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IMPLEMENTATION ANALYSIS OF LEAN ENABLERS FOR MANAGING ENGINEERING PROGRAMS

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1. Introduction

A modern society relies heavily on technology and complex and large systems. Examples are cars, airplanes, factories, power plants, or our communication infrastructure. Those technical systems are being developed through engineering programs. These complex and large-scale programs are often faced with significant cost and schedule overruns [GAO 2009], [Cantarelli 2010]. Lean systems engineering offers valuable enhancements to the effectiveness and efficiency of the development process [Oppenheim 2011a]. Still, insufficient integration of systems engineering and program management causes inefficiencies through unproductive tension [Conforto 2013]. Consequently, the Consortium for Engineering Program Excellence (CEPE) at the Massachusetts Institute of Technology has developed a set of 43 Lean Enablers ("best practices") and 286 Subenablers for better managing engineering programs [Oehmen 2012]. These Lean Enablers integrate the domains of program management and systems engineering and are based on the fundamental lean thinking principles value, value stream, flow, pull, perfection, and respect for people.

A program can be defined as "a temporary, flexible organization created to coordinate, direct and oversee the implementation of a set of related projects and activities in order to deliver outcomes and benefits related to the organization's strategic objectives" [UK 2011]. While the Lean Enablers were originally developed for managing engineering programs, they can also enhance the management of engineering projects. While some Lean Enablers are very program management specific, others reach deep into the projects and the actual product development process.

The higher performance of programs incorporating Lean Enablers has been shown in previous research and the Guide to Lean Enabler for Managing Engineering Programs offers some advice on the implementation of Lean Enablers [Oehmen 2012]. The implementation of program management based on internationally renowned program management standards, such as "Managing Successful Programmes" (MSP) developed by the UK Cabinet Office [UK 2011] or "The Standard for Program Management" from the Project Management Institute (PMI) [PMI 2013a], is addressed in the standards publications and the certified training for those standards. The assessment and improvement of the program management maturity is enabled through corresponding maturity models [UK 2010], [PMI 2013b].

Lean thinking was mistakenly perceived as being mainly centered around manufacturing [Oppenheim 2011b], but nowadays it is known to be applicable in many fields, such as product development [Liker 2006], [Ward 2007], systems engineering [Oppenheim 2011a], or generally at the enterprise level [Murman 2002]. But as lean thinking is a philosophy and not just a set of tools, the implementation of lean is always bound to the specific area of application. A specific implementation framework for the Lean Enablers for Managing Engineering Programs does not exist currently.

This paper presents research to improve the applicability of the Lean Enablers and consists of two parts. The first is a case study of a very successful project management maturity improvement initiative at Siemens Industry Sector's Industry Automation division in the US. It views the initiative from the perspective of the Lean Enablers [Oehmen 2012] and is based on information from [Sopko 2009, 2010, 2012a,b], interviews, internal documentation, and the used MSP program management methodology [UK 2011]. The analysis of Lean Enablers incorporated in the MSP framework reveals the potential of Lean Enablers being applied in change programs. Incorporating the knowledge gained in the case study, the second part shows the development of a framework for the implementation of Lean Enablers.

2. Siemens PM@IA Program Case Study

The Siemens AG is one of the leading global engineering and electronics conglomerate company with core activities in the fields of energy, healthcare, industry, and infrastructure & cities. At the end of fiscal year 2012 Siemens had business activities in approximately 190 countries, had around 370.000 employees, and reported consolidated revenue of €78.296 billion. The Industry Automation Division is part of the Siemens' Industry Sector and offers a variety of products ranging from automation systems such as programmable logic controllers, to sensors such as process instrumentation and analytics, and industrial software such as product lifecycle management and manufacturing execution systems software.

Project Management is an integral part of Siemens AG and its continuous success, as it is responsible for more than 50% of Siemens' global sales volume. In 2000, the executive board specifically acknowledged the importance of project management and launched the PM@Siemens global project management improvement initiative. Since then, this has evolved into a corporate program constantly refining Siemens' internal project management standard. This standard is mainly based on internal experience and best practices but also incorporates knowledge from internationally renowned standards from the International Project Management Association (IPMA) and PMI.

