Twenty-three years on in Lean manufacturing: Is there still anything for practitioners to learn?

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Abstract

Twenty-three years have elapsed since Lean techniques originated from the Automotive sector. From then on, Lean techniques have been adopted and fitted to several purposes and their application now ranges to several industry sectors. Meanwhile, the industry has been evolving so quickly that the ability to demonstrate Lean capabilities has turned into a mere order-qualifier in order for some manufacturers to be able to compete, forcing them to find new ways of facing the increased pace of change. An appealing solution for any firm would be to be able to increase their Lean maturity in the short-term. This research suggests that, as an alternative to a painful and costly internal development of Lean, the desired improvement can be achieved in a fast, efficient and cost-effective way by the direct transfer of existing Lean best practices currently implemented in different fields. This paper combines data gathered from a cross-industry interview-based research, conducted with some Australian Lean practitioners, with a comprehensive case study-based literature review of Lean best practices, in order to understand which combinations of best practices and industrial sectors would be able to guarantee the highest mutual benefits by a cross-industry transfer of Lean knowledge. The analysis (1) reviews current Lean best practice applications in (a) Aerospace; (b) Software development; (c) Fast Moving Consumer Goods; (d) Construction; (e) Mining; (f) Food supply chain; (g) Military; (h) Services; together with guidelines on how firms can perform an optimal transition to Lean, (2) benchmarks gathered data with Automotive and (3) clarifies the concept of maximum achievable Lean maturity accordingly. The outcomes have been plotted on a series of qualitative maps. Findings include that an optimal best practice knowledge transfer can be performed within four knowledge transfer “circles”, whose implementation is, therefore, highly recommended in order for each of the involved sectors to quickly achieve a fast and effective improvement in Lean maturity.

Keywords

Lean Manufacturing, Implementation, Best Practice, Cross-Industry, Knowledge Transfer

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1. Introduction to Lean Best Practice Applications Across Industry

More than 20 years have elapsed since Lean techniques originated from the Automotive sector in order to solve its intrinsic production inefficiencies and face the increased challenges of the global market. From then on, Lean techniques have been adopted and fitted to several purposes. Their application now ranges to several industry sectors from Aerospace, to Construction, to Consumer Goods. The current practice of these companies has started and evolved from the Lean principles described by Taiichi Ohno (1988) up to taking diverse and particular shapes. This research project starts from the idea of investigating the different patterns and characteristics Lean practices have followed in different industries and benchmark them to the latest developments of the 23-year-experienced Automotive mainstream. Nonetheless, there still appear to be several, fast-changing barriers to an effective implementation of Lean no matter how it is finally applied. In the recent past, researchers have been suggesting that obstacles to Lean thinking might hide within the company's own culture and the fierce competition it undergoes on the market, limiting its potential and resources to change and the availability of the latest information on how to do it (Mann 2010). As being confronted or challenged by an outsider's perspective can trigger new insights and pathways for collaboration (Clegg, Kornberger and Pitsis 2005), an effective strategy to overcome the barriers to Lean could be the evolution of current communities of Lean practice towards a cross-industry perspective. Indeed, as knowledge transfer has a proven link to organisational effectiveness (Tsai-Lung 2007), a short-term improvement via knowledge transfer of Lean best practices across several industrial sectors could represent a less costly and painful alternative to a long-term research and implementation. Each industry, then, could look at borrowing best practices from other fields, as these might have experienced similar problems in the past and have the right solutions available. This practice could turn out to be the fastest and even only solution for firms to be able to effectively acquire new Lean capabilities and increase their Lean maturity in the short-term. For what concerns geographical boundaries, this research has been carried out in the Australian environment. This constitutes both an advantage and a disadvantage. On the downside, as a continent with a small population and relatively low concentration of large businesses, there is a risk that Australia does not represent the overall latest development in terms of Lean applications. On the other hand, considering the advanced, multi-cultural and mostly unbiased economy, the Australian environment can be seen as the optimal scenario for an independent implementation of original, creative and successful Lean best practices that have been relieved from the pressure of the North American, European and Japanese Lean mainstreams.

2. Research Aims & Methods

This research aims at outlining a common pattern of evolution of Lean techniques from Automotive to other industries. To accomplish this task, the research analyses different sources and identifies common patterns in Lean techniques that have been exchanged across industries. By comparing them with case studies and integrating the analysis with the judgement of consultants and experts active in the field, the research achieves the definition of a unique framework able to facilitate the transfer of Lean knowledge across distinct environments and increase the effectiveness of the system. The research approach consists

of (1) a literature review of case studies of successful Lean implementations and (2) of targeted interviews tailored to the leading concepts found in the literature. This process is iterated for each analysed sector according to the information flow shown in Figure 1 (in Appendix). First, the literature and case studies are gathered and analysed (1), then a general set of questions is created (2) in order to obtain an overall plot for the interview. Therefore, the interview is performed (3) and data are collected (4). The next steps consist in the post-analysis of the results (5) and the formulation of preliminary hypotheses (6). Once all scheduled interviews have been conducted, the general framework to classify and assess Lean best practices is developed (7) and hypotheses on possible knowledge transfer flows are turned into conclusions (8). Steps from one to six have been iterated for every industrial sector to be analysed. Step seven has included a cross-reference analysis of all sectors in order to understand common aspects and develop the main hypotheses on the findings. In order to attain a global view of the different Lean practices which have been applied over the years, the selection of case-studies to be reviewed has focused on all sectors, in addition to Automotive, where Lean has found intensive implementation and use. These include:

