Lean Management of IT Organizations: Implementation Success Factors and Theoretical Foundation

Full Paper

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Abstract

Lean Management has been successfully applied in production/manufacturing functions since more than four decades. Recently, the interest to investigate Lean Management also in service functions increased. Therefore, this study aims to (1) Consolidate critical success factors (CSFs) for the implementation of Lean Management of IT organizations; and (2) Describe a theoretical foundation for these CSFs. With respect to (1) a database-driven search was conducted. CSFs then were extracted and categorized. In total 13 CSF groups were assigned to three dimensions: Mindset and behavior; Organization and skills; and Process facilitation and performance management. To understand underlying mechanisms better, and with respect to (2) we related existing (IS) theory to identified groups of CSFs. Especially, five theoretical concepts are discussed: Absorptive capacity, Agency theory, Cognitive dissonance, Dynamic capabilities, and System dynamics. Future research needs to validate the results of (1) and (2) empirically in IT functions.

Keywords

Lean Management; Lean; Lean IT; Information technology; Information systems; Theory; Critical success factors; CSF; Lean knowledge work; Lean services; Application development; Application maintenance; Infrastructure services.

Introduction

Lean Management aims to continuously increase value and decrease waste in organizations (Stone, 2012, p. 114). It understands value as the *"[…] capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer"* (Womack & Jones, 1996, p. 311) and waste as *"[…] any human activity which absorbs resources but creates no value"* (Womack & Jones, 1996, p. 15). Examples for waste include defects, extra processing, inventory, motion, overproduction, transport, and waiting (Ohno, 1988, pp. 19–20). Lean Management of IT organizations focuses on the application of Lean Management in an IT-related context, i.e., on "change IT" and "run IT" (including application development, application maintenance, infrastructure services as well as IT management or governance). Thereby IT organizations with internal focus (provisioning of IT services for non-IT functions in the same company) and external focus (provisioning of IT services for other companies/end-users) are comprised. In a structured investigation on the state of the art in the field, Kobus and Westner (2015) find that the current research focus is mainly on IT organizations in a supporting role during the implementation of Lean Management in other functions (mostly manufacturing/production) rather than on the investigation of IT organizations themselves. Especially two research opportunities exist as (1) Research does not provide a clear and justified answer to what makes the implementation of Lean Management of IT organizations successful; and (2) Research is merely related to theory.

While taking on an IT managerial- and business-oriented point of view, this study aims to address this research potential by answering two research questions (RQ):

(RQ1) What are critical success factors (CSFs) for the implementation of Lean Management of IT organizations described in literature?

RQ1 is of special interest as an answer provides management with a starting point where and how to spend its time best during the implementation in order to increase the chances for success. To emphasize this point, we focus explicitly on CSFs of the implementation process ("*How was the implementation facilitated?*") rather than the end state ("*What exactly was implemented?/What was the outcome of the implementation*"). However, while answering RQ1 we acknowledge the ongoing discussion of success factors research, especially on its ability to create actionable research findings for practitioners (Nicolai & Seidl, 2010; Kieser & Nicolai, 2005).

It was necessary to divide the analysis to RQ1 into two parts. Within the first part we focused on Lean Management of IT organizations. Unfortunately, we only identified few IT-related literature items – a result we already expected based on the previous state of the art analysis (Kobus & Westner, 2015). As a consequence, we broadened the search focus to further functions (production/manufacturing and other service functions) in the second part. However, since the complexity of real world management problems cannot be appropriately addressed by a set of compiled CSFs, we examine a potential theoretical foundation within RQ2.

(RQ2) Which existing Information System (IS) theories could provide a theoretical foundation for the identified CSFs for the implementation of Lean Management of IT organizations?

RQ2 is of special interest to current research stream, as an answer provides suggestions for future research to build around discussed theories. RQ2 uses the results of both parts of RQ1 aiming to uncover underlying mechanisms and gaining a deeper understanding of how the previously compiled CSFs for the implementation of Lean Management of IT organizations work and interact.

The rest of this paper is categorized in four sections. The first section briefly discusses the historical development of Lean Management in general and with respect to IT organizations in particular. Section two discusses CSFs derived from literature and categorizes them. The identified categories are then matched with existing IS theories in order to describe a possible theoretical foundation in the third section. Finally, research limitations and opportunities are discussed.

Historical Development of Lean Management of IT Organizations

Lean Management led to a rethinking of a wide range of manufacturing operations (Holweg, 2007, p. 420) and is nowadays considered as a standard management approach in production/manufacturing (Shah & Ward, 2007, pp. 785–786). Toyota is the most famous company related to Lean Management application while the Toyota Production System (TPS) is seen as the source of Toyota's outstanding performance (Spear & Bowen, 1999, p. 97) and the origin of many ideas of Lean Management (Holweg, 2007, pp. 420–423). Today, Toyota is the world's biggest car manufacturer (Bloomberg, 2014) and achieved its highest ever annual profit of USD 17.9 billion (IndustryWeek, 2014) in the financial year 2014.