An integral part of the PM@Siemens initiative is Siemens' proprietary organizational project management maturity model, Maturity in Project Management (MPM), developed by Siemens' Corporate Technology Unit. The model is based on the widely accepted CMMI (Capability Maturity Model Integration) process model and incorporates elements of PMI's OPM3 (Organizational Project Management Maturity Model), Siemens PM@Siemens requirements, and practical experience. The MPM assessment offers an internal and external view, confidentiality, reference to best practices and, as a Siemens-wide standardized methodology, also comparable results. The project management maturity is measured on a CMMI-like five level scale ranging from initial, managed, standardized, quantitatively managed, to optimizing.

The Siemens headquarters set the target that all organizations with a relevant project business need to achieve at least level 3. Achieving and maintaining level 3 has and still does prove to be difficult for many organizations. One of the main reasons is the habit of conducting the improvement efforts as projects. Projects by definition of MSP deliver capabilities, whereas programs deliver benefits [UK 2011]. Only when linking the new or enhanced capabilities, such as standardized processes, to actual business benefits, such as increased profit margins, management buy-in and organizational support can be achieved.

For that reason the Industry Automation division in the US decided in 2008 to adopt the proven MSP methodology to run its improvement efforts as a program. This program was called PM@IA and was successful in generating sustainable business benefits. The MSP methodology consists of three main elements that can be seen in Figure 1. The first is the seven underlying principles of program management depicted in the outer ring. The inner ring contains the nine governance themes that support all the different phases of the program. The center shows the transformational flow, which is the sequence of the program phases.

The first phase of PM@IA was identifying the program, whereby the program vision was evaluated, the program brief formed, the program organization established, and the high-level business case formulated. PM @ IA was opened with 3 primary benefit goals: (1) Improved customer satisfaction, (2) improved project profit margin, and (3) standard project business processes (measured in delivery

reliability). The business case for the program is that reaching maturity level 3 improves the organizations ability to deliver the projects on time, budget and scope and thereby realize the intended benefits.

Management buy-in and the organizational commitment are vital for the success of change programs and are achieved through MSP's structure of the program board. It consists of the Senior Responsible Officer (SRO), the Program Manager, and one or more Business Change Managers (BCM). The SRO of the PM@IA program was the Business Excellence Director acting on behalf of the Vice President of Finance and is the link between the new capabilities and the overall financial goal of the program. The director of the project management office is simultaneously also the Program Manager of the improvement program. He is responsible for managing the delivery of the new capabilities. The role of the BCM is assisting in the program's delivery of the new capabilities and transforming those into the intended business benefits. He is thereby usually a well-respected senior member from the organizational "business-as-usual" part of the business that is changed through the program. The role of the BCM is the essential for the organizational commitment to change.