- Aerospace
- Software Development
- Fast Moving Consumer Goods (FMCG)
- Construction
- Mining
- Food Supply Chain (SC)
- Military
- Services
- The Overall Transition to Lean

The last sector, i.e. the generalised transition of a business into Lean, has been used as a "virtual" yardstick to evaluate single sectors. In total, seven interviews have been conducted with the assortment reported in Table 1. The other relevant areas have been covered by literature case studies alone.

Table 1: Interviewee List

N.	***Interviewee***	***Position***	***Relevant Sector***
1	L.S.	Project Coordinator, Aerospace Projects	*Aerospace*
2	Dr R.T.	Senior Lecturer, Faculty of Science and Technology Owner, Technological Consulting	*Software Development*
3	S.S.	Managing Director, Management Consulting	*FMCG*
4	T.R.	Area Manager, Construction	*Construction*
5	P.G.	Project Manager, Mining EPCM Contractor	*Mining Projects*
6	R.S.	Former Director of Acquisition and Logistics, Air Force	*Military*
7	Dr E.F.	Associate Professor, Faculty of Business	*Transition to Lean*

Interviews have been “conducted by both researchers, one adopted the lead interview role, posing questions, whilst the other adopted a data collection role” (Perez et al. 2010, 62). Roles have been assigned in each interview in such a way that the leading interviewer would be the one who supervised the relevant literature review. The fact that a great amount of effort has to be put in the preparation and contact with the interviewee can cause the total amount of interviews performed to be far from representing a relevant sample. This is the reason why data collection has been aimed at exploiting a high-quality exchange of information in order to compensate for the low quantity of the tested sample. Indeed, the iterated one-to-one approach and subsequent discussion between the authors have still allowed to critically analyse the collected information with an unbiased approach, which constitutes the key to any critically-led research (Facione 2010). This process has yet promoted a two-way continuous flow of information between the interviewer and the interviewee, challenging the traditional and rigid one-way flow towards the interviewer and creating a positive, proactive environment for the interviewee to feel both engaged and comfortable at all times. The detailed case study literature review, related sources and the specific interview questions have not been reported in this paper in order to comply with length limitations. Due to the large dimension, graphs and figures generated by the research have been included as a separate appendix.

3. Identified Lean Best Practice Scenarios

A Lean best practice is intended to be a specific characteristic of the Lean system under analysis, i.e. a tool, a procedure or a set of actions aimed at productivity improvement and/or cost reduction. Therefore, the higher the number of Lean best practices, the more mature the Lean system is. The review of Lean case studies from the literature and the information collected in the interviews have allowed the identification and categorisation of Lean best practices within the different environments.

3.1 Current Lean Best Practice Scenario

The research has led to the identification and categorisation of the current Lean best practices per industrial sector under analysis. The confrontation with practitioners has shown the strong correlation of the number of best practices with the Lean effectiveness in different environments, proving the validity of the approach. It has been possible to observe that different best practices are currently widespread among different sectors. The results are reported in the Lean Best Practice Table attached as **Error! Reference source not found.** (in Appendix). The Lean Best Practice Table illustrates the current state of knowledge and implementation of Lean best practices across the analysed sectors in light grey. The character “✓★” means the Lean practice represents a world-class best practice of the related industrial sector. The character “✓” indicates that the Lean practice is well implemented in the related industrial sector and close to matching the performance of the leading sector. An empty box entails no known correlation between the analysed sector and the related Lean practice. This observation does not imply that future applications in the field are not feasible, whereas it merely conveys the present state-of-the-art. The field “Mining Operations” has been marked differently, as not enough research data were available. Therefore, listed items require further research in order to be confirmed as actual best practices.