Research on Lean Management spans a history of more than four decades (Stone, 2012, p. 112) and can be differentiated in six phases (phases 1-5 based on Stone (2012)) as Figure 1 illustrates: (1) Discovery; (2) Dissemination; (3) Implementation; (4) Enterprise; (5) Performance; and (6) Differentiation.

(1) During the *Discovery phase* (1970-1990), especially the 1973's oil crisis triggered Western interest in Japanese management methods as the Japanese manufacturers were gaining market share quickly and were perceived to have competitive advantage (Holweg, 2007, p. 424). In this context, from 1985 to 1990, the Massachusetts Institute of Technology's (MIT) International Motor Vehicle Program (IMVP) investigated differences in car manufacturing of Western and Japanese companies. In 1990, the results were published in the report *"The machine that changed the world"* (Womack, Jones, & Roos, 1990), crediting much of the competitive advantage of the Japanese car manufacturers to Lean Management (Holweg, 2007, pp. 423–427). This made the term Lean Management widely known.

Historical development of research on Lean Management

	1970-1990	1991-1996	1997-2000	2001-2005	2006-2009	2010-present
Phase	(1) Discovery	(2) Dissemination	(3) Implementation	(4) Enterprise	(5) Performance	(6) Differentiation
Characteristics	Interest in Japanese production methods mainly triggered by 1973 oil crisis. Results of MIT's IMVP published	Deployment within US companies (as JIT, TQM, etc.)	Focus on implementation	Expansion to non-production functions	Measuring leanness	Focus on function-specific contexts

Figure 1: Historical development of research on Lean Management based on Stone (2012)

(2) Research interest in the *Dissemination phase* (1991-1996) focused mainly on investigating and detailing the underlying concepts of Lean Management, e.g., Just In Time (JIT) production or the Toyota Production System (TPS). (3) During the *Implementation phase* (1997-2000), initial support for mainly production/manufacturing functions was provided to better implement Lean Management, e.g., dealing with resistive forces, labor relations, and worker stress. Also, first empirical studies were published further extending the body of knowledge. (4) During the *Enterprise phase (*2001-2005), the research focus started to widen from mainly production/manufacturing to also non-production/manufacturing functions including, e.g., product development, marketing, and sales. (5) During the *Performance phase* (2006-2009) research mainly investigated the development of performance outputs of Lean Management transformations and the measurement of a company's leanness. (6) The *Differentiation phase* (2010-present) combines the results of previous phases and takes up especially the early work from the *Enterprise phase*. Research in this phase investigates the transferability of research findings of Lean Management in production/manufacturing to other enterprise functions more empirically and on a broader scale. It acknowledges that the implementation of Lean Management is highly context-specific. Examples for the wide range covered by research in the *Differentiation phase* include: *construction* (Tezel & Nielsen, 2013; Alves, Thaís da C. L., Milberg, & Walsh, 2012); *education* (Antony, 2014); *ethics* (Ljungblom, 2014); *healthcare* (Mazur, McCreery, & Rothenberg, 2012; Radnor, Holweg, & Waring, 2012); *product development* (Martinez León & Farris, 2011); *public organizations* (Kuipers et al., 2014); *real-estate* (Jylhä & Junnila, 2014); *services* (Carlborg, Kindström, & Kowalkowski, 2013); *workers health and safety* (Longoni, Pagell, Johnston, & Veltri, 2013). However, most research is still published in production and supply chain journals (Arlbjørn & Freytag, 2013, p. 174).

Of special interest to this paper is the research focus on IT organizations during the *Differentiation phase*. Several scholars contributed to this area (Haley, 2014; Kumar Kundu & Bairi, 2014; Pernstål, Feldt, & Gorschek, 2013; Turner & Lane, 2013; Lane, Fitzgerald, & Ågerfalk, 2012) covering aspects of Lean Management in mainly application development and infrastructure services. The recently introduced application of Kanban (LKCE, 2014; Ahmad, Markkula, & Oivo, 2013; Anderson, 2010) in application development[1] is a particularly good example of adapting a "classical" Lean Management tool originated in production/manufacturing to use in IT. However, application development and infrastructure services are only parts of an IT organization. Since Lean Management is a holistic approach (Näslund, 2008, p. 278; Dahlgaard & Dahlgaard-Park, 2006, pp. 273–274; Liker & Morgan, 2006, p. 9), research should not focus

[1] Ahmad, Markkula, and Oivo (2013) describe Kanban in application development mainly as process management tool for information exchange between different application development steps.

on only parts of an IT organization but rather on the overarching implementation throughout the organization. However, up until today it is unclear what the CSFs for the implementation of Lean Management of IT organizations are, and how they are related to existing theory.

