Lessons for organisational leaders from Building Information Modelling development in AECO business ecosystem

1. Introduction

Architecture, design, construction and operation (AECO) industry is adopting new technologies, processes and practices that have already started to disrupt long established operational patterns. Some of the most prominent challenges posed for existing practices can be attributed to Building Information Modelling (BIM) which proposes fundamentally new methods of handling and creating information rich models and new ways of working with other stakeholders by re-aligning the disciplinary roles and responsibilities, and creating opportunities for additional roles for the sector (Eastman et al., 2011). The potential of BIM integration for AEC practice is evident (Miettinen and Paavola, 2014).

BIM adoption and efficacy is challenged with limitations when faced with complex problems involving multiple organizations and collaborators with diverse and often conflicting viewpoints. BIM adoption disrupts prevailing practices and challenges institutional momentum, and, consequently, suffers a slow rate of adoption. In this article, we view BIM as technological development that has potential to reconstruct the existing industry but due to certain reasons was not adopted to its potential to become a systemic change connecting digitally individuals, teams and organisations throughout the whole building lifecycle supply chain. Literature on BIM tend to focus on technological innovation within singular firms and therefore fail to capture the multiple and complex dimensions of innovation and technological adoption which transcends the boundaries of any singular firm and industry (Astley, 1985) which, more often, provides new pathways to further innovation through the emergence of new practices or their reconstruction (Van de Ven and Garud, 1993). Organisations never innovate in isolation as there are various external factors that influence technological innovations; for example, market structure and technological products that shape innovations and adoptions (Teece, 2010).

In support to this assumption, "the odds of successful innovation development for an individual firm are largely a function of the extent" to which external and internal factors influence industrial community level development (Van de Ven and Garud, 1993). From this perspective, it would be fair to say that the reconstruction of existing AEC industry does not constitute the traditional notions of industries as such but rather consists of a constellation of collaborating and interacting set of firms, software developers, public and academic organisations. These actors play the key roles in the creating the business ecosystem for the reconstruction of existing industries and development of new technologies to support new practices. However, to understand and describe an evolution of the industry to an ecosystem is not an easy research as there are only few studies in the literature that have paid attention to the emerging logic of business ecosystem to crafting manager's strategy for innovation adoption and understanding the values creation by establishing a platform that other members of the ecosystem can use (Moore, 1993, Iansiti and Levien, 2004, Horn, 2005, Li, 2009, Chesbrough, 2010, Hamer, 2010).

An understanding of technological emergence to reconstruct existing industries in relation to business ecosystem evolution is considered to be invaluable to industry policy makers and entrepreneurs (Rosebloom, 1966, Van de Ven et al., 2008). On the other side, there is a growing interest of studies in research on construction industry on innovations going towards innovation in project networks (Taylor and Levitt, 2007) and BIM ecosystem (Gu et al., 2014). These studies still stay at the level of projects organisation. It is argued in this paper that research on BIM adoption may also benefit from studies with a shifted focus from individual organisations and project networks to the emergence of technological innovations and business ecosystem within interfirm networks and technological communities at a national level (Kogut and Zander, 1996, Spencer, 2003).

To address this gap, this paper provides a new methodological approach to study technological development in Finnish construction industry. Finland was chosen as a case study to explain the development of BIM at the national level and thus describing the business ecosystem that supported this development. We consider this case study as unique, as Finland has a long history of cooperating organisations and early adoption of BIM supported with strong funding for R&D for technological development at the national level. The collaborative culture and availability of resources have generated the positive environment for technological development and adoption in Finland. However, the business ecosystem still lacked certain elements to generate the transition from old ways of work to the new ones with the use of BIM that go beyond technological adoption within singular organisations. This article is rather tries to present the lessons learnt from the industry with long technological history for industries that are yet to go through the process of BIM adoption and to understand what are the issues are yet to be addressed. The long process of technological development and adoption in conjunction with supportive and collaborative culture can highlight challenges that other cultures might be about to experience once they go through a process of BIM adoption and collaboration.

