D14.1 – Integrated Service Life Cycle Model
VERSION HISTORY

<table>
<thead>
<tr>
<th>NO.</th>
<th>DATE</th>
<th>NOTES AND COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>27.06.2012</td>
<td>STRUCTURE OF DELIVERABLE</td>
</tr>
<tr>
<td>0.2</td>
<td>17.07.2012</td>
<td>FIRST DRAFT BY IAO</td>
</tr>
<tr>
<td>0.3</td>
<td>24.07.2012</td>
<td>COMMENTS BY PROJECT COORDINATORS</td>
</tr>
<tr>
<td>0.4</td>
<td>27.08.2012</td>
<td>CONTRIBUTION BY DITF</td>
</tr>
<tr>
<td>0.5</td>
<td>30.08.2012</td>
<td>CONTRIBUTION BY POLIMI</td>
</tr>
<tr>
<td>0.6</td>
<td>12.09.2012</td>
<td>SECOND DRAFT, INTEGRATION OF CONTRIBUTIONS</td>
</tr>
<tr>
<td>0.7</td>
<td>19.09.2012</td>
<td>DRAFT TO BE COMMENTED BY PEER REVIEWERS</td>
</tr>
<tr>
<td>0.8</td>
<td>25.09.2012</td>
<td>COMMENTS BY PROJECT COORDINATORS</td>
</tr>
<tr>
<td>0.9</td>
<td>15.10.2012</td>
<td>DRAFT TO BE COMMENTED BY PEER REVIEWERS</td>
</tr>
<tr>
<td>0.95</td>
<td>22.10.2012</td>
<td>PEER REVIEWERS SEND THEIR COMMENTS</td>
</tr>
<tr>
<td>1.0</td>
<td>24.10.2012</td>
<td>COMMENTS PROCESSED AND DELIVERABLE FINISHED</td>
</tr>
</tbody>
</table>

DELIVERABLE PEER REVIEW SUMMARY

<table>
<thead>
<tr>
<th>ID</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>We suggest not using that much bold type, especially in the executive summary. Consider justifying the text alignment of the whole document.</td>
</tr>
<tr>
<td>2</td>
<td>The introduction should be shorter, a shorter description of the objectives and the content. (chapter 2.2 is fine)</td>
</tr>
<tr>
<td>3</td>
<td>Check figure’s numbering and figure title/description, especially in chapter 2</td>
</tr>
<tr>
<td>4</td>
<td>We suggest eliminating chapter 4.2.3 and explaining those issues at the beginning of chapter 4.2</td>
</tr>
<tr>
<td>5</td>
<td>Chapter 4.3.1 should be better explained. It is not clear enough what D12.1 and D12.3 are and the connection to this chapter</td>
</tr>
<tr>
<td>6</td>
<td>Don’t see a clear and concise explanation on the relation between “Service Ideation” phase inside SLM and the “Innovation Framework” to be developed by BIBA inside WP21. It is pointed that there is an obvious relation, but it is not further explained.</td>
</tr>
<tr>
<td>7</td>
<td>Check and refine other comments throughout the document</td>
</tr>
</tbody>
</table>

Addressed (✓) Answered (A)
# TABLE OF CONTENTS

1. **EXECUTIVE SUMMARY** ............................................................................................................. 5

2. **INTRODUCTION** ..................................................................................................................... 6
   
   2.1. **Objectives of Deliverable D14.1** ...................................................................................... 6
   
   2.2. **Structure of Deliverable D14.1** ...................................................................................... 7

3. **LIFE CYCLE MANAGEMENT: STATE OF THE ART** .......................................................... 8
   
   3.1. **Product Life Cycle Management (PLM): State of the Art** ................................................. 8
      
      3.1.1. **Introduction to PLM** .............................................................................................. 8
      
      3.1.2. **Definition of Product Life Cycle Management PLM** ............................................ 8
      
      3.1.3. **The Extended Product Concept** ............................................................................. 9
      
      3.1.4. **Definition of ExtPLM** ........................................................................................... 10
   
   3.2. **Service Life Cycle Management (SLM)** ......................................................................... 13

4. **SLM FRAMEWORK FOR MSEE** ......................................................................................... 15
   
   4.1. **Derivation of Architecture for a generic SLM Reference Framework (top down approach)** ................................................................. 15
      
      4.1.1. **Overview of Service Innovation Processes and Architectures** .............................. 15
      