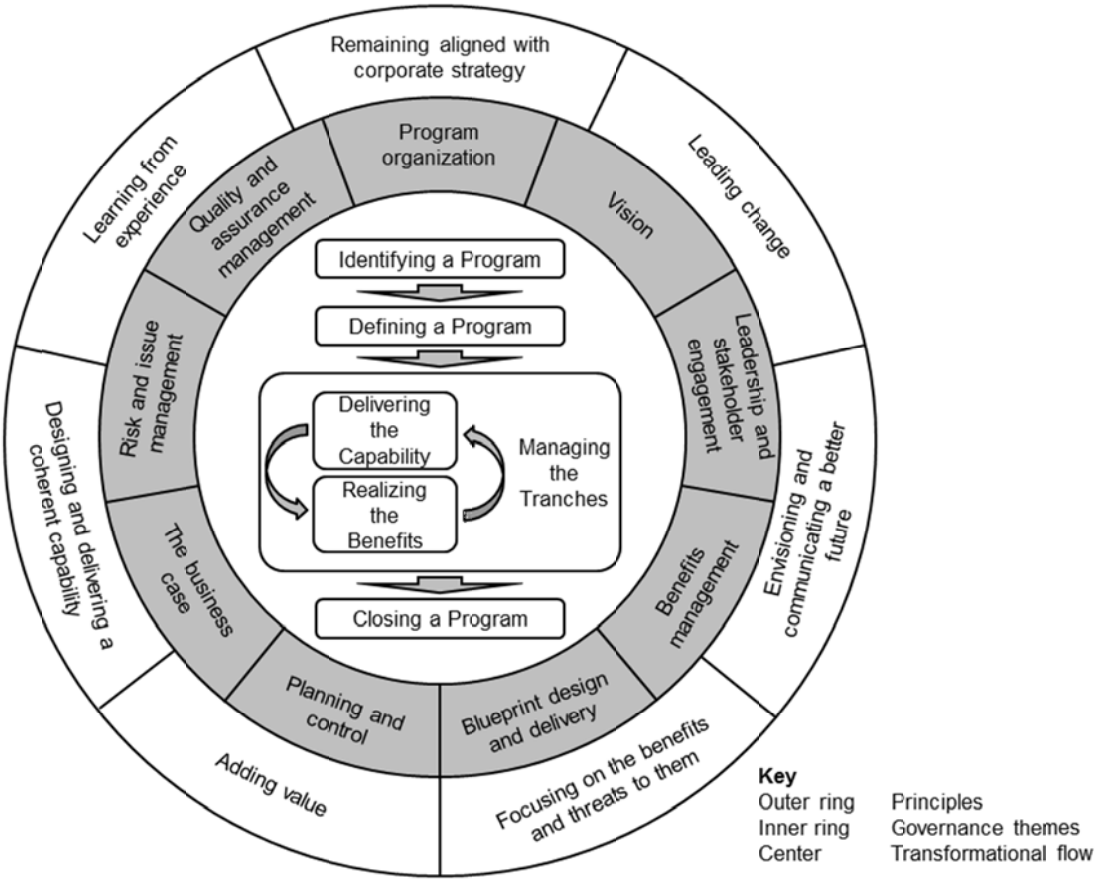

Figure 1. MSP governance themes and transformational flow (adapted from [UK 2011])

The core of the PM@IA program is the newly developed Policy and Process Framework, which was to be implemented by all the relevant organizational units. This framework resembles the standardized project management processes required for MPM level 3 and thereby also covers all mandatory requirements of PM@Siemens. The implementation of this framework delivers the capabilities for a variety of intermediate benefits, which can be seen in Figure 2. Customer satisfaction, project profit margin and project delivery reliability were the final benefits chosen as key performance indicators for the program.

The PM@IA Policy and Process Framework depicted in Figure 2 consists of the 7 domains: Project Acquisition, Project Execution, Communication, Configuration Management, Design Engineering, Quality, and Training. The development of the framework was conducted in three overlapping phases,

which are called tranches in the MSP methodology. The first tranche covered the area of project acquisition, which focuses on the customer requirements, the bid preparation, contract negotiation, and the handover to the execution team. It was developed first as it resembles the basis of a successful program, and this is far more reasonable than improving the execution of poorly defined and contracted projects. The third tranche focused on the execution as that policy and its processes builds upon the five remaining policy and process domains. These five, Communication, Configuration Management, Design Engineering, Quality, and Training, are enabling domains covering different topics relevant for the project execution. These policies were therefore developed in the second tranche and then combined through the execution policy and processes.

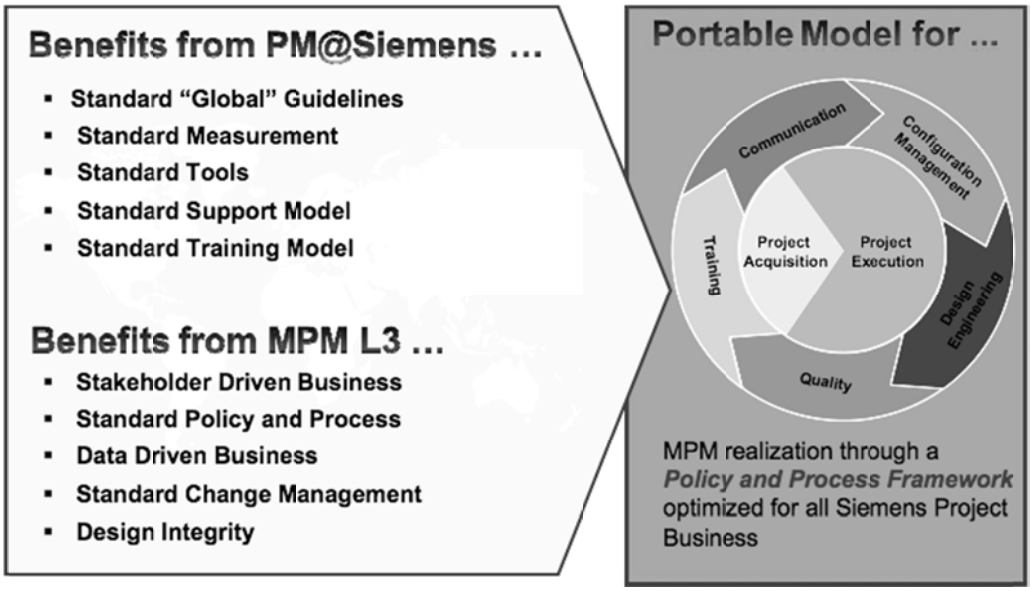

Figure 2. PM@IA Policy and Process Framework (Figure taken from [Sopko 2012b])