The proposed methodological approach is merging the methodological notions of grounded theory for reiterative knowledge discovery and emerging categorisation (Glaser and Strauss, 2009) and methods of studying innovation development by Van de Ven et al. (2008). Grounded theory approach was used to analyse the five viewpoints on the evolution of Building Information Modelling as a technological innovation in Finland. These viewpoints were: 1) governmental funding agency that sponsored the ICT development in Finland (TEKES), 2) academia, 3) management & business, 4) BIM users and 5) client's perspective on BIM development. See the selection of interviewees in Appendix section, Table 1. The juxtaposition of different viewpoints on history of technological development brings into focus contrasting views of socio-technical change and development that possibly led practices to today's situation with BIM adoption. "Working out the relationships between such seemingly divergent views provides opportunities to develop new theory that has stronger and broader explanatory power than the initial singular perspectives" (Van de Ven et al., 2008, Van de Ven, 2007). The unit of analysis is AEC business ecosystem as a constellation of the key Finnish organisations involved in the development and adoption of BIM in construction industry at the national level.

To complement the qualitative approach, the methodology is adopting a historical perspective on the emergence and adoption of BIM in Finnish construction industry. The study is based on the assumption that a "failure to analyse historical change in a general equilibrium context tends to result in a unidimensional perspective on the relationships bearing on technical and institutional change" (Ruttan and Hayami, 1984). Therefore, this research aims to explore the following questions: *(1) How the development and adoption of Building Information modelling in the Finnish construction business ecosystem was evolving? (2) Can a historical perspective on technological development in construction industry's business ecosystem provide new insights towards slow adoption of BIM? If yes, what are these insights?* We believe that this case study supported by new methodological approach can provide new insights on slow adoption of BIM taking in consideration the viewpoints of lessons learnt from the cooperating actors in the business ecosystem that supported BIM development.

Section 2 explains the art of the methodology. A new method of studying a BIM emergence is adopted to enable a wider view on the problems associated with BIM adoption at national level. It is argued, that there are socio-technical problems that cannot be solved by technologies in conjunction with an influence of technology developers on practice evolution and values that industry inherited. Section 3 explains the historical and evolutionary BIM development in Finland based on the methodology described in Section 2. Section 4 presents the results of generalised problems in Finland in relation to BIM adoption derived from the historical analysis and the analysed five viewpoints. The explained problems are interdependent and explain the slow adoption of BIM in the Finnish context. It is also argued that Finnish case of slow adoption of BIM at present can be generalised to other countries to provide a wider view for future actions.

2. The art of methodology

We assume that by a new exploratory analysis it is possible to generate a new perspective of the established problems taking in consideration interactions between elements of the business ecosystem. Taking this perspective, the proposed methodological approach is merging the methodological notions of grounded theory for reiterative emerging knowledge discovery and categorisation (Glaser and Strauss, 2009) and methods of studying innovation development through historical perspective by Van de Ven et al. (2008). Van de Ven (2008) offered a mixed method methodology to analyse innovation and organisational change of business ecosystem across 240 case studies in various industries followed during twenty years under the Minnesota Innovation Research Program (Van de Ven and Poole, 2000). The methods proposed by Van de Ven and Poole (1990) explain how innovations develop over time by analysing process patterns. The contribution of the Minnesota studies is that the discovered patterns can be applied in other studies as the results are generalised. However, this research does not strictly follow the method proposed by Van de Ven and Poole (1990) but rather takes the main concepts applicable to our case and the patterns from this research have been cross-referenced with the discovered patterns from the Minnesota studies. Historical approach to the analysis of data in this research takes a central importance as it was emphasised to trace technological change. We see the process of change as developmental event sequence of interacting actors that produce tangible and intangible outcomes through convergent and divergent cycles of activities. To accomplish this qualitative study, we analysed BIM development by collecting all available literature published in Finland and outside about technological developments that have contributed to BIM emergence during 1955-2015. The collected material helped to gain the knowledge and prepare to the interviews that were based on the on long semi-structured interview process by McCracken (1988). The interviews were transcribed, coded and analysed by the first author. The analysis of interviews which lasted one year had an iterative process with refining the concepts and identifying new subcategories and dimensions that have been coded in Nvivo software. As concepts have been refined, additional data in the form of published literature have been revised to expand the understanding and description of the phenomena. There are two levels of analysis: historical technological development process where periods of development have been analysed and generalised findings of lessons learnt identified from the analysis process. The historical map that was constructed and refined is presented in the Appendix section, see Figure 1. The periods of BIM development and lessons learnt are presented in the following sections.