Critical Success Factors for the Implementation of Lean Management of IT Organizations

Implementation of Lean Management affects the way how operational work is done, requires significant enterprise resources, and invokes organizational changes. As IT organizations and their management usually have to take care of several projects/programs besides the implementation of Lean Management in parallel, it is important to allocate enterprise resources where they create most value in the implementation process. Additionally, IT management has to decide which tasks to delegate and which to handle itself. CSFs can provide appropriate guidance for these decisions. They are defined as "*[…] the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They describe the few key areas where 'things must go right' for the business to flourish*" (Rockart, 1978, p. 85). CSFs are relevant to managers, for example, to know where they should focus their attention or to develop appropriate measures in order to understand progress on these factors (Rockart, 1978, p. 87). We focus on CSFs during the implementation phase since only a successful implementation enables a subsequent focus on specific Lean Management goals (e.g., increased productivity, efficiency, and quality or decreased production time and cost). In order to identify CSFs for the implementation of Lean Management of IT organizations, we applied a database-driven search approach in four steps based on Cooper and Hedges (2009), Remus and Wiener (2009) and Piccinini, Gregory, and Muntermann (2014): (a) Literature retrieval; (b) Literature exclusion; (c) Literature categorization; and (d) Literature analysis. Figure 2 and Figure 3 visualize the search approach and its results for (a) and (b), Figure 4 for (c) and Figure 5 for (d).

(a) Literature retrieval: We needed to divide our search into two parts: (1) Investigating CSFs for the implementation of Lean Management of IT organizations; and (2) Investigating CSFs for the implementation of Lean Management in further functions (e.g., manufacturing/production or other services than IT). Initially, because of RQ1's focus on IT organizations only the first part was planned, however, as only few IT-focused literature items could be retrieved, the broadening in the second part was necessary. Four databases were searched for peer-reviewed journal articles[2]: EBSCO's Business Source Complete, Emerald Insight, ProQuest-ABI/INFORM Complete, and Science Direct. Additionally, five IS conferences were searched through the AIS Electronic Library (AISeL) and Digital Library at IEEE[3]: AMCIS, ECIS, HICSS, ICIS, and PACIS. In part 1 (IT focus), we additionally extended the search to Google Scholar[4], and examined the first 300 hits of resulting items.

[2] Query string for part 1 (IT focus) searched in title, abstract, and keywords: "Lean" AND "Success" AND ("Information technology" OR "Information systems" OR "Application maintenance" OR "Application development" OR "Infrastructure" OR "Support"). Query string for part 2 (non-IT focus) searched in title, abstract, and keywords: "Lean" AND "Success".

[3] Query string for AISel searched in title, abstract, and keywords: "Lean". Query string for HICSS Digital Library at IEEE searched in title: "Lean". IT focus is already given through the selection of respective conferences.

[4] Query string for Google Scholar: "Lean" AND "Success" AND ("Information technology" OR "Information systems" OR "Application maintenance" OR "Application development" OR "Infrastructure" OR "Support").

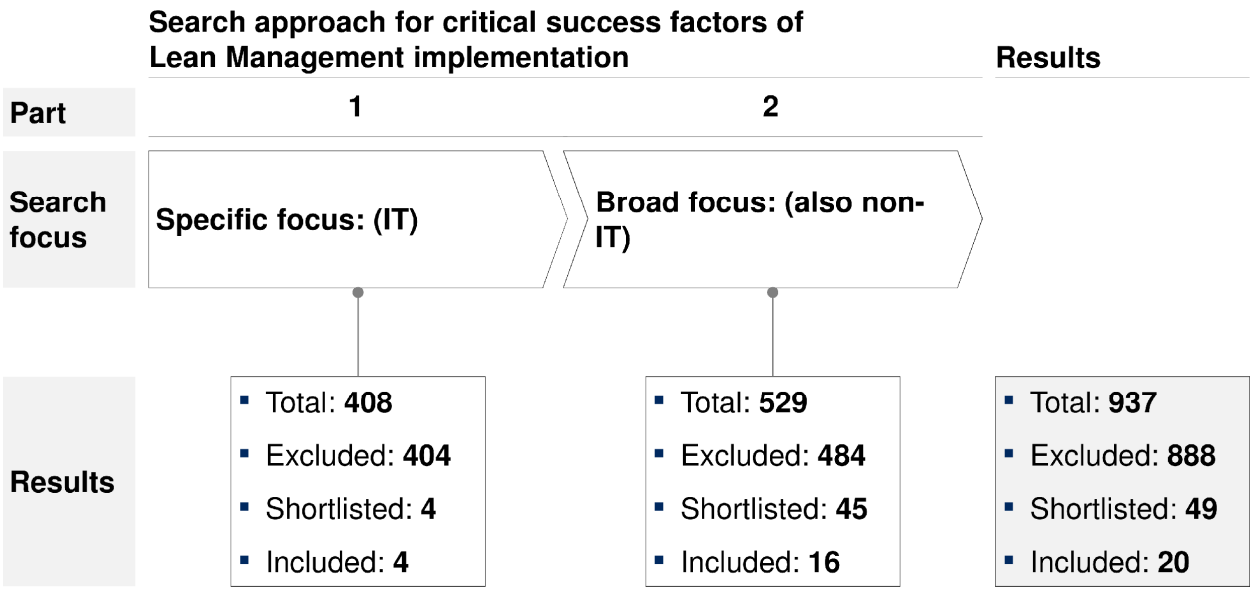

Figure 2: Search approach for critical success factors of Lean Management implementation