3.2 Recommended Lean Best Practice Scenario and Comparison

The dark layer in Table 3 (in Appendix) relates to a possible future state of Lean best practices across different sectors, i.e. Lean implementations that can be raised to the level of best practices in each sector. The previous Lean best practice scenario in light grey has been used as a yardstick against which the analysis of possible knowledge expansion has been conducted. The symbol "↗" is employed to denote these Lean applications and recommend them as potential best practices for a future development of Lean in each particular sector. The analysis can be further extended to compare the current state of Lean practice against the recommended one on graphs. Therefore, a histogram and a bar graph can be plotted: the former regarding the sector analysis (Table 4: Lean Best Practice Chart

Figure 2 in Appendix) and the latter concerning the diffusion of Lean best practices (Figure 3 in Appendix). As shown in Table 4: Lean Best Practice Chart

Figure 2, Automotive is the sector which possesses the widest application of Lean best practices. Construction ranks sixth, behind, besides Automotive, Aerospace, Software Development FMCG and Services, but ahead of Military, Food SC and Mining Projects. According to

Figure 3, some practices such as the use of “visual supporting tools” or the adoption of “introductory workshops to Lean” are well spread across all sectors, as the nature of these practices is very straightforward and versatile. In contraposition, practices such as “predisposition towards the Lean culture” and the “focus on performance outputs” are not extensively implemented at a world-class level, although a future implementation through knowledge transfer is feasible.

3.3 Definition of Lean Maturity

Besides the visual approach, it is also possible to compare the values that have been used in order to generate the graphs. Table 4 (in Appendix) shows a rank (from best to worst) of sectors where Lean techniques have been implemented and the most widespread practices at current and recommended states of knowledge transfer (left and right columns). It also illustrates the rank of the necessary transfer of best practices and the sectors that would most benefit from a cross-industry knowledge transfer (central column). The numerical analysis of the Current and Recommended Lean Scenarios presented in the left and central columns by an even subdivision of the values into five categories enables to determine the current and recommended Lean maturity of a determined sector. The results are presented in Table 2. The number of times a specific Lean best practice has been used, as presented in the right column of Table 4 (in Appendix), can be, instead, used to determine the easiness of implementation of the practice itself, yielding the ranking of recommended improvements (not presented in table format). Despite ranking as “high”, Automotive still exhibits the potential for a considerable leap forward up to reaching the maximum achievable maturity. Nonetheless, each sector has the potential to make a leap forward in Lean maturity. In the case of Construction, Military and Food Supply Chain, this leap can lead up to an increase of two rankings in term of Lean maturity. These outcomes implies that, notwithstanding the fact that it originated in the Automotive field, Lean has been further developed by other sectors and has a tremendous potential for improvement in some of the currently lower ranked sectors, such as Construction, ranking first in recommended improvement differential.

Table 2: Current and Recommended Lean Maturity by Sector

Lean Maturity / Sector	Very High (25-21)	High (20-16)	Fair (15-11)	Low (10-6)	Very Low (5-0)
Automotive	***R***	*C*			
Aerospace	***R***		*C*		
Software Development		***R***	*C*		
FMCG			***R***	*C*	
Services			***R***	*C*	
Construction		***R***		*C*	
Military			***R***		*C*
Food Supply Chain			***R***		*C*
Mining Projects				***R***	*C*

C – Current; ***R*** – Recommended

3.4 Lean Best Practice Map

In order to allow not only the ranking of best practice knowledge, but also the visualisation of the distribution of this knowledge across the analysed industrial sectors, the outcomes of the above analysis have been plotted on a qualitative bi-dimensional map, the Lean Best Practice Map (Figure 4: Lean Best Practice Map / Knowledge Transfer Map in Appendix). In the Lean Best Practice Map, the two axes represent a continuum of Process/Project and Product/Service orientation of each sector. This choice allows to make some considerations on the achievability of an optimal knowledge transfer of Lean best practices among confining sectors. Process/Project represents the level of operational versus project work typically performed in the sector, the former being of ongoing and repetitive nature, whereas the latter being temporary and unique (Project Management Institute 2008, 22). Service/Product represents the mix of tangible and intangible goods a business sector is involved with and has been developed by Kotler et al. (1999, 646-647). The Lean Best Practice Map contains three indicators; extension, distortion and orientation of the oval shapes representing the analysed sectors. The extension of the oval shapes on the Lean best practice map is directly proportional to the score each analysed sector has obtained in the best practice count (see

Figure 2 in Appendix) and, consequently, the current and recommended Lean maturity. The distortion of the oval shapes along a specific dimension has been determined by a qualitative review of the spread of the sector practices along that dimension. For example, the Automotive sector has been held as characterised by a higher dispersion and variety of process and project-applications than on the Service/Product dimension. Perfectly round shapes represent sectors showing a balanced spread of practices along both dimensions. The orientation of the oval shapes has been defined by qualitative reasoning on the level of correlation shown by the two Process/Project and Service/Product dimensions in each sector. For example, it has been held that a more complex product would require an Aerospace company a more project-orientated approach. On the other hand, a more complex service effort, i.e. on maintenance, would require a higher process-orientated approach to the very same company. Perfectly horizontally or vertically aligned shapes represent sectors showing no sign of correlation between the two Process/Project and Service/Product dimensions. Both measures of distortion and orientation have been achieved without altering the overall extension value, i.e. the area of the shape corresponding to the Lean maturity.