2.1 Identifying Lean Enablers applied in the PM@IA program

The success of the PM@IA maturity improvement program, expressed in realizing the intended benefits, depends on two related dimensions. Dimension 1 describes "what" was implemented in form of the Policy and Process Framework to improve the project management maturity. Dimension 2 addresses "how" this framework was implemented through change program management based on the MSP methodology. In the following, the two dimensions will be analyzed for their conformance with the Lean Enablers.

Dimension 1 was analyzed by comparing the content of the company's internal PM@IA Policy and Process Framework documentation with the 286 Subenablers. A three-level scale was used to state whether a Subenabler was fully, partially or not addressed by the policies and processes of each of the seven domains. Each Lean Enabler typically consists of 5-8 Subenablers. In each of the seven domains the results of the assessment were then condensed by calculating two percentage values for each of the 43 Lean Enablers.

The first is the percentage of constituent Subenablers fully addressed and the second the percentage of those partially addressed. The second value was multiplied with a factor 0.5 and added to the first value. This was done to further condense the data for the scope of this paper, while still taking into account the difference of Subenablers being fully or partially addressed. These final results are shown on the left side of Figure 3. At last, each Lean Enablers addressed was linked to the domain its most represented by, which is indicated though the bold values. The analysis of the PM@IA Policy and Process Framework reveals that in total 47% of all Subenablers are fully addressed and 24% partially addressed. The results in Figure 3 show that the Lean Enablers of two of the six lean principles are comparably less addressed than the other principles. These are the Lean Enablers 5.X supporting the principle of flow and the Lean Enablers 1.X, which address treating people as the most important asset.