      4.1.2. **Conclusion on Service Innovation Architectures with Regard to Approach on MSEE SLM** ........................................................................... 19
   
   4.2. **Approach on SLM Framework for MSEE** ...................................................................... 19
      
      4.2.1. **The Phases of the MSEE SLM Framework** .............................................................. 20
      
      4.2.2. **MSEE SLM as a Stage-Gate-Process** ...................................................................... 21
   
   4.3. **Description of the Phases of the MSEE SLM Framework** ............................................ 24
      
      4.3.1. **The SLM Phase of “Service Ideation”** .................................................................... 25
      
      4.3.2. **Roles in the SLM Phase of “Service Ideation”** ....................................................... 26
      
      4.3.3. **The SLM Phase of “Service Engineering”** ............................................................. 26
      
      4.3.4. **Role model for the SLM Phase of “Service Engineering”** .................................... 27
      
      4.3.5. **The SLM Phase of “Service Operations Management”** ....................................... 28
      
      4.3.5.1 **Service Sales and Marketing Module** ................................................................. 32
      
      4.3.5.2 **Service Delivery Module** ................................................................................... 33
      
      4.3.6. **Roles in the SLM Phase of “Service Operations Management”** ............................ 34
   
   4.4. **Integration of Service and Product Life Cycle Management (SLM & PLM)** .................. 36

4.5. **Length of PLM and SLM** .................................................................................................... 36

4.6. **Modification of MSEE SLM Framework According to Type of Service** ....................... 39
   
   4.6.1. **Typologies for Services** ........................................................................................ 39
   
   4.6.2. **Procedure of Adapting the MSEE SLM Framework** ............................................. 40

4.7. **Conclusion on Chapter 4** .................................................................................................. 42

5. **SUMMARY AND OUTLOOK** ............................................................................................... 43

6. **REFERENCES** ..................................................................................................................... 44
TABLE OF FIGURES

Figure 1 The three Axis of the MSEE SLM Framework ........................................ 6
Figure 2 Product Life Cycle Management PLM .................................................. 9
Figure 3 Product Lifecycle Phases .................................................................. 10
Figure 4 The Extended Product Concept ....................................................... 11
Figure 5 ExtPLM Schema ............................................................................. 12
Figure 6 Stage-gate model for NSD, based on (Cooper and Edgett 1999). ....... 15
Figure 7 Revised stage-gate model for services according to (Susmann et al. 2006) 16
Figure 8 Total solution development mode, taken from (Susmann et al 2006). ..... 16
Figure 9 NSD-process cycle, based on (Riedl 2011) ........................................ 18
Figure 10 Innovation process for services according to the DIN (Tilebein 2006) .... 18
Figure 11 Architecture of MSEE SLM – SLM Phases, Artifacts and Outcomes ... 20
Figure 12 Stage-Gate-Model of MSEE SLM .................................................. 22
Figure 13 Overview of MSEE SLM Reference Framework ............................. 24
Figure 14 Funnel of Perception for Service Ideas ............................................. 25
Figure 15 Role Model for the “Service Engineering” Phase of MSEE SLM Reference Framework ................................................................. 27
Figure 16 Porter’s Value Chain ....................................................................... 29
Figure 17 Value Chain for Services ................................................................. 30
Figure 18 Derivation of a Model for Service Operations Management in the Form of a Value Chain .......................................................... 31
Figure 19 Role of Service Operations Controlling within SOM ..................... 32
Figure 20 Modules of Service Sales & Marketing .......................................... 33
Figure 21 Modules of Service Delivery .......................................................... 34
Figure 22 Role Model for the “Service Operations Management” Phase of MSEE SLM Reference Framework ........................................ 35
Figure 23 Length of PLM and SLM ................................................................. 37
Figure 24 Service Typology by Variety and Contact Intesity (Fähnrich and Meiren 2007) 40
Figure 25 Modification of MSEE SLM Framework according to Type of Service 41

TABLE DIRECTORY

Table 1 Decision Criteria for SLM Framework .................................................. 24
1. Executive Summary

The MSEE Service Life Cycle Management Framework (MSEE SLM framework) illustrates an approach on SLM for manufacturing firms for the first time in scientific literature.

Within this deliverable D14.1 the structure of the MSEE SLM framework is derived on the basis of the state of the art of product life cycle management (PLM) and service innovation processes.