4. Achievement of the Future Recommended Lean Scenario via Knowledge Transfer

4.1 Required Knowledge Transfer

Knowledge transfer across industry has been held in this study as the key to allow the Lean approach to progress to both a higher level of maturity in current applications and the development of new applications. The term knowledge transfer (KT) refers, in this research,

to the implementation of Lean tools and techniques from one sector to another characterised by a lower quality of such practices. Therefore, a KT analysis has been performed on the outcomes of the Lean best practice tables, with the support of the Lean Best Practice Map. The KT analysis has been based upon the hypothesis that an effective cross-industry knowledge transfer of Lean best practices would be facilitated by map proximity, i.e. confining sectors could more-easily achieve an effective transfer. This hypothesis is backed by English and Baker's (2006) framework for Rapid Knowledge Transfer (RKT), Tsai-Lung's (2007) review of the most common barriers to knowledge transfer and Holoyak and Thagard's (1995) view of analogical thinking as a source of highly novel innovations. Indeed, the first step in English and Baker's (2006) studies on how to achieve RKT is to search and import best practices, intended as any process input, step or output showing outstanding capability, reliability and adaptability by others. On the other hand, two of the top three barriers preventing an effective knowledge transfer, according to Tsai-Lung (2007), are environmental and technological characteristics. This standpoint, together with the lack of specific cross-field studies (Tsai-Lung 2007), does not preclude the idea that cross-industry knowledge transfer can be facilitated by sector affinity, i.e. confining sectors on the Lean Best Practice Map can be eligible for a highly effective transfer of Lean best practices. Eventually, Holoyak and Thagard (1995) state that cross-industry innovation often originates from analogical thinking, i.e. the process of adapting somebody else's idea to one's own setting and application (Gentner, Rattermann and Forbus 1993). This idea will work better if structural similarities that are most valuable for problem solving are recalled in the process.

4.2 Knowledge Transfer Map

The results of this analysis have been superimposed to the Lean Best Practice Map, generating the Knowledge Transfer Map reported in Figure 4 (in Appendix). This map shows the optimal knowledge transfer patterns of best practices among neighbouring sectors by white arrows and allows drawing some conclusions on the feasibility of the short-term increase of Lean maturity via knowledge transfer. In some cases, however, recommended Lean maturity cannot be achieved by optimal KT only. Non-optimal transfers have been added and categorised in the Knowledge Transfer Map by grey-scale arrows. Observations on both maps are reported in the concluding section.

5. Final Considerations

5.1 Knowledge Transfer Circles – Where to Gain Lean Maturity from

The presented Lean Best Practice chart (Table 4 in Appendix) has shown that each of the analysed sectors, including Automotive, has the potential to quickly improve the current level of Lean maturity in the short-term via knowledge transfer. The shift should happen by each sector transferring some of its current Lean best practices to other sectors prone to accept it. According to this analysis, sectors currently scoring the highest Lean maturity (Table 4 in Appendix) are, not-unexpectedly, Automotive, Aerospace and Software Development. Nonetheless, the fact that Aerospace and Automotive also score, respectively, second and fifth in gap to maximum achievable Lean maturity proves that there is indeed, even for these sectors, still something to learn. The lower ranking of some sectors such as Construction,

though, does not hinder the potential of improving considerably in the short-term. In particular, Construction, ranking sixth in current Lean maturity, leads the chart of recommended improvement.

A possible interpretation of the above findings is:

1. Effectively, there is still something for practitioners, even in Automotive, to learn (this is the definitive answer to the question posed in the research title);
2. Some Lean best practices currently implemented in different sectors have the potential to bring the Automotive (and Aerospace) leadership in Lean to a whole new level in the short-term.
3. The Construction business has the highest potential to increase its Lean maturity in the short-term, suggesting that even a project-centred environment can reach a "High" Lean maturity by improving in process capabilities

Doubts on the above findings, though, can concern whether the required knowledge transfer to reach maximum Lean maturity can always be achieved at an optimal level for every case. Thanks to their proximity on the map, an optimal and bi-directional best practice knowledge transfer can be achieved only within neighbouring sector areas. Examples include:

1. FMCG, Automotive and Aerospace;
2. Aerospace, Military and Software Development;
3. Construction and Mining Projects;
4. Services and Food Supply Chain.

In particular, an ongoing reciprocal transfer of information between Automotive and Aerospace is facilitated by the high levels of Lean maturity already scored by both in the current scenario. Such transfer shows the potential of not only achieving a reciprocal increase in Lean maturity, but of developing a whole new generation of Lean best practices and techniques. In addition, the cooperation among commercial Aerospace, Military and Software Development, and between Construction and Mining Projects also fits the common idea of ongoing similarities among these sectors and confirms the applicability of an optimal knowledge transfer of Lean best practices. Furthermore, the map positioning of Construction seems also to justify the current difficulties in developing a consistent Lean Construction theory directly from the Automotive basics. Nonetheless, the Construction sector unveils a large potential to improve once a higher focus towards the process, i.e. an expansion towards the left area of the map, is achieved. Further research will need to focus on finding ways of transforming what would be a complex Lean best practice knowledge transfer, due to the distance on the map, into an effective one. In this matter, the high degree of similarity noticeable between Construction and Mining Projects could help these two sectors, once reached a uniform knowledge level to move together in order to increase the speed and effectiveness of the process. As for the Lean maturity leader, Automotive, no matter the accessibility of the outgoing knowledge transfer flows, the inbound knowledge transfer (directed towards Automotive) would be characterised by a high degree of complexity, resulting in a considerable difficulty to achieve improvements. Nonetheless, quite unexpectedly, Services and Software Development seem to hold the right qualities to help