3. Results on the emergence of BIM Development in Finnish Construction industry

3.1. Historical Development of Building Information Modelling - Theoretical findings of Finnish innovation journey.

This section aims to present briefly the periods of historical development that can be also seen in the visual map attached in the Appendix section, table 2. The historical development was divided into six periods: **Period 1**. Formation of Innovation Unit; **Period 2**. Theory Development**; Period 3**. Depression Time. Loss & Gain; **Period 4.** Technological development; **Period 5**. Implementation of Innovation. Piloting Projects; **Period 6**. Industry Stabilization and Emergence of a Dominant Design. Each period has its distinct aim and contribution that followed logical steps of development. The Table 2 in the Appendix section that shows the periods of innovation journey that was taking at the national level of Finnish business ecosystem. It is not possible to describe each period here but table rather provides a short description of BIM Innovation Journey and how the innovation was evolving in the business ecosystem of Finnish construction industry on the way to BIM adoption.

4. Concluding Discussion

One might conclude that it is impossible to generalise results based on the one case study. Although, the further investigation and analysis of other case studies needed, the methodology provides an augmented view on how Finnish industry attempts to reconstruct itself through technological development and how various elements of this development go beyond organisational innovation towards business ecosystem. The research provides a more holistic view on the connections between various proponents of the business ecosystem that encourage the technological emergence and adoption. it is clear for us that an understanding of the Finnish technological development in AEC business ecosystem through qualitative analysis of historical technological emergence helped us to reflect on the process of industry's attempt to reconstruct itself and systemic problems that were inherent in the industry manifested throughout the history. The proposed methodology could be strengthened by quantitative analysis in the future. Despite that these findings seem to be context specific for Finland, we suggest that some of the findings can be generalised to other countries as well. This paper tries to derive results from the research efforts and outcomes of BIM development in Finnish context to potentially make conclusions that can serve construction industries worldwide with new visions for future technological development and adoption. Although, it is not possible to describe all the findings in one article, especially in six pages, one of the findings are presented in the following sub-sections:

1. **Finnish BIM development is a technology push rather than market pull.** Finnish BIM development was a clear technology push over the market pull as there was an overemphasis on technological possibilities abstracted from social, cultural and organisational proponents of the industry. The initial technological developments were initiatives of the champions in the industry that could gain resources from Tekes for the realisation of the ideas to realise their visions for re-construction of the industry, change and improvement of personal practices with new technologies. The Finnish champions were driven by the tools development as when the development took place, the market was not offering any that could serve the industry-specific purposes. In other words, BIM developed into a productivity tool that was aimed to eliminate information contradictions from multiple stakeholders and automate work processes with standardization. Thus, the Finnish construction industry fixated on technological developments due to cultural enthusiasm of technological possibilities although there were soft evidence and critical view of the industry's problems were not technological (Björk, 1986). On the other side, the software business is international and to be able to make a successful interoperable software, it must be at the international level. Development of software for a small market is not profitable on a long term. In thinking about innovation opportunities, companies have a choice about how much of their efforts to focus on technological innovation and how much to invest in business model innovation. Review of R&D BIM portfolio of Finland revealed that most of the nation's initiatives in R&D expenditures were going to technological developments or developments around technological implementation with visions for radical innovations. The problem with innovation improvement efforts is rooted in the lack of an innovation strategy at organisational and national level. Only few companies were able to translate visions into the viable business.
2. **Commitment to unique in-depth technological knowledge distanced early adopters from traditional industries in Finland.** Over the years, Finnish champions and participating organisations were able to develop deep and strong digital capabilities by exploring technological possibilities of BIM in improving personal work practices and in piloting projects. By engaging in cooperative and competitive relationships and by interacting in the same networks, groups of entrepreneurs in the public and private sectors distanced themselves from traditional industries by virtue of their interdependencies and growing commitments to and unique knowledge of technological visions and use of technologies. Indeed, Finnish partnerships are not based on lowest prices, but are contracted in tight relationships between one to three companies of each specialist type in the network based on trust (Taylor and Levitt, 2007). Similar patterns of behaviour of business ecosystem happen in other industries as well (Van de Ven et al., 2008). This condition has pushed for BIM development at the national level.

3. **High levels of diffusion of ideas can hinder the innovation as well as promote it.** The interesting finding is related to the quotes: "we are a small nation", "people move between organisations", "everybody knows everybody", "four people can come together and decide the destiny of the country, I have never seen that in other countries". Indeed, practitioners move between research institutions, government and industry organisations and hierarchies. The analysis also shows the high diffusion of ideas as people keep repeating similar ideas and come to similar conclusions. Finland holds social corporatist political structure where bricolage of organisations collaborate and mutually adapt while they compete for market share (Garud and Karnøe, 2003). The pre-existing relations among firms and social networks helped champions to build trusting relations with organisations in attempting to reconstruct the industry (Taylor and Levitt, 2007). However, "there are disadvantages of this system that were painfully revealed during the depression time" (Diederen, 1999). Such conditions might create low collective intelligence as small community centred groups are more susceptible or perceptible to groupthink than the large and diverse ones. Strong ties with monogamy of talents have over time replicated each other (Malone and Bernstein, 2015, Surowiecki, 2005). The groupthink might have lead the organisations to biased decisions amongst those that are in power and hold of resources. In addition, those that hold the power of resources are usually suspicious of new ideas in general (Van de Ven et al., 2008). Our research shows that strong ties with monogamy of talents have over time replicated each other with thinking and distance BIM initiatives from traditional practices.
4. **Public funding incentivises organisations rely on public sector.** The very institutional arrangements of Tekes created to facilitate industry for technological development became invisible forces that hindered subsequently technological development and adaptation in Finland on the long run. The Tekes's expectation to make Finnish construction industry a world leader in technological development has brought positive results although not at the expected level. One of the reasons claimed to lower the expectations is that due to applied research that is prevalent in construction industry, research in construction industry cannot reach the same level as it happens in medical science for example. Our research shows that Finnish companies might also have configured themselves based on the expectations of public funding at large. The companies often mirror to priorities of their governmental customers and to rely on public sector for funding when selling in international markets as well (Spencer et al., 2005). As a result, companies were competing on the national level instead of global level. The local thinking claimed to be hindrance for BIM adoption is possibly a manifestation of incentives that funding agency has provided.
5. **Governments are advised to mandate BIM at national level.** Most of the BIM developments are done at piloting or demonstration projects which represent depth strategy for adoption of innovations. According to the research by Lindquist and Mauriel (1989), depth strategy is to the implementation of innovations is less effective than breadth strategy. With depth strategy, it is easier for opposing forces to mobilise efforts to sabotage a favoured demonstration site than it is to produce positive evidence of the merits and generalizability of an innovation. When depth strategy is implemented heralded by top management, the demonstration project soon loses visible attention and institutional legitimacy from top-level management, as their agenda is becoming preoccupied with other pressing management problems. If public clients that own large number of properties for example, use only one project for BIM implementation as a demonstration for others, this would be a depth strategy. From this perspective, UK strategy for implementation of BIM across the whole industry is anticipated to be more successful as government stays in control of the implementation of innovation across the whole sector simultaneously; while Finnish industry hopes for the government to be more active and to support Finnish champions with better strategy targeting technological innovations at the national level. Twenty interviewees out of twenty made a conclusion that BIM must be mandated at the national level to gain promised benefits: "*if it is mandated, then everybody does it*" (Quote_BIM user).
6. **Individual organisations are more agile to changes than governments. Managerial role gains an increased importance in BIM adoption.** On the contrary, managers can change firm's organisations much more easily and quickly than governments change their institutional structures. Governmental policy changes may create further institutional constraints as "*the more revolutionary*

