles to be exploited (Table 2). Seven roles with 2-3 leadership styles were defined and identified in connection to the main objectives of each role.

During analyses some examples of the management procedures were defined including preferences of leadership styles to be exploited for their supportive effect on output or change. (1) Support adaptation: ensure that all stakeholders understand the new process where creation of valuable information is in the key role. Leadership styles to be encouraged: directive and transformational. (2) Create a BIM Plan for the project. Create the descriptions of BIM actions together with the team and schedule them. BIM focus area is a value adding, pre-planned and described task or row of tasks executed in a certain phase during the process with defined BIM actions. The task description include definitions of responsibilities, objectives and roles: Together with BIM function the BIM action method

describes what is done, with which model and who are involved in executing action. Leadership styles to be encouraged: participatory, use people-oriented and task-oriented together. (3) Strive for value. The overall aim for a BIM focus area is to provide valuable information to decision making. Management focus should be in striving for value with help of BIM in project level and support and develop new IDDS practices on company level. Leadership styles to be encourages (a) in planning: transformational and empowering; (b) in design and delivery: transactional and empowering.

Table 2: The analyses of matching leadership styles with the objectives of project level roles shown in a maturity matrix table

	Integration champion	BIM expert Coordinator Technical champion	BIM Modeller, Designer	Design group manager, Chief designer	Project manager (consultant of owner)	Project management of the owner	Supervision of design disciplines (owner)
Leadership styles to be exploit in challenging projects (levels 4-6)	Servant and Transformational and Participatory leadership	Participatory and Transformational	Task-oriented and Participatory	Empowering and Participatory	Directive and Participatory	Transactional and Participatory	Task oriented and Servant leadership
Skill level 6 authorised	Authorized qualifications with wide experience in challenging IDDS/BIM project environments. Very high customer satisfaction.						
Skill level 5 excellent	Strong experience and qualifications with wide competence on IDDS/BIM integrated and value based practices. Project control, guidance, problem solving and people leadership is executed well to support project goals without heavy work load to the team. High customer satisfaction.						
Skill level 4 very good	Strong capabilities and experience in integrated BIM practices with references on successful project and satisfied management. Strong customer satisfaction.						
Skill level 3 good	Good capabilities and competency on integrated BIM practices. Some experience on use of BIM functions on task level in project environment.						
Skill level 2 satisfactory	Basic capabilities and understanding of key concepts exists on BIM practises. Little experience in BIM based projects.						
Skill level 1 poor	Poor capability on BIM practices. Negative or suspicious attitude to BIM benefits. No experience in BIM based projects.						

4. Conclusion

Results were diverse in the area of leadership styles usage. One reason for this is the short history of BIM based project practice in the field of infrastructure development and construction in Finland. It was clear that management and leadership skills are both needed. Especially when working in a BIM process that is still new for the stakeholders and either adaptation and nor implementation is fully finalized. Results from the analyses indicates that when defining the roles and skills needed in integrated design and delivery the importance of leadership styles and tactical use of behaviours have a place and meaning. Therefore we recommend that the guidelines describing the essence of BIM project management should include the essence of BIM leadership. As the roles of the project level business environment are going through a change process it is possible to develop supportive leadership behaviours as personal managerial skills. Leadership skills can be consciously

developed - as any needed skill - in similar ways than strong leaders on organisation level can be fostered (Gill, 2012). Results of BIM skill maturity development are greatly influenced by how well the company has adopted a BIM based design strategy as its own way of action.

The benefits of leadership are direct when building up IDDS/BIM maturity and capability levels. When catching up with the knowledge of leadership theories and getting more familiar with leadership practices and the orientation of each style, it is possible to accelerate (a) BIM adoption (b) BIM maturity and capabilities, and (c) value-adding actions in the process. As leadership is a key component to be introduced and discussed in BIM managerial guidelines. The results of our study support the idea that issues of management and strong leadership should be emphasized more in procurement and delivery models and project organizational and contractual structures. Management principles should be communicated through requirements and guidelines as they are part of design collaboration culture in transition.

Infrastructure development and construction projects are complex and high value large projects which should be lead systemically with strong project management. Intense city structures with connection to building design and construction form even extra challenges. In this kind of district level projects there is (a) a need for multidisciplinary management systems to support decision making and (b) a need for strong management and leadership in order to motivate many disciplines evolved to integrated design practices. Further research is needed to show if there is a certain project quality level which cannot be reached without strong leadership actions. It is highly evitable that the need for leadership actions and use of variety of styles is higher when stakeholders move further in IDDS/BIM maturity.

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