Automotive to improve, confirming Automotive-specific shortcomings in term of service, team pacing and requirement-related Lean practices. Whether a complex knowledge transfer from Services or Software Development into the Automotive sector could possibly be achieved by higher investments or the use of intermediaries (Gassmann, Daiber and Enkel 2011), its real value should be benchmarked by further studies against other possible alternatives to allow the achievement of a short-term improvement in Lean maturity. This reasoning applies to any transfer outside of the “optimal” ones expressed by the circles. The process required in order for any individual sector to benefit from complex knowledge transfer of Lean best practices in the near future would call for further considerable economic and research-related efforts.

5.2 Further Studies

The study has confirmed the need for further research on:

1. Validation of the proposed model for cross-industry knowledge transfer of Lean best practices with firms. A survey approach would guarantee the sufficient statistical sample (Lavrakas 2008; Wiedenfels 2009) to be able to draw some quantitative considerations on the achieved level of refinement and potential acceptance;
2. Implementation of proposed optimal cross-industry knowledge transfer of Lean best practices;
3. Investigation on feasibility of complex knowledge transfer outside of the circles and study of possible alternatives to allow the reaching of maximum Lean maturity;
4. Reweighting of proposed model and implementation strategy from a global perspective;
5. Reweighting of proposed model and implementation strategy from a different local perspective presenting systemic cultural and political differences from Australia;
6. Definition and evaluation of Lean-culture and productivity-related KPIs, such as effectiveness of knowledge transfer (Zhao 2011) and attained productivity increase versus Lean maturity, to allow evaluation of actual achieved results.

All of the listed points listed strongly support the idea that cross-industry transfer of Lean knowledge is a topic in great evolution with wide opportunities of research.