(b) Literature exclusion: Literature exclusion was done in two steps (aa) Create a shortlist of relevant literature items; and (bb) Decide which items from the shortlist should be included for detailed analysis. (aa) In order to decide on the relevance of a retrieved literature item, we read its title, abstract, and keywords. A research item was considered as relevant when all of the following criteria applied: Its main focus is on the investigation of CSFs (or critical inhibitors in case of a failed implementation) of Lean Management implementation[5]; its length is 5 pages or more; it does apply a managerial- or business-oriented point of view. This resulted in a total list of 49 literature items. (bb) Since the focus of RQ2 is to understand the underlying mechanisms and to gain a deeper understanding of how the CSFs work and interact from a theoretical perspective, we decided to focus on articles published in highly ranked journals in order to obtain research contributions meeting highest levels of rigor and relevance with a strong theoretical underpinning. To reduce the risk of omitting other major contributions using this approach, we applied the following decision logic: While using the SCImago journal ranking (SJR), each shortlisted literature item was investigated on the (1) Relative ranking[6] of the journal it was published in; (2) H-Index of the journal it was published in; and (3) Citation count in Google Scholar[7]. Step (1) ensured the inclusion of articles published in "Q1-rated" journals (highest possible rating of SJR meaning the journal is in the top quartile of its category) resulting in eleven items for further analysis. Step (2) takes into consideration research items published in very competitive research fields (for example business journals where it might be more difficult for a journal to be part of the "Q1-rated" group). Therefore we included the top three items for further analysis. Step (3) ensured to not ignore articles published in non-listed journals by SJR. Therefore we included the three most cited items for further analysis. Additionally, because of topic relevance, we also included the research articles with an IT focus for further analysis. Figure 3 visualizes the results.

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[5] Also Lean Six Sigma implementations were included, as described by Dahlgaard and Dahlgaard-Park (2006, p. 263); literature items only were included when the paper focused on the overarching implementation not on only specific parts of it (e.g., only on the role of management or only on the role of HR).

[6] Relative journal ranking and H-index retrieved from SJR, http://www.scimagojr.com/ (access date: 17.12.2014). Details for relative journal ranking http://www.scimagojr.com/SCImagoJournalRank.pdf (access date: 15.01.2014). Definition H-index: *"The h index expresses the journal's number of articles (h) that have received at least h citations. It quantifies both journal scientific productivity and scientific impact and it is also applicable to scientists, countries, etc."* http://www.scimagojr.com/help.php (access date: 15.01.2014).

[7] We decided for Google Scholar as web of science did not provide adequate coverage for identified articles and overall "*[…] there is considerable agreement that Google Scholar is a worthwhile alternative source of citation data, in particular in the Social and Information Sciences*" Van-Der-Wal and Harzing (2009, p. 42). Correspondingly, Mingers and Lipitakis (2010, p. 613) state a better coverage of Google Scholar in the area of management research.

Included literature items from shortlist

Reason for inclusion (source)	Literature items
Published in Q1-rated journal (SJR)	Dora et al. 2013; Taylor et al. 2013; Bhasin 2012; Mazzocato et al. 2012; Timans et al. 2012; Bhasin 2011; Vinodh and Joy 2011; Scherrer-Rathje et al. 2009; Näslund 2008; Repenning and Sterman 2001; Karlsson and Ahlström 1996
Published in journal with highest H-index (SJR)	Martínez-Jurado and Moyano-Fuentes 2014; Manville et al. 2012***; Psychogios et al. 2012
Most cited item (Google Scholar)	Achanga et al. 2006; Bhasin and Burcher 2006; Dahlgaard and Dahlgaard-Park 2006
IT focus	Haley 2014; Holden and Hackbart 2012; Kundu and Manohar 2012; Manville et al. 2012***
Not included	Al-Balushi et al. 2014; Assarlind and Aaboen 2014; Jadhav et al. 2014; Lertwattanapongchai and Swierczek 2014; Čiarnienė and Vienažindienė 2013; EL-Khalil and Farah 2013; Görener et al. 2013; Gupta et al. 2013; Habidin and Yusof 2013; Matt and Rauch 2013; Näslund 2013; Sim and Chiang 2013; Akbulut-Bailey et al. 2012; Antony et al. 2012; Laureani and Antony 2012; Čiarnienė and Vienažindienė 2012; Jayaraman et al. 2012; Salleh et al. 2012; Scalera 2012; Searcy 2012; Rahbek et al. 2011; Sullivan 2011; Dalal 2010; Grove et al. 2010; Jeyaraman and Kee Teo 2010; Upadhye et al. 2009; Wilson and Roy 2009; Manotas Duque and Rivera Cadavid 2007; Lathin and Mitchell 2001

*** Item included because of H-index, however is also focusing on IT (counted as "IT item" in Figure 2)

Figure 3: Included items for analysis of critical success factors of Lean Management implementation

(c) Literature categorization: To categorize relevant literature we investigated (aa) Involved functions; (bb) Reference theory; (cc) Research methodology; and (dd) Number of CSF groups covered. Figure 4 visualizes the results.