policy changes required, the greater incompatibilities that can arise" (Spencer et al., 2005). Governments in general are less agile to fast-changing world. In general, it falls to the managers to assess the innovative and technological adoptions and whether they work effectively. However, the local thinking and conservatism of industry stakeholders have been identified as hindrance to becoming a global leader in technological development.

7. **Finnish academia did not change to support cultural change with BIM practices.** The change of traditional architectural and engineering education to BIM education has been called by multiple researchers across the world to address the cultural change (Sacks and Pikas, 2013, Mills et al., 2013, Kocaturk and Kiviniemi, 2013, MacDonald and Mills, 2011). Several interviewees have mentioned that students know the technologies but do not do BIM designing, moreover, less students enter the Finnish construction market. On the other side, practitioners do not usually have higher than bachelor degree which could be an obstacle to see the business opportunities beyond traditional business models. Only entrepreneurship within the industry will produce the change (Spinosa et al., 1997). Lack of entrepreneurship is linked to the education that produces future workforces for a cultural change as established industry is considered to be conservative. Conservatism is linked to education. Moreover, lack of BIM professors in Finland and across the world is under the question.

To conclude, the early technological development and adoption is understood by many as an uncertain process and business. Such development as BIM requires different degree of change in the industry and thus requires greater time and greater chance of failure (Van de Ven et al., 2008). Technological developments do not just reside in individual's efforts but rather are influenced by industry functions (Van de Ven and Garud, 1993). The Finnish case highlights that BIM is an innovation that is exposed to system functions such as education, strategies for technological development and adoption at international scale, markets and resource distributions that are influenced by culture. Most importantly, new technological developments always face uncertainties and pass incremental evolutionary and invisible processes of refinery and adaptations to the context. Our research also shows that strategic incentives for the resource distribution might greatly influence the technological development in terms of business thinking.

Today, innovation must include business models innovation, rather than just technology and R&D. "As better business model often will beat a better idea or technology" (Chesbrough, 2007). Finnish champions introduced first products on the market and invested in immature technologies early, but as it usually happens, second and third movers can often and rapidly introduce a better product or a service to the market later (Van de Ven et al., 2008). BIM perhaps of the first developers turns out not to become the dominant design that ultimately yields the greatest benefits as first. In thinking about innovation opportunities, companies have a choice about how much of their efforts to focus on technological innovation and how much to invest in business model innovation. BIM is a disruptive technology that challenges established business models but industry have struggled to change its business models. Business model innovation and change of contracts to support new collaborative practices is possibly a next step towards a change in the industry. But to continue the change, our interviewees claim that it must be mandated at the national level to be implemented as the values of BIM for the clients that are considered to be the drivers of changes are not understood. Our research also shows that BIM technologies were employed in the tiers of an industry where competitors are stretching towards the frontiers of functionality because the necessary information that is required to support efficient functioning of the industry does not exist due to complexity of construction industry practices (Christensen et al., 2002). Thus, the organisations in construction industry tend to integrate for efficient coordination across disciplines and actors and as a result it falls to managers for make it happen. To conclude, there are strategies and economic motives that must be understood and developed further at national level to gain the promised benefits of BIM as the developments do not just reside in individuals and organisations but rather influenced by industry systems organisations, functions and incentives towards the business ecosystem.