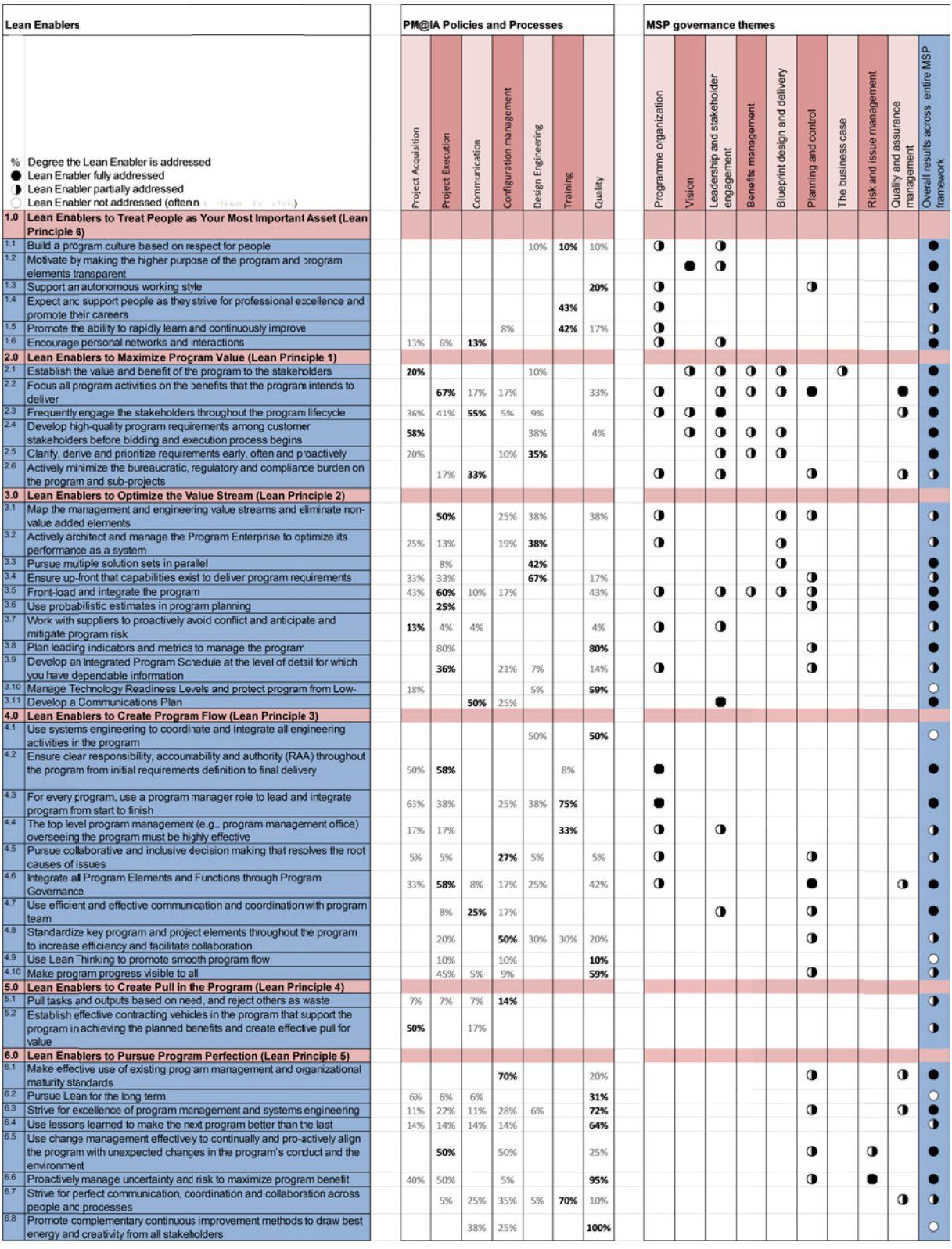

Figure 3. Mapping of the PM@IA Policies and Processes (Dimension 1 - left) and of the MSP governance themes (Dimension 2 - right) to the Lean Enablers

To understand which Lean Enablers were used in the change management (Dimension 2), the detailed description of the MSP framework [UK 2011] was analyzed for the degree the Lean Enablers are addressed. The governance themes define most of the MSP framework and can be seen as the frameworks equivalent of the Lean Enablers. Therefore, the analysis was performed once individually

for the nine governance themes and once across the entire framework. As the later analysis looks simultaneously at all nine governance themes as well as the program management principles and the transformational flow, the overall results might therefore be higher than the ones of the governance themes. Each result is given on a three-level scale and takes into account the degree a Lean Enablers is addressed at the Lean Enabler level as well as the number of constituent Subenablers explicitly addressed. The Lean Enabler is "fully addressed" if the Lean Enabler is mostly or fully addressed at the Lean Enabler level and at least half of the constituent Subenabler are addressed. Otherwise the Lean Enablers is "partially addressed" or "not addressed". The result of the analysis given on the right side of Figure 3 show that the MSP framework fully addresses 22 Lean Enablers, partially addresses 16 and only 5 Lean Enablers are not addressed at all.

2.2 Discussion

The Policy and Process Framework by its nature consists of policies and mainly processes. The Lean Enablers 1.X and its Subenabler regard treating people as the most important asset and are therefore less of a process nature. Thus, this topic is less represented in the framework and therefore the degree of Lean Enablers addressed is lower. Still this does not imply that the Lean Enablers are not applied in the organization. They might be applied but just not through the Policy and Process Framework. The framework is not specifically based on lean thinking. Especially the pull principle is very lean specific, which is why the corresponding Lean Enablers 5.X also comparably less addressed. Furthermore the framework is written for the project management level and not an overarching program management level, with the latter being the focus of the Lean Enablers. Still the framework includes some topics, like stakeholder management, which are usually more associated with program management and not so much with project management.

When bearing in mind this process and project focus of the framework, the overall results of 47% fully and 24% partially addressed Subenablers are actually high numbers. The results of the assessment of the theoretical framework do not reflect the precise degree of implementation in Siemens IA's project business. On the one hand, the framework supports all five levels of project management maturity. The mandatory maturity level 3 contains most of the fully or partially addressed Subenablers but not all of them. On the other hand, conducting an assessment of the actual level of implementation across the entire organization and not just analyzing the theoretical Policy and Process Framework would increase the results. In general, implementing the Lean Enablers and Subenablers not fully addressed bears a potential to enhance the PM@IA Policy and Process Framework and the organization and enable an even more effective, efficient and human focused project management.