In the opinion of the MSEE project partners the MSEE SLM framework should be composed of the three axis “life cycle phases”, “roles in the life cycle” and “methods and tools”. The axis “life cycle phases” illustrates out of which phases a life cycle of a product-related service in manufacturing industries is built. We propose the three subsequent phases “service ideation”, “service engineering” (cf. WP1.2) and “service operations management” (to be introduced in this D14.1).

In this deliverable D14.1 these three constitutive and subsequent phases are detailed and mirrored with a special focus on the “roles” (second axis) within service engineering and service operations management.

The three phases of service life cycle management are connected with gates in analogy to the stage-gate-approach of Cooper and Edgett. Furthermore, the artifacts or outputs of the three phases are different towards each other.

The life cycle phase of service operations management (SOM) is worked out in derivation of Porter’s famous value chain approach on businesses. For the MSEE SLM framework the four components “sales and marketing”, “service delivery” (both primary activities in the understanding of Porter) as well as “service portfolio management” and “service operations controlling” (both secondary activities in the understanding of Porter) are proposed as being important for SOM and the SLM framework.

In the second half of this deliverable it is observed, how PLM and SLM interact. Ideal typical alternatives are elaborated and described in order to approximate the real life situation in the daily business practice of European manufacturing companies.

Moreover, as not all services provided by manufacturing companies are homogeneous, a typology is presented in order to classify the broad field of heterogeneous services. With the help of a service typology, the MSEE SLM framework may be adapted and applied in practice depending on the type of service to be developed, offered and delivered. This deliverable proposes a first procedure of modifying and applying the MSEE SLM framework with regard to different types of services.
2. Introduction

2.1. Objectives of Deliverable D14.1

The main objective of Deliverable D14.1 is to propose a framework for Service Life Cycle Management (SLM).

This MSEE SLM framework should be derived from the state of the art of innovation processes and respect existing models for product life cycle management (PLM). Furthermore, as one vital pillar, the existing approach on service engineering (cf. deliverables D12.1 and D12.3) should be integrated into the SLM and play a prominent role.

The MSEE SLM framework should consist of the three axis “Phases of Service Life Cycle Management”, “Role Model for Service Life Cycle Management” and “Methods and Tools for Service Life Cycle Management”. The following Figure 1 illustrates the three axis of the MSEE SLM framework:

As already mentioned, the three chapters of the SLM framework shall be regarded from two different dimensions being relevant in the MSEE project context. These two dimensions are depicted by the second and third axis in Figure 1. The proposed dimensions are “roles” and “methods and tools”. Within D14.1 the dimension of “roles” will be detailed with respect to the three phases of the SLM framework. The dimension of “methods and tools” will be presented in the subsequent deliverable of WP14.

Another key objective of Deliverable D14.1 is to explain the characteristics of the phase “service operations management (SOM)”. Furthermore, an important question to be answered is, in what way service and product life cycles interact. Here probably the most famous challenge to be managed in practice is to align the length of the product and service life cycles. As the MSEE SLM framework to be proposed in the following chapters has to be regarded as generic, it is also interesting how to adapt it in practice. This paper sketches a procedure how the framework might be modified in order to match with different types of services. For this purpose different conceivable typologies for services are presented.
2.2. Structure of Deliverable D14.1

Deliverable D14.1 consists of six chapters. Chapter 1 is the Executive Summary and sums up the most important results of the paper. In chapter 2, an overview is given over the objectives and contents of D14.1. In chapter 3 the state of the art concerning Life Cycle Management is analyzed. On the one hand, it is presented what can be understood by the terms Product Life Cycle Management (PLM). On the other hand, the understanding of Service Life Cycle Management (SLM) is presented in the context of the MSEE project.

The main focus of chapter 4 is to elaborate a SLM framework in the context of the MSEE project. At first, the MSEE SLM framework is derived on the basis of service innovation processes and with analogy to PLM. The framework then is explained in detail.

Also in chapter 4, the interplay of PLM and SLM is regarded. Furthermore it is presented that it is conceivable to modify the framework depending on the type of service it focuses.