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Appendix

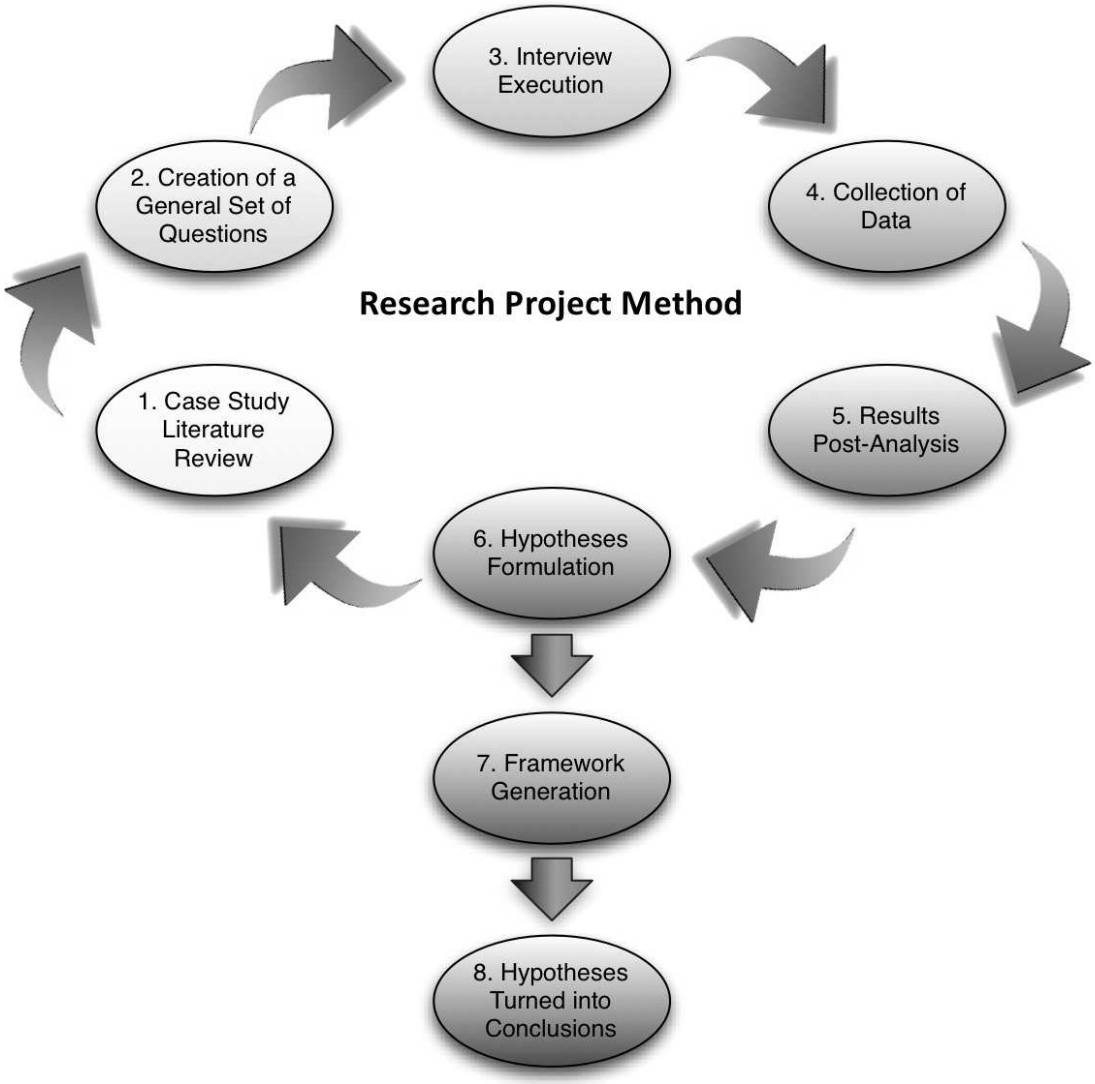

Figure 1: Research Method Framework

Recommended Lean Best Practice Scenario

Analysed Sectors		Reviewed Lean Best Practices: 1 Lean as a "Core Strategy"	2 Direct Knowledge Transfer from Automotive	3 "Ideal" One-Piece Flow	4 Lean Enterprise Approach	5 Pacing/Synchronisation of Development Teams	6 Customer Involvement	7 Optimised Flow of Information	8 Focus on Performance Outputs	9 Maintenance as Key to Functionality	10 Holistic Approach Towards Change	11 Lean Design/Engineering	12 Lean Project Delivery System	13 Projects as "Temporary Production Systems"	14 Visual Tools Support	15 Introductory Workshops to Lean	16 Use of the Client's Lean Tools	17 Lessons Learnt/Embedment of Lean	18 Simple Lean in SMEs	19 Value Chain Analysis	20 Standardization of the Supply Chain	21 Kaizen in Product Quality/Reliability/Mantainability	22 Lean Requirements Management	23 Lean Service	24 Cross-Functional Improvement Teams	25 Confort/Confidence in Self-Managed Teams	26 Predisposition Towards Lean Culture
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Automotive		✓		↗	✓	↗	↗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↗	✓	✓	✓	↗	↗	✓	✓	✓
Aerospace		✓★	✓★	✓★	✓★	↗		↗	↗		✓	↗		✓	✓	✓	✓	✓		✓	↗	✓	↗		✓	↗	✓
Software Development					✓	✓★	✓★	✓★	✓			✓	✓	✓	✓	↗		↗				✓	✓	↗	✓	✓	↗
FMCG		↗	✓	✓	↗			↗	✓★	✓★	✓★				✓	✓		↗		✓	↗	↗					✓
Construction						↗	↗	↗	↗		↗	✓★	✓★	✓★	✓★	✓	✓	↗	↗						↗	↗	↗
Mining	Projects							↗	↗				↗	↗	✓	✓★	✓★	✓★								↗	↗
	Operations			ⓘ	ⓘ			ⓘ	ⓘ	ⓘ	ⓘ				ⓘ	ⓘ		ⓘ		ⓘ	ⓘ				ⓘ	ⓘ	ⓘ
Food Supply Chain					↗		↗		↗		↗				✓	✓			✓★	✓★	↗	↗					↗
Military								↗**	↗	✓		↗			✓	↗					✓★	✓★	✓★		↗	↗	↗
Services		↗*		↗			✓	✓	✓						✓	✓			↗	✓	✓	✓		✓★			↗
Transition to Lean																									✓★	✓★	✓★

✓★	Best practice examined in the relevant section of the research
✓	Best practice confirmed by the research
ⓘ	Needs further investigation (see shortcomings)
↗	Recommended implementation via best practice knowledge transfer
*	Excluding applications with specific constraints (e.g. Emergency Rooms in Healthcare - see Lean Service section)
**	Excluding classified data
	Not implemented / Not applicable
	According to the authors' experience in the field
	Transversal section used as a benchmark to evaluate lean transition (see "The Overall Transition to Lean" section)
	To be reviewed in further studies