(aa) The majority of literature items focused on production/manufacturing functions (13 items), mostly investigating different industries in parallel. Remarkably, even with a broad IT focus during the search only a few literature items focusing on IT functions could be identified (4 items). Additionally other services (for example product development) were investigated (3 items). As Lean Management originated in the automotive production/manufacturing function, the focus on production/manufacturing was expected. However, with seven service related items (4 IT + 3 other services) there is a clear indication that Lean Management is of research interest in these areas, too. (bb) Although highly ranked journals were targeted, the majority of literature (18 items) did not have a theoretical underpinning. This result is in line with previous research findings (Kobus & Westner, 2015). Only two items use a clear theoretical foundation in system thinking (Repenning & Sterman, 2001) and dynamic capabilities (Manville, Greatbanks, Krishnasamy, & Parker, 2012). Näslund (2008, p. 178) at least discusses briefly system thinking as perspective to increase likelihood of a successful Lean Management implementation. (cc) The majority of literature items used a qualitative empirical approach (case study – 14 items) followed by some non-empirical items (literature review – 4 items) and quantitative empirical items (survey – 2 items). (dd) In total 13 groups of CSFs were identified. Most literature items covered seven to eight (9 items) or nine to ten groups of CSFs (8 items).

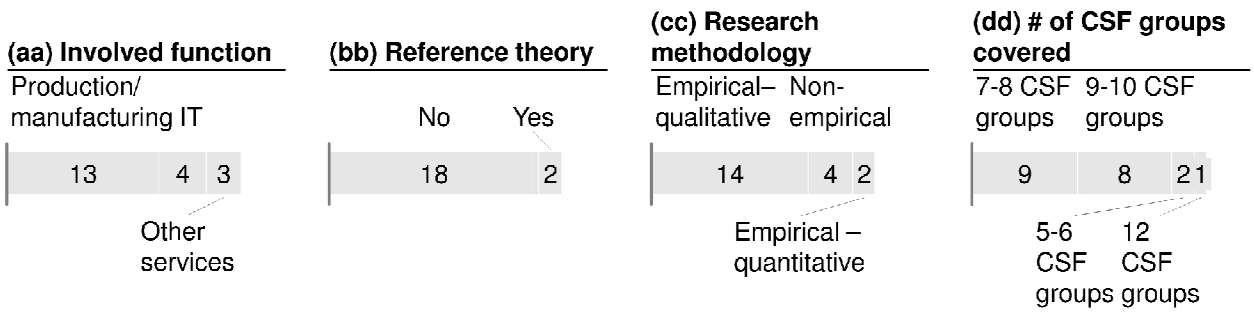

Figure 4: Categorization framework

(d) Literature analysis:

The analysis of CSFs based on identified literature shows that a common understanding of terminology or hierarchy of CSFs does not exist (for example the term leadership "commitment" was not differentiated clearly from e.g. "sponsorship", "involvement", "willingness", "encouragement", "support", "enthusiasm", "visibility", or "availability"). Therefore we decided to investigate the content areas of the mentioned CSFs in each research item and inductively build a hierarchical/framing categorization around these. In order to ensure consistency, grouping logic and hierarchy building was reviewed by the second author independently. We used 3 hierarchical levels: (1) Atomic level: the CSF as mentioned in the source (e.g., "management willingness" or "management support"); (2) Group level: related atomic CSFs are grouped (e.g., the atomic CSFs "management willingness" or "management support" are grouped under the group CSF "leadership involvement"); and (3) Dimension level: Related groups of CSF are grouped again to dimensions (for example the groups of CSF "leadership involvement" and "employee involvement" are grouped (together with more, see below) to the dimension of "mindset and behavior"). During the process of categorization we aimed to minimize overlaps by assigning each atomic CSF to only one group of CSF and each group of CSF to only one dimension of CSF. Regarding data analysis on atomic level, we focused on papers' overviews, rankings, conclusions, or implications in order to extract the CSFs. However, in case the authors did not provide any of these, we aimed to extract the mentioned atomic CSFs and grouped these ourselves. For reasons of phrasing consistency, we reversely phrased critical inhibitors (for example "lack of awareness for implementation" was reversed into "create awareness for implementation"). After several iterations of regrouping and inductive category building we identified an overarching categorization including three dimensions and 13 related groups of success factors. The dimensions are (aa) Mindset and behavior; (bb) Organization and skills; and (cc) Process facilitation and performance management.