The mapping of MSP and the 43 Lean Enablers reveals that most of them are fully (22) or partially (16) addressed. MSP strongly addresses the Lean Enablers that promote the effectiveness of creating the intended program benefits and value. MSP has the strong focus on change programs and is not specifically based on Lean thinking. This explains why Lean Enablers regarding Systems Engineering, Technology Readiness Levels and explicit lean thinking are not addressed. Some of the underlying ideas of the systems engineering Lean Enablers could improve MSP in the area of the design of the new operational state that is to be reached through the change process. The UK Cabinet Office has developed the Management of Value (MoV) guide [UK 2010], which is complementary to MSP and emphasizes on efficiency in program management. Yet the Lean Enablers go beyond MoV's scope. Enriching MSP with relevant Lean Enablers not yet fully applied and lean thinking in general could even further improve its efficiency.

The Managing Successful Programmes methodology is presented in a very detailed and applicable way [UK 2011]. This applicability was experienced by the PM@IA program management when applying MSP for the development and implementation the PM@IA framework. As MSP proves to be valuable in the implementation of the framework that actually resembles a great number of Subenablers and furthermore has a high number of Lean Enablers in the methodology itself, MSP is suggested to be a very suitable approach for implementing the Lean Enablers in an organization. Lean Enablers found in the MSP methodology used to implement the Policy and Process Framework might be able to have some kind of a pilot case role, if they are not only found in MSP but also the framework. For example if MSP recommends a stakeholder analysis at the beginning of the change

program – also suggested by the Lean Enablers – then this serves as a vivid example for the implementation of the process, which demands a stakeholder analysis in large customer engineering projects.
The PM@IA program was and is highly successful in delivering the intended benefits, especially when considering the devastating worldwide economic crisis during the early years of the program. It still delivers sustainable business benefits and is the reason why the program has not been terminated. Over the course of three years the customer satisfaction improved by 8%, the project profit margin improved by 11% and the delivery reliability by 3%. Both, the PM@IA Policy and Process Framework implemented as well as the MSP methodology used for the implementation, are the basis for the sustainable improvements. These successes and the high number of Lean Enablers applied give yet another example of the applicability and improvement potential of the Lean Enablers.

3. Lean Enabler cluster and proposed implementation order

Lean Enablers are not a program management framework but improve such frameworks in organizations to have more efficient and effective programs. They are not detailed like a policy but rather one or two sentences catching the essence of what a detail policy should represent. The Lean Enablers can be used to improve existing program management frameworks already implemented in an organization. Or they are to be implemented as part of a program management framework that an organization newly develops or adopts.
The case study was conducted to understand how Lean Enablers can be implemented. Besides the degree of Lean Enabler implementation and the implementation approach, two questions were of particular interest. Which Lean Enablers are implemented simultaneously? Is there a preferred implementation order for those clusters? In the case study, the project management framework consists of 7 different policy domains that were developed and implemented in 3 tranches. Each domain addresses one topical area of project management. Such a topical ordering is common in program management and system engineering frameworks. Examples are the nine governance themes in MSP, the five program management performance domains in PMI's Standard for Program Management, or the systems engineering process groups in INCOSE's (International Council on Systems Engineering) Systems Engineering Standard [INCOSE 2011]. With regards to the case study, it can be said that the Lean Enablers found in one topical domain of the Policy and Process Framework, are the Lean Enablers implemented simultaneously.
Currently, the Guide to Lean Enablers for Managing Engineering Programs [Oehmen 2012] presents the Lean Enablers grouped into the six rather abstract lean principles. Additionally, the Lean Enablers are mapped to PMI's program management performance domains and INCOSE's systems engineering process groups. These latter two mappings support the implementation of the Lean Enablers when one of those two frameworks is used. Still, a generic topical ordering structure for the Lean Enablers does not exist currently. Such a topical structuring of the Lean Enablers would improve the applicability of the Lean Enablers. When a certain topical area of an existing framework is revised and improved, all corresponding Lean Enablers enhancing this area can simply be found in a column of a table. In the case of the development of a new framework, this topical clustering is even more important. It gives guidance on which Lean Enablers belong together as a cluster implemented simultaneously and thereby need to be view together when detailing the specific topical area of the framework. An example is the cluster containing all Lean Enablers regarding communications and stakeholder management. This cluster contains all the Lean Enablers that are relevant when detailing a communications and stakeholder policy in the new framework.
Equally important is the order in which those topical areas of a framework, and thus the corresponding clusters of Lean Enablers, are to be developed. It is important because often not all of the topical areas can be developed and implemented at the same time. The Siemens PM@IA program case study has shown that it was reasonable to develop and implement the topical policies in three tranches containing one or more topical policies. The implementation order described in the case study will later be reflected in the proposed implementation order.