Table 3: Lean Best Practice Table

Table 4: Lean Best Practice Chart

Current Scenario		
Sectors		
1	Automotive	19
2	Aerospace	14
3	Software Development	13
4	FMCG	9
4	Services	9
6	Construction	6
7	Military	5
8	Food Supply Chain	4
8	Mining Projects	4
Best Practices		
1	Visual Tools Support	9
2	Introductory Workshops to Lean	7
3	Kaizen in Product Quality/Reliability/Mantainability	5
2	Value Chain Analysis	5
5	Focus on Performance Outputs	4
5	Projects as "Temporary Production Systems"	4
5	Use of the Client's Lean Tools	4
8	Cross-Functional Improvement Teams	3
8	Holistic Approach Towards Change	3
10	Lean Design/Engineering	3
10	Lean Enterprise Approach	3
10	Lean Project Delivery System	3
10	Lessons Learnt/Embedment of Lean	3
10	Maintenance as Key to Functionality	3
10	Optimised Flow of Information	3
10	Predispostion Towards Lean Culture	3
10	Standardization of the Supply Chain	3
18	"Ideal" One-Piece Flow	2
18	Confort/Confidence in Self-Managed Teams	2
18	Customer Involvement	2
18	Direct Knowledge Transfer from Automotive	2
18	Lean as a "Core Strategy"	2
18	Lean Requirements Management	2
24	Lean Service	1
24	Pacing/Synchronisation of Development Teams	1
24	Simple Lean in SMEs	1

Recommended Improvements		
Sectors		
1	Construction	10
2	Aerospace	7
2	Food Supply Chain	7
2	Military	7
5	Automotive	6
5	FMCG	6
5	Mining Projects	6
8	Services	4
8	Software Development	4
Best Practices		
1	Predispostion Towards Lean Culture	6
2	Focus on Performance Outputs	5
2	Optimised Flow of Information	5
4	Confort/Confidence in Self-Managed Teams	4
5	Customer Involvement	3
5	Lessons Learnt/Embedment of Lean	3
5	Pacing/Synchronisation of Development Teams	3
5	Simple Lean in SMEs	3
5	Standardization of the Supply Chain	3
10	"Ideal" One-Piece Flow	2
10	Cross-Functional Improvement Teams	2
10	Holistic Approach Towards Change	2
10	Introductory Workshops to Lean	2
10	Kaizen in Product Quality/Reliability/Mantainability	2
10	Lean as a "Core Strategy"	2
10	Lean Design/Engineering	2
10	Lean Enterprise Approach	2
10	Lean Requirements Management	2
10	Lean Service	2
20	Lean Project Delivery System	1
21	Projects as "Temporary Production Systems"	1
22	Direct Knowledge Transfer from Automotive	0
22	Maintenance as Key to Functionality	0
22	Use of the Client's Lean Tools	0
22	Value Chain Analysis	0
22	Visual Tools Support	0

Recommended Scenario		
Sectors		
1	Automotive	25
2	Aerospace	21
3	Software Development	17
4	Construction	16
5	FMCG	15
6	Services	13
7	Military	12
8	Food Supply Chain	11
9	Mining Projects	10
Best Practices		
1	Focus on Performance Outputs	9
1	Introductory Workshops to Lean	9
1	Predispostion Towards Lean Culture	9
1	Visual Tools Support	9
5	Optimised Flow of Information	8
6	Kaizen in Product Quality/Reliability/Mantainability	7
7	Confort/Confidence in Self-Managed Teams	6
7	Lessons Learnt/Embedment of Lean	6
7	Standardization of the Supply Chain	6
10	Cross-Functional Improvement Teams	5
10	Customer Involvement	5
10	Holistic Approach Towards Change	5
10	Lean Design/Engineering	5
10	Lean Enterprise Approach	5
10	Projects as "Temporary Production Systems"	5
10	Value Chain Analysis	5
17	"Ideal" One-Piece Flow	4
17	Lean as a "Core Strategy"	4
17	Lean Project Delivery System	4
17	Lean Requirements Management	4
17	Pacing/Synchronisation of Development Teams	4
17	Simple Lean in SMEs	4
17	Use of the Client's Lean Tools	4
24	Lean Service	3
24	Maintenance as Key to Functionality	3
26	Direct Knowledge Transfer from Automotive	2