Chapter 5 sums up the main findings of D14.1 and gives an outlook on upcoming project work. The references used in D14.1 are being provided in chapter 6.
3. Life Cycle Management: State of the Art

3.1. Product Life Cycle Management (PLM): State of the Art

3.1.1. Introduction to PLM

Nowadays customers are more and more specialized in terms of product quality and relevant services. In order to maintain and to improve their competitiveness, market leaders have to improve both effectiveness and efficiency (reducing not-value-added tasks) and to foster innovation, as far as product, process and organization are concerned. As a consequence, enterprises are focusing their attention on core-competences and on products, which are becoming once again value creators.

Product management essentially consists of a complex mix of overlapped processes, which are strongly affected by increasing customers’ requirements and needs, thus putting pressure on support processes. This “product centric” or “product-driven” approach may be well represented by the following reference frameworks: Product Lifecycle Management and Extended Product.

3.1.2. Definition of Product Life Cycle Management PLM

Product Life Cycle Management (PLM) is about managing actively the whole life of a physical product, starting from the idea and ending with the decommissioning. Important elements of this “management” are the planning, controlling and monitoring of all business process in context of the product. The main objectives of PLM are to increase product quality (important external perspective from customers’ point of view) and to boost product and company profitability (important internal perspective from firm’s share- or stakeholders’ point of view). Furthermore companies applying PLM gain more transparency about their business.

The term Product Life Cycle Management (PLM) defines a set of different tasks carried out by R&D, Production Logistics, Purchasing, Quality, etc. across the whole life-cycle of industrial products. This cycle starts from the concept, the design and the development of a product and goes through the whole manufacturing process till delivery, after sales servicing and disposal/recycling.

All these activities are strongly bound and supported by engineering and production management information systems. As such, it entails (Garetti, 2004):

- a strategic management perspective, wherein the product is the enterprise value creator,
- the application of a collaborative approach to better use the enterprise competences distributed amongst diverse business actors,
- the adoption of different ICTs in order to practically establish a coordinated, integrated and access-safe product information management environment in the extended context.

Therefore PLM deals with the management of all the relevant product data which are created, stored and managed along the lifecycle of a product, from its design to its end of life. According to Stark (Stark 2004), “PLM brings together products, services, structures, activities, processes, people, skills, application systems, data, information, knowledge, techniques, practices, skills and standards”.

As far as literature is concerned, there are a lot of different lifecycle models, most of them mainly consisting in the following phases (see Figure 2):
- Beginning of Life (BoL): when the product is managed by the manufacturer.
- Middle of Life (MoL): when the product is owned by the consumers.
- End of Life (EoL): when the product has finished its useful life and it has to be disposed of.

**Figure 2 Product Life Cycle Management PLM**

A product lifecycle is based on four different instances (Figure 3):

1. **Product Development**: it deals with the R&D of a new product, starting from product design up to process and facilities development. Each of these product development sub-phases usually starts from the *requirements analysis* (requested performances, costs, marketing strategies and so on) and goes through review and validation till the detailed design.

2. **Product Production**: both production and distribution processes are considered in the product production phase. *Production phase* usually includes several processes, such as pre-production and prototyping, manufacturing, assembling, finishing, testing, packaging, etc.
   *Distribution* is related to product storing and delivering.

3. **Product Use**: this phase generally comprehends the use, consumption, maintenance and service of the product.

4. **Product Disposal**: at the end of its life the product is destroyed, or rather disassembled and recycled or reused.
3.1.3. The Extended Product Concept

A new kind of concept, defined as *Extended Product*, has recently been proposed, where the product is not a simple item any longer, but it is a complex mix of tangible and intangible components (see Figure 4).

![Figure 3 Product Lifecycle Phases](image-url)
The meaning of extension is usually related to the functionality or a new business process around the product. According to Jansson (Jansson 2003) and Hirsch (Hirsch 2001) tangible extended product can be intelligent, highly customized, and user-friendly. An intangible product is mostly the business process itself.

![The Extended Product Concept](image)

Figure 4 The Extended Product Concept

The extended product is characterized by the following aspects:

- technology enablers and solutions resulting from developments such as e-commerce, e-business or more general multi-mode business,
- a combination of a physical product and associated services/enhancements which improve their offer to the market,
- smart, highly customized, user-friendly tangible products, including embedded services or features like maintenance,
- intangible features, which are based on information and knowledge and which can consist of services, engineering, software, etc,
- customer focus on a value-added services and not on the physical product only.