(aa) Mindset and behavior includes five groups of success factors: (1) Leadership involvement (What management needs to do in a transformation?) (2) Change culture & work ethic (Which employee's attitude towards change helps most?); (3) Employee involvement (How to involve employees upfront and during the transformation?); (4) Clear vision/long term focus (How to create consistent perception of employees?); and (5) Customer focus (Is the voice of the customer the center of action?).

Within leadership involvement special focus is on role modeling (Kundu & Murali Manohar, 2012, p. 306), and visible support (Scherrer-Rathje, Boyle, & Deflorin, 2009, p. 86) of management. Change culture & work ethic is crucial to overcome implementation resistance (Martínez-Jurado & Moyano-Fuentes, 2014, p. 338) and ensure the sustainability of implementation (Bhasin, 2012, pp. 439–441). Employee involvement needs to be ensured by a collaborative rather than dictatorial implementation approach (Holden & Hackbart, 2012, pp. 199–200). A clear vision and long term focus helps management to accept the impossibility of detailed cost/benefits predictions at the beginning (Achanga, Shehab, Roy, & Nelder, 2006, p. 461) and provides orientation for employees. Customer focus is of central importance (Timans, Antony, Ahaus, & van Solingen, 2012, p. 339) in Lean Management, this includes both internal (for example other departments) and external customers.

Overview on success factor groups of literature items

	Leadership involvement (aa)	Change culture & work ethic (aa)	Employee involvement (aa)	Training and education (bb)	Clear vision/ long term focus (aa)	Performance management (cc)	Existing skills (bb)	Holistic approach (cc)	Organizational changes/ standardization (bb)	Customer focus (aa)	Communication (cc)	Financial resources (bb)	Implementation facilitation (cc)	Total
Haley, 2014	x	x	x	x		x		x		x	x			8
Martínez-Jurado & Moyano-Fuentes, 2014	x	x	x	x	x		x		x					7
Dora, Kumar, van Goubergen, Molnar, & Gellynck, 2013	x	x	x	x			x	x			x	x		8
Taylor, Taylor, & McSweeney, 2013	x	x		x	x	x	x		x		x		x	9
Bhasin, 2012	x		x	x	x	x		x	x		x		x	9
Holden & Hackbart, 2012	x	x	x	x		x		x	x	x			x	9
Kundu & Manohar, 2012	x	x	x	x	x	x					x	x		8
Manville, Greatbanks, Krishnasamy, & Parker, 2012	x		x	x	x		x			x				6
Mazzocato et al., 2012	x		x			x		x	x	x		x	x	8
Psychogios, Atanasovski, & Tsironis, 2012	x	x	x	x	x	x	x			x				8
Timans, Antony, Ahaus, & van Solingen, 2012	x	x	x	x	x	x	x	x	x	x	x	x		12
Bhasin, 2011		x	x	x	x	x	x	x		x		x	x	10
Vinodh & Joy, 2011	x	x	x	x				x	x	x				7
Scherrer-Rathje, Boyle, & Deflorin, 2009	x	x	x		x	x	x		x		x	x	x	10
Näslund, 2008	x	x		x	x	x	x	x	x		x	x		10
Achanga, Shehab, Roy, & Nelder, 2006	x	x		x	x		x		x			x		7
Bhasin & Burcher, 2006	x	x	x		x	x		x	x	x	x		x	10
Dahlgaard & Dahlgaard-Park, 2006	x	x	x	x	x		x	x		x	x			9
Repenning & Sterman, 2001		x	x	x	x	x								5
Karlsson & Ahlström, 1996	x	x				x	x	x	x	x			x	8
Total	**18**	**17**	**16**	**16**	**14**	**14**	**12**	**12**	**12**	**11**	**10**	**8**	**8**	**168**
Percentage	90%	85%	80%	80%	70%	70%	60%	60%	60%	55%	50%	40%	40%	

Dimensions: (aa) Mindset and behavior; (bb) Organization and skills; (cc) Process facilitation and performance management

Figure 5: Overview on success factor groups for Lean Management implementation as mentioned by literature items

(bb) Organization and skills includes four groups of success factors: (1) Training and education (How to teach employees and managers necessary skills?); (2) Existing skills (What type of skillset necessary/ desirable to start with?); (3) Organizational changes/standardization (Which roles, procedures, jobs or responsibilities need to be shifted/created?); and (4) Financial resources (Are necessary funds secured?).