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7. Appendix

Table 1 Selection of interviewees at four levels

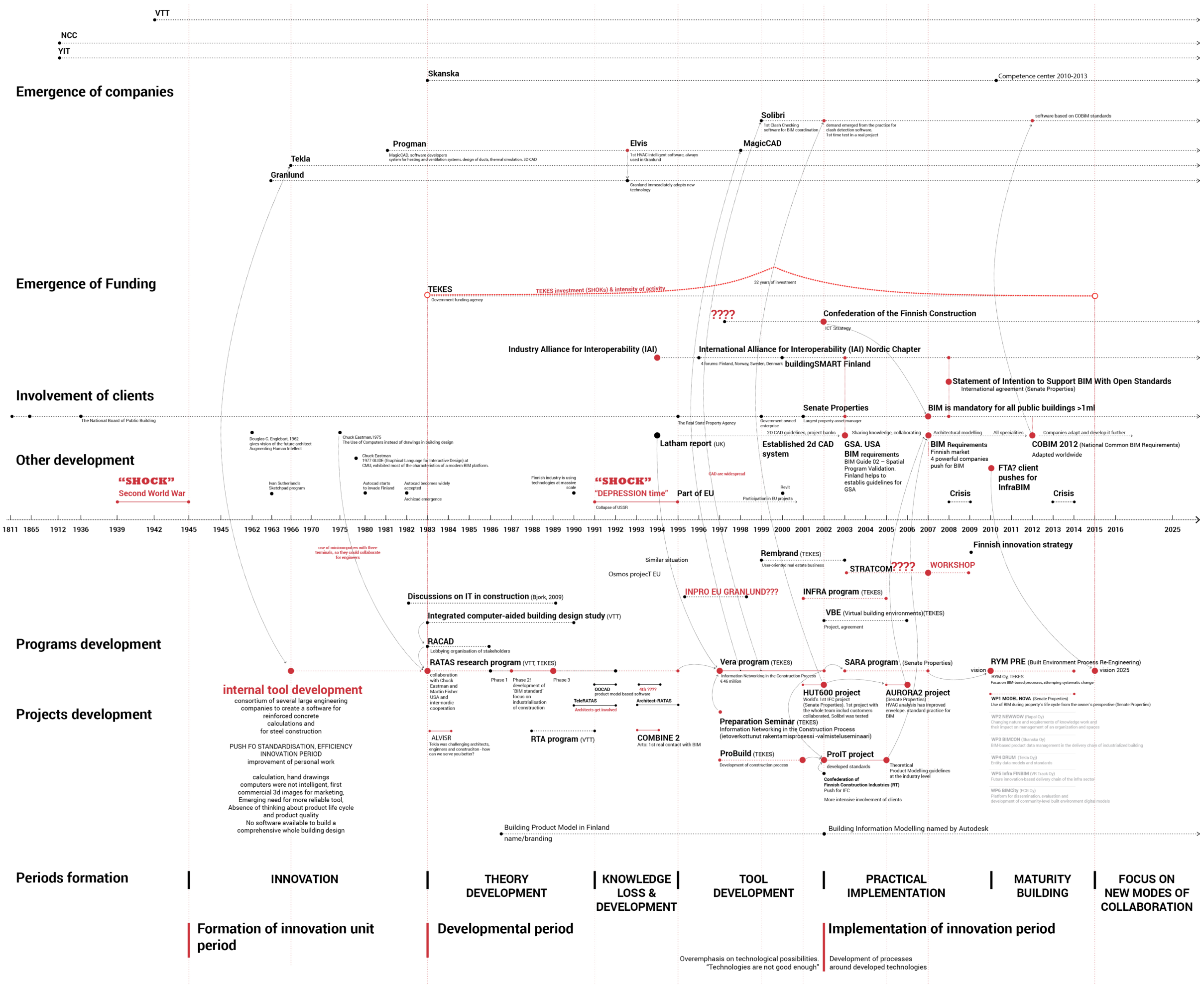
Levels	Sector	Profession and organisation	N	N total
1. Academia	Academia	Research Scientist involved in Finnish ICT development	5	5
2. Public owned clients	Senate Properties (Building sectors)	BIM managers	3	3
	Finnish Transport agency (Infrastructure sectors)	BIM manager	1	1
3. Governmental funding agency	Governmental funding agency	Innovation manager	1	1