Lean Enablers		Lean Program Management Themes						
		1. Program Benefits: Value, Requirements & Contracting	2. Program Management: Leadership, Roles & Responsibilities	3. Program Planning & Control	4. Stakeholder & Communications Management	5. Program Culture, Staffing and Professional Development	6. Program Engineering	7. Program Execution & Improvement
1.0	**Lean Enablers to Treat People as Your Most Important Asset (Lean Principle 6)**							
1.1	Build a program culture based on respect for people		20%			**70%**		10%
1.2	Motivate by making the higher purpose of the program and program elements transparent	50%				**50%**		
1.3	Support an autonomous working style		20%			**80%**		
1.4	Expect and support people as they strive for professional excellence and promote their careers					**100%**		
1.5	Promote the ability to rapidly learn and continuously improve					**100%**		
1.6	Encourage personal networks and interactions		**38%**		25%	25%		13%
2.0	**Lean Enablers to Maximize Program Value (Lean Principle 1)**							
2.1	Establish the value and benefit of the program to the stakeholders	**80%**			20%			
2.2	Focus all program activities on the benefits that the program intends to deliver		**100%**					
2.3	Frequently engage the stakeholders throughout the program lifecycle	9%		9%	**73%**	9%		
2.4	Develop high-quality program requirements among customer stakeholders before bidding and execution process begins	**100%**						
2.5	Clarify, derive and prioritize requirements early, often and proactively	**60%**			20%		20%	
2.6	Actively minimize the bureaucratic, regulatory and compliance burden on the program and sub-projects			**67%**	33%			
3.0	**Lean Enablers to Optimize the Value Stream (Lean Principle 2)**							
3.1	Map the management and engineering value streams and eliminate non-value added elements			**75%**				25%
3.2	Actively architect and manage the Program Enterprise to optimize its performance as a system		**38%**	38%		13%	13%	
3.3	Pursue multiple solution sets in parallel						**100%**	
3.4	Ensure up-front that capabilities exist to deliver program requirements	**67%**		33%				
3.5	Front-load and integrate the program	13%	7%	**73%**	7%			
3.6	Use probabilistic estimates in program planning			**100%**				
3.7	Work with suppliers to proactively avoid conflict and anticipate and mitigate program risk	17%		17%	**50%**		8%	8%
3.8	Plan leading indicators and metrics to manage the program			**100%**				
3.9	Develop an Integrated Program Schedule at the level of detail for which you have dependable information		14%	**71%**				14%
3.10	Manage Technology Readiness Levels and protect program from Low-TRL delays and cost overruns			18%			**82%**	
3.11	Develop a Communications Plan				**100%**			
4.0	**Lean Enablers to Create Program Flow (Lean Principle 3)**							
4.1	Use systems engineering to coordinate and integrate all engineering activities in the program						**100%**	
4.2	Ensure clear responsibility, accountability and authority (RAA) throughout the program from initial requirements definition to final delivery		**100%**					
4.3	For every program, use a program manager role to lead and integrate program from start to finish		**100%**					
4.4	The top level program management (e.g., program management office) overseeing the program must be highly effective		**100%**					
4.5	Pursue collaborative and inclusive decision making that resolves the root causes of issues		**91%**		9%			
4.6	Integrate all Program Elements and Functions through Program Governance		33%	**50%**				17%
4.7	Use efficient and effective communication and coordination with program team		17%		**67%**			17%
4.8	Standardize key program and project elements throughout the program to increase efficiency and facilitate collaboration			20%		20%	20%	**40%**
4.9	Use Lean Thinking to promote smooth program flow			10%	10%			**80%**
4.10	Make program progress visible to all			**91%**				9%
5.0	**Lean Enablers to Create Pull in the Program (Lean Principle 4)**							
5.1	Pull tasks and outputs based on need, and reject others as waste	0%	0%	14%	14%	0%	0%	**71%**
5.2	Establish effective contracting vehicles in the program that support the program in achieving the planned benefits and create effective pull for value	**100%**	0%	0%	0%	0%	0%	0%
6.0	**Lean Enablers to Pursue Program Perfection (Lean Principle 5)**							
6.1	Make effective use of existing program management and organizational maturity standards		**60%**					40%
6.2	Pursue Lean for the long term		13%			13%		**75%**
6.3	Strive for excellence of program management and systems engineering		22%			22%	22%	**33%**
6.4	Use lessons learned to make the next program better than the last				14%			**86%**
6.5	Use change management effectively to continually and pro-actively align the program with unexpected changes in the program's conduct and the environment		**100%**					
6.6	Proactively manage uncertainty and risk to maximize program benefit		10%	**80%**				10%
6.7	Strive for perfect communication, coordination and collaboration across people and processes				**60%**	10%		30%
6.8	Promote complementary continuous improvement methods to draw best energy and creativity from all stakeholders							**100%**