Training and education is a fundamental part of the implementation of Lean Management and should be seen as preventive cost (Bhasin, 2012, p. 455) in order to avoid subsequent (and possibly higher) costs caused by inappropriate skills. It is important that all hierarchical levels understand and respect the underlying concepts (Manville et al., 2012, p. 14). Existing skills focus mainly on the ability to understand and apply Lean Management concepts. Previous knowledge in process improvement programs can be valuable for the skills necessary to implement Lean Management (Timans et al., 2012, p. 351). Organizational changes/standardization need to reflect the new way of working in the organization by, for example, shifting/creating responsibilities. Examples include the introduction of a dedicated Lean Management steering team taking care of the lean implementation in a change agents role (Martínez-Jurado & Moyano-Fuentes, 2014, p. 338), the relocation of process-dependent teams next to each other (Mazzocato et al., 2012, p. 9) or to anchor new standards as formal procedures e.g., in standard operating documents to disambiguate work (Holden & Hackbart, 2012, p. 199). Consistent financial resources to cover implementation costs (for example trainings or consultancies) are necessary (Dora, Kumar, van Goubergen, Molnar, & Gellynck, 2013, p. 159).

(cc) Process facilitation and performance includes four groups of success factors: (1) Performance management (How to set expectation/measure progress of Lean Management implementation?); (2) Holistic approach (How to focus on overall improvement and not only optimization in sub-parts?); (3) Communication (When to communicate what?); and (4) Implementation facilitation (What is the change strategy and time planning?).

Performance management is important during a Lean Management implementation in order to measure progress and success. However, it is not enough to focus on traditional (mostly financial) metrics, as specific lean-adapted metrics are necessary to fully understand the current status of an implementation (Bhasin, 2011, p. 988). Lean Management works best as a holistic approach, therefore it is important to implement it across functions and departments (Näslund, 2008, p. 278; Dahlgaard & Dahlgaard-Park, 2006, pp. 273–274). Implementation facilitation operationalizes the concept of CSFs as it maps actions (what to do – the above mentioned CSF) on a timeline (when to do). However, a simultaneous application of several Lean Management tools is necessary (Bhasin & Burcher, 2006, p. 67). These also need to be adapted to the specific context of a company (Bhasin, 2012, pp. 454–455). Finally regular and open communication of already achieved progress and success from (top) management (Scherrer-Rathje et al., 2009, p. 87) influences the perception of Lean Management implementation of the organization especially on working level.

From an IT perspective the literature analysis showed that current state of the art does not reflect the IT function appropriately. This is in line with previous findings (Kobus & Westner, 2015). There was only one paper on CSFs of the introduction of Lean Management in IT support services (Kundu & Murali Manohar, 2012) without a fully replicable approach and without theoretical foundation. This supports the relevance of RQ1 and especially RQ2 to identify a theoretical foundation in the next section.

A Theoretical Foundation of Critical Success Factors for Implementation of Lean Management of IT Organizations

As part of the literature analysis, we tried to identify theories used to explain mechanisms of successful Lean Management implementation in previous research. However, despite our strict selection process on highly ranked journals, we found only two literature items using a theoretical underpinning in systems thinking (Repenning & Sterman, 2001) and dynamic capabilities (Manville et al., 2012). Consequently, this section takes up these two and provides our own perspectives on further theories which might be able to explain specific CSFs for the implementation of Lean Management of IT organizations better. Following, we briefly describe applicable theories and relate them to the CSF groups from the previous section. Figure 6 provides an overview on the results.

Theoretical foundation of lean management of IT organizations

Category	Theoretical concept	Level of analysis	Most affected CSF groups
Economic	Agency theory	Organizational	Change culture and work ethic; Holistic approach; Performance management
	System dynamics	Individual, organizational	Holistic approach; Change culture and work ethic; Clear vision/long term focus
Social	Absorptive capacity	Individual, organizational	Training and education; Existing skills; Organizational changes/standardization
	Cognitive dissonance	Individual	Leadership involvement; Change culture and work ethic; Clear vision/long term focus
Strategic	Dynamic capabilities	Organizational	Overarching

Figure 6: Overview on theoretical concepts relating to Lean Management (adapted from Dibbern, Goles, Hirschheim, and Jayatilaka,2004, p. 17)

In order to classify possible theories for the implementation of Lean Management of IT organizations, we adapted the structured approach of Dibbern et al. (2004, p. 17) and categorized three types of theories: Economic theories which *"[…] focus on the coordination and governance of economic agents regarding their transactions with one another"*; Social theories which *"[…] concentrate on the relationships that exist between individuals, groups, and organizations"*; and Strategic theories which *"[…]* focus on how firms develop and implement strategies to achieve a chosen performance goal*"*. In total five theoretical concepts were identified: (1) Agency theory; (2) System dynamics; (3) Absorptive capacity; (4) Cognitive dissonance; and (5) Dynamic capabilities.

(1) Agency theory describes a *"[…] partial goal conflict among participants"* (Eisenhardt, 1989, p. 59) and *"[…] reminds us that much of organizational life, whether we like it or not, is based on self-interest"* (Eisenhardt, 1989, p. 64). Applied in the given context, the implementation of Lean Management most likely affects organizational structures and the way how employees carry out daily work. Because of changing roles/responsibilities/job profiles some employees will perceive the implementation of Lean Management as advantageous whilst other as disadvantageous. Therefore, most affected CSFs are (a) Change culture and work ethic as employees are likely to sabotage the change in case they personally perceive it as disadvantageous; (b) Holistic approach, as sub-optimization might be beneficial for an individual (for example the focus of a department lead on his department) but does not lead necessarily to an optimization of the company; and (c) Performance management, as used appropriately, it can reduce the conflict of agent and principal by aligning their interests.