Figure 2: Current vs. Recommended Lean Best Practice Scenario – By Sector

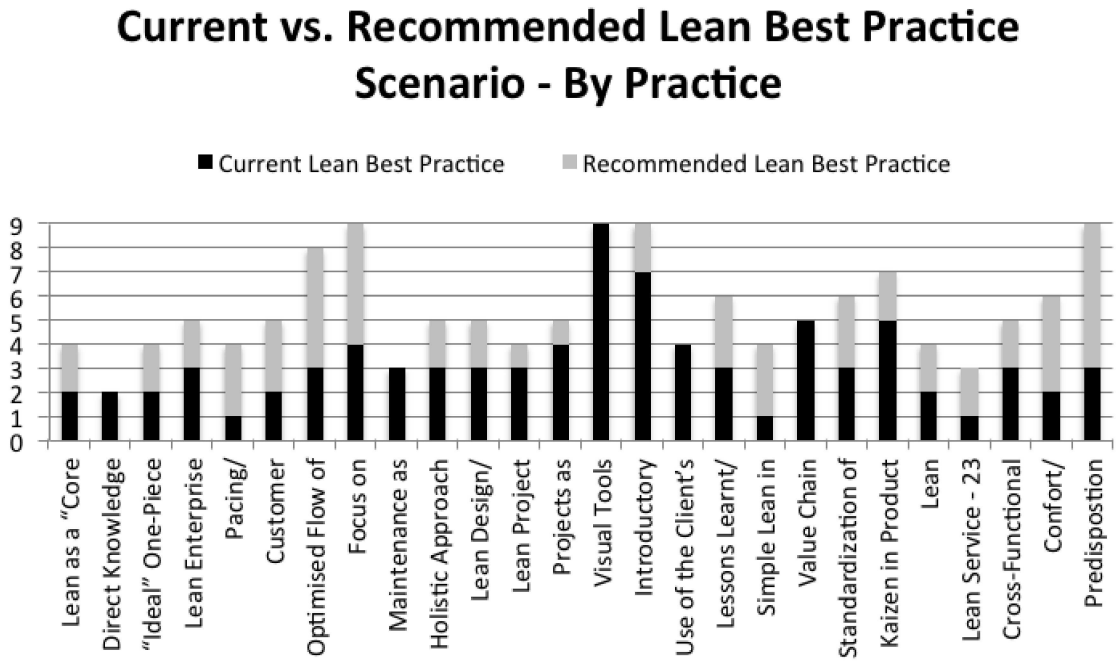

Figure 3: Current vs. Recommended Lean Best Practice Scenario – By Practice

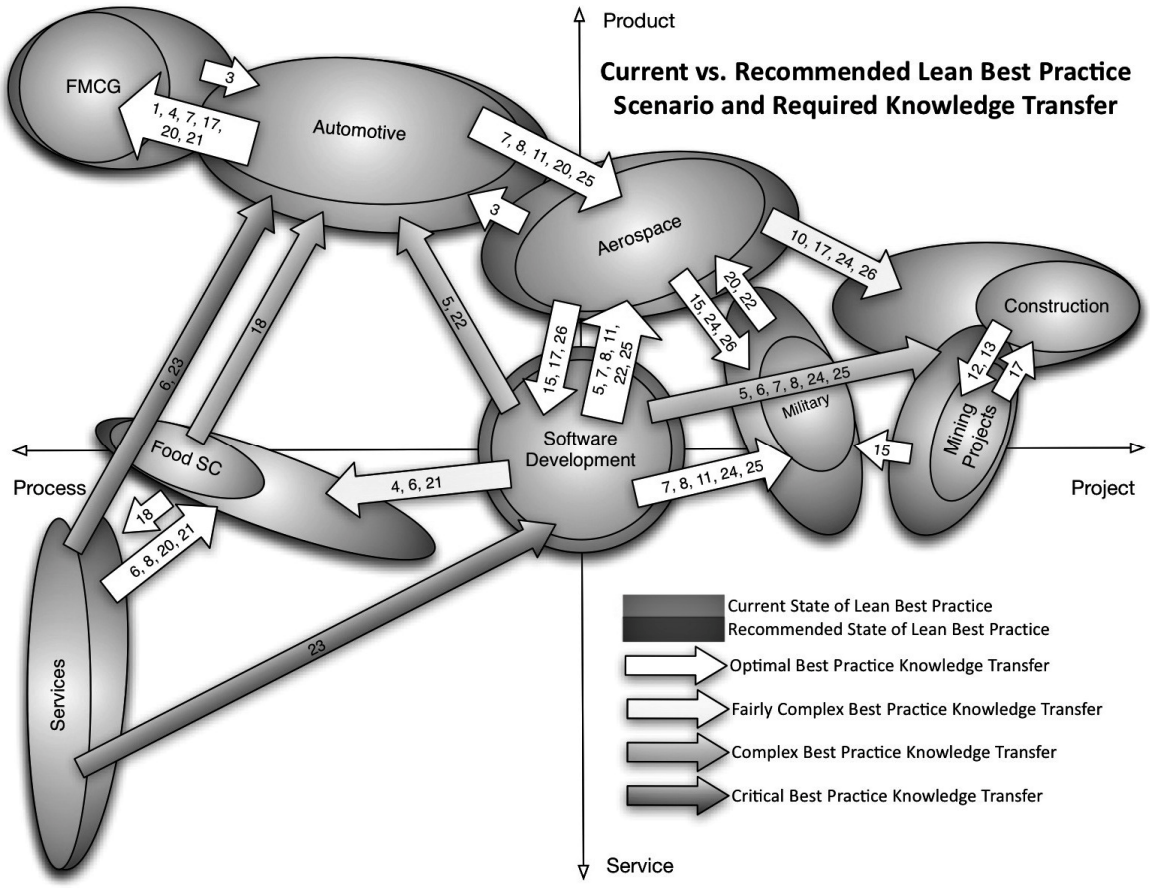

Figure 4: Lean Best Practice Map / Knowledge Transfer Map