Figure 4. Generic Clustering of Lean Enablers into Lean Program Management Themes

3.1 Research method

A multistep process was used to identify generic clusters of Lean Enablers. The first step was analyzing each of the 286 Subenablers for its predominant theme. The result was a collection of 20 themes and the Subenablers addressing the individual themes. The identification of a single predominant theme proved to be difficult for a large part of the Subenablers as they often touch more than one topic. A perfect example would be a Subenabler encouraging frequent communication with all stakeholders. The Subenabler therefore has two predominant themes, Stakeholder Management and Communications Management. In a second step the Subenablers were grouped into the clusters, each addressing one overarching theme containing all the corresponding Subenablers to be implemented simultaneously. The resulting seven main themes are now less connected via specific Subenablers but more through the general connection between the different domains of program management. Furthermore the smaller set of main themes gives a better overview of the topics the Subenablers address. The last step was to go from the detailed Subenabler level to the higher Lean Enabler level.

Therefore, for each of the 43 Lean Enablers the number of underlying Subenablers addressing one of the seven main themes was divided by the total number of Subenablers constituting the specific Lean Enabler, producing a percentage. The table in Figure 4 shows the 43 Lean Enablers and the percentage they address in each of the seven main themes. The highest value per Lean Enabler defines which main theme and therefore cluster the Lean Enabler belongs to.

3.2 Lean Program Management Themes

As a result of the described procedure, while also taking in account knowledge gained through the case study and from additional literature, the following seven clusters have been identified. These clusters will be called Lean Program Management Themes:

1. Program Benefits: Value, Requirements & Contracting
2. Program Management: Leadership, Roles & Responsibilities
3. Program Planning & Control
4. Stakeholder & Communications Management
5. Program Culture, Staffing and Professional Development
6. Program Engineering
7. Program Execution & Improvement

As stated earlier, when developing and implementing a new program management framework in an organization or improving an existing framework, it might not be possible to work on all program management themes simultaneously. Therefore a suggested implementation order would be helpful. It is suggested to start with the implementation of the Program Benefits Theme as it focuses on the value the program intends to deliver, the development of clear requirements and the contracting. These define the goal of the program and are therefore vital for the program success. It furthermore makes less sense to improve a program in its effectiveness and efficiency if it does not target the desired program stakeholder value. In the second tranche the next five Lean Program Management Themes should be implemented. They all are the foundation for a successful execution of a program as they target different enabling topics. They are especially important in the beginning of the program, when the program plan, structure and so forth are being set. The third tranche will be the Program Execution & Improvement Theme. With the right program stakeholder values targeted and the other enabling Lean Program Management Themes implemented, the focus is now on an effective and efficient program execution. Continuous improvement is thereby the key to pursuing program excellence. The suggested implementation order is also in line with the findings from the Siemens PM@IA case study.

4. Conclusion

Lean Enablers for Managing Engineering Programs have been shown previously to be associated with greater success of engineering programs. This potential to improve projects and programs developing technical systems was proven again in the case study. Although the PM@IA program did not specifically implement the Lean Enablers, a large number of Lean Enablers could be found in the PM@IA Policy and Process Framework improving the engineering project management as well as in the MSP methodology used for the change program management. Therefore, Lean Enablers can also be applied to improve organizational change programs. Incorporating the knowledge gained in the case study, it is suggested to manage the implementation of Lean Enablers as an organizational change program and thus focus on the actual benefits that the implementation enables. This will enable a more successful and sustainable Lean Enabler implementation. As Lean Enablers can also be used in the management of the organizational change program, they can thereby serve as a pilot case for their own in implementation in engineering programs. The topical clustering of Lean Enablers into seven Lean Program Management Themes presents the Lean Enablers in a clearer and more applicable structure, that advices which Lean Enablers should be implemented simultaneously. This structuring, in conjunction with the proposed implementation order, eases the implementation of Lean Enablers.

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