(2) System dynamics is *"[…] the ability to see the world as a complex system, in which we understand that 'you can't do just one thing' and that 'everything is connected to everything else'"* (Sterman, 2001, pp. 9–10). In given context especially affected CSF groups are: (a) Holistic approach, which also aims to understand and handle the complexity of a Lean Management implementation; (b) Change culture and work ethic as it is impossible to steer every detail in a complex system and therefore it is necessary to have general guidelines, and beliefs in place; and in this context also (c) Clear vision/long term focus, to provide a final state to which the system should be optimized in the long term and to provide a guiding vision on all working levels.

(3) Absorptive capacity is described as *"[…] the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends […]"* (Cohen & Levinthal, 1990, p. 128). Since

during a Lean Management implementation several tools need to be applied/learned in parallel and consistently across systems and structures, individuals/organizations have a lot to digest. Therefore, especially affected groups of CSFs are: (a) Training and education to help employees understand and apply related concepts faster; (b) Existing skills (for example gained through previous improvement programs) might reduce the knowledge gap and can serve as fundament to build new ideas/knowledge upon; and (c) Organizational changes/standardization to ensure changed/new tasks and job profiles fit to respective employees. Further related theories in this context are organizational knowledge creation theory defined as *"[…] the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it to an organization's knowledge system"* (Nonaka, Krogh, & Voelpel, 2006, p. 1179) and organizational learning theory defined as *"[…] the process of improving actions through better knowledge and understanding"* (Fiol & Lyles, 1985, p. 803). A carefully defined knowledge sharing process will increase the capability of employees and is fundamental to a flexible workforce (for example with the goal to enable employees to carry out the work of different job profiles – also known as "multiskilling").

(4) Cognitive dissonance theory states *"[…] that people feel a tension when they are aware of an inconsistency either between two attitudes or between an attitude and a behavior"* (Festinger & Carlsmith, 1959, p. 113). In given context especially affected groups of CSF are: (a) Leadership involvement, as employees will observe attitudes and behaviors of their leadership (role modeling); (b) Change culture and work ethic, as individuals need to be ready to align their own beliefs and behaviors with the ones now expected of them; and (c) Clear vision/long term focus as it provides orientation and the scale perceived attitudes and behaviors of colleagues/leadership can be evaluated against.

(5) Dynamic capabilities are described *"[…] as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"* (Teece, Pisano, & Shuen, 1997, p. 516). In given context this might not directly be applicable to a specific group of CSFs but rather to the combination of all together. Lean Management can be seen as dynamic capability itself because it sustainably enables an organization, through its focus on continuous improvement, to reflect and act on environmental changes. Related theories include resource based view defined as *"[…] how competitive advantage within firms is achieved and how that advantage might be sustained over time"* (Eisenhardt & Martin, 2000, p. 1105).

Research Limitations and Opportunities for Future Research

This research contribution faces three limitations: (1) Lack of IT-related literature; (2) Selection of literature items for detailed analysis; (3) Lack of actionable results for practitioners. (1) Since we could only identify four IT-related literature items, it is questionable how far the results can be applied to the implementation of Lean Management of IT organizations. However, since Lean Management is *"[…] a true systems approach that effectively integrates people, processes, and technology"* (Liker & Morgan, 2006, p. 5) which can be applied to not only production/manufacturing functions (Staats & Upton, 2011, pp. 100–103) and contains several characteristics of a change method (Näslund, 2013, p. 86), we believe the identified sets of (a) CSF groups and (b) Theories create a reliable starting point for further research in order to validate the results in IT organizations. With respect to (a), future research could focus especially on the confirmation, that these CSF groups are exhaustive and the most important ones; on the relative (internal) ranking of the CSF groups; on the outcome of the implementation depending on which CSF group was implemented how well; and on the timing on which CSF group need focus at which time of the implementation. With respect to (b), future research could focus on the identified theories' validity regarding their suitability to explain differences in IT functions compared to, for example, manufacturing/production functions. To address (2), we aimed to create full transparency on the selection process and also incorporated external rankings. However, since a selection based on a ranking is only as good as the ranking itself, we cannot guarantee that we incorporated all relevant research contributions in our investigations. With respect to (3), we acknowledge the ongoing discussions of success factors research (e.g., Nicolai & Seidl, 2010; Kieser & Nicolai, 2005). While the objective of this work was clearly not to provide a Lean Management implementation "guideline" for practitioners the results may still serve as a generic template for the implementation of Lean Management of IT organizations (which still needs to be instanced respecting the company-specific context). Academically

the work lays a foundation for further empirical investigations of the implementation of Lean Management of IT organizations.

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