4. Business & Management	Software development company	Software Developer	1	7
	General Contractor	General & Business Manager	3	
	Architectural office	Architectural Manager	2	
	Private Organisation	Consultant	1	
5. Workspace	Direct users of ICT & BIM at operational level	Site Manager	1	3
		HVAC Engineer	1	
		BIM technician	1	
			TOTAL	**20**

Table 2 Analysis of historical development of BIM in Finnish business ecosystem

Timeline	**1955-1983**	**1983-1990**	**1991-1995**	**1996-2002**	**2003-2007, 08-09**	**2010-2014**	**2015>**
		ICT development supported financially by TEKES (1983-2015)					
Programs		**RATAS**	**Depression**	**Vera**	**Sara**	**RYM PRE**	
	Innovation	**Theory**	**R&D**	**Tools & Process**	**Business**	**Process**	**New Modes of Collaboration**
2nd World War	**Formation of Innovation Unit period**	**Developmental period**			**Implementation of innovation period**		
	Abstract development		**Loss &Gain**	**Concrete development, Adoption, Implementation**			
"SCHOCK"			**"SCHOCK"**				
drivers	Future Champions develop first IT skills in universities, first access to computers, formation of first ideas for digitalisation of practices	TEKES drives interest in champions to do R&D projects	Recession forces to invest into development of tech. skills and technologies supported by heavy losses of experts	Need to develop tools not available on the market to support new information management	Industry wider implementation, Small incremental improvements, Maturity building, interest in ICT in the industry is slowing down, process of stagnation is increasing, champions are getting retired, BIM is used in large projects only, BIM is co-business. Lack of support from top management level to share information. Culture, contracts and processes have not changed, Contracts are based on 2D and do not supporting collaboration. Not clear who, when and what needs and how to make contractors and engineers friends, Infrastructure sector starts BIM adoption, increasing focus on safety		
Organisational Change process	Creation of fundamental principles & knowledge, use of computers for calculations and simulations, establishment of new universities, need for standardisation, emergence of small software companies, architects are resistant to adopt new tools, recognised problems of culture and organisation	Lobbying for Tekes funding, spread of theoretical knowledge and ideas for ICT, establishment of visions, first theoretical research, international collaboration	Loss of knowledge, experts and young generation, expertise building in technology, Finland becoming high-tech society, increased adoption of computers and CAD, downsizing of companies, need to be efficient, first group for Lean management	Development of practical knowledge and technologies for Integrated information management during the whole lifecycle, first piloting projects, spread of knowledge at international level, over-emphasis on tools development	Piloting projects, Development of roadmaps for business, "no significant results", spread of knowledge at international level, R&D inside companies, wider adoption only after 2005, development of BIM guidelines 2007, top level was not ready to share information,	Spread of practical knowledge at industry level, internal adaptation, first requirement, focus on inter-organisational collaboration, increase awareness in the need in the new modes of collaboration, models are getting less precise as in 2005, Lack of Managers that can lead change	Expand use of IPD, Alliance and Knotworking, focus on energy research, need for government to demand BIM at national level, need in inter-organisational collaboration supported by new contracts and business models, less of research on BIM, BIM is used only in large scale buildings
Standards	**Emergence of the need for standardisation to resolve issues of integration**	Standards for CAD are emerging	CAD standards are mature		IFC is not yet as mature enough, Industry and academia collaborate to develop BIM guidelines	Industry develops national BIM requirements (COBIM 2012),	Expansion of standards to BIM dictionary in collaboration with Norway
Finnish software developed	Tekla, Progman, DOGs by Tekla, UseTechnick (Vertex Argos), Aoftware, Prokons CAD (opposition to CAD), Aoftware		Elvis (MagiCAD)	Solibri, MagiCAD, Tekla Structures	VICO	Tekla BIMsight	
International software developed	Autocad (82), Radar CH, GLIDE (77), Sketchpad (63, 1st CAD)	Archicad (82, 1st BIM software on personal computer), EdCAAD, Cedar, RUCAPS, Sonata, Reflex, Pro/ENGINEER (88), CATIA, Microstation, MiniCAD, Medusa, SurfCAM (CAD/CAM program) (77)	IFC, Building Design Advisor (93), Internet became available public (91), SolidWorks (93)	Revit (2000), Inventor (99)			
Technological change process	In-house development of new tools that were not available on the market, 3D visual marketing, digital services to companies. Technologies support structural, mechanical and electrical design, first time international vendors enter Finnish market (79s), CAD techn. Are too expensive.	Development of research concepts, solid modelling becomes reality for commercial use (80s)	No building product model yet	Development of technologies at large scale, need for more reliable and extensible tools.	Software became capable to do complex design only after 2005	Market offers a range of tool sets to support processes	Focus on mobile technologies, Internet of Things, energy simulation and space organisation and use for FM

Figure 1 Visual map of historical development of BIM in Finnish business ecosystem


Emergence of companies
VTT
NCC
YIT
Skanska
Competence center 2010-2013
Solibri
Progman
Elvis
MagicCAD
Tekla
Granlund
Emergence of Funding
TEKES
????
Confederation of the Finnish Construction
Industry Alliance for Interoperability (IAI)
International Alliance for Interoperability (IAI) Nordic Chapter
buildingSMART Finland
Statement of Intention to Support BIM With Open Standards
Involvement of clients
Senate Properties
BIM is mandatory for all public buildings >1ml
Other development
"SHOCK"
Second World War
Latham report (UK)
Established 2d CAD system
GSA. USA
BIM Requirements
COBIM 2012 (National Common BIM Requirements)
"SHOCK"
"DEPRESSION time"
Part of EU
FTA? client pushes for InfraBIM
Crisis
Crisis
1811 1865 1912 1936 1939 1942 1945 1945 1962 1963 1966 1970 1975 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2025
Finnish innovation strategy
Rembrand (TEKES)
STRATCOM????
WORKSHOP
Discussions on IT in construction (Bjork, 2009)
INPRO EU GRANLUND???
INFRA program (TEKES)
Integrated computer-aided building design study (VTT)
VBE (Virtual building environments)(TEKES)
Programs development
RACAD
RATAS research program (VTT, TEKES)
Vera program (TEKES)
SARA program (Senate Properties)
RYM PRE (Built Environment Process Re-Engineering)
vision 2025
internal tool development
Projects development
HUT600 project
AURORA2 project
Preparation Seminar (TEKES)
ALVISR
RTA program (VTT)
COMBINE 2
ProBuild (TEKES)
ProIT project
Building Product Model in Finland
name/branding
Building Information Modelling named by Autodesk
Periods formation
INNOVATION
THEORY DEVELOPMENT
KNOWLEDGE LOSS & DEVELOPMENT
TOOL DEVELOPMENT
PRACTICAL IMPLEMENTATION
MATURITY BUILDING
FOCUS ON NEW MODES OF COLLABORATION
Formation of innovation unit period
Developmental period
Implementation of innovation period
Overemphasis on technological possibilities. "Technologies are not good enough"
Development of processes around developed technologies.