### 3.1.4. Definition of ExtPLM

The concept of cooperation among enterprises and their customers may be defined as an extended PLM; indeed, customers are integrated in all phases of the life cycle, creating new technical functionalities and services, improving both the practical (e.g. improving usage, improving safety, allowing predictive maintenance) and the emotional side (e.g. extreme customization) of the product.
In Figure 5 the product, recognized by its id, is interfaced to the user, who interacts with it as an avatar. The ExtPLM aims at following this extended product through all its lifecycle phases, giving the end-user a set of services that will extend the usability and the utility of the product itself and improving the ownership experience. These services can also improve the market value of the product and can be sold both to the customer (e.g. predictive maintenance) and to other companies (e.g. specific advertising). Examples of applications could be a deep customization, predictive maintenance, customized manuals and FAQs (frequently asked questions), self adaptability to the user etc.

**Example of Research on PLM**

**The PROMISE Project**

PROMISE (PROduct lifecycle Management and Information tracking using Smart Embedded systems - website www.promise-plm.com) is a framework project founded by EU (FP6-IST-IP-507100-2004).

Its primary aim is the development of instruments making the closing of the products lifecycle information loop possible, which translates in the availability of information to all the actors involved in products life, ranging from managers who have to take strategic decisions, to
service and maintenance operators, to end-of-life operators. This is pursued with the creation of a new Product Information Tracking and Flow Management system which allows a seamless flow of information in any moment from any product installed virtually in any part of the world. The long-term goal of this is the synthesis of the gathered product information to knowledge.

In order to achieve the desired results, the PROMISE project is divided in specific sub-tasks covering all the research areas of interest including information systems modelling, smart embedded systems, short and long distance wireless communication technologies, data management and modelling, statistical methods for preventive maintenance, End Of Life planning, adaptive production management and Design.

In the development phase the PROMISE PLM system has been applied to ten application scenarios covering a variety of sectors (automotive, railway, heavy load vehicles, EEE, instrumental and white goods) in order to guarantee the widest possible availability of the final system.

The PDLM-Produkt-Dienstleistungs-Lifecycle-Management Project

The objective of the current project “PDLM-Produkt-Dienstleistungs-Lifecycle-Management” (translated literally from the German expression into English: “PSLM product service lifecycle management”) is to develop a reference framework for service life cycle management that allows companies to manage service from the ideation phase until decommissioning, as they already do within their product business. The PDLM project focuses relevant core functions of life cycle frameworks that shall be implemented and put to operation by means of IT-supported first prototypes in chosen German SMEs of the high technology sector.

The PDLM project (2011 until 2014) is funded by the German Free State of Saxony and the European Union.

3.2. Service Life Cycle Management (SLM)

The expression “service life cycle management” has been coined mainly by the information technology industry with regard to IT or internet services. Here, the SLM depicts, how IT services are managed between the two main phases “design-time” and “runtime” (i.e. operation of IT services).

In the field of services for manufacturing companies, however, the expression has not been established yet. There is almost no reference in current literature about service life cycle management. At the meantime, the discipline of service innovation was focused in various research projects and publications, also with focus on manufacturing. Therefore, in the following chapter an approach for a SLM will be derived on the basis of service innovation processes.

In analogy with the traditional approach on PLM the term SLM can be approximated (in derivation of the PLM definition in chapter 3.1.2):

Service Life Cycle Management (SLM) is about managing actively the whole life of a service, starting from the service idea and ending with the decommissioning of the service. Important elements of this “management” are the planning, controlling and monitoring of all business processes relevant for the service. The main objectives of SLM are to increase service quality (important external perspective from customers’ point of view) and to boost service and company profitability (important internal perspective from firm’s share- or stakeholders’ point of view). Furthermore companies applying SLM gain more transparency about their service business.
The term Service Life Cycle Management (SLM) defines a set of different tasks that may be carried out by different departments, such as R&D, sales and marketing or quality.
4. SLM Framework for MSEE

4.1. Derivation of Architecture for a generic SLM Reference Framework (top down approach)

In this chapter the state of the art of service innovation process architectures is analyzed. Therefore chosen approaches are presented and observed (cf. the following chapter 4.1.1).

On the basis of this analysis on guiding examples, in next chapter 4.2 a framework for service life cycle management (SLM) in the context of the MSEE project has to be derived.

4.1.1. Overview of Service Innovation Processes and Architectures

Developing a new service typically follows a more or less predefined process, often stated as NSD-Process (New Service Development process). A lot process models are proposed in literature (Rothkopf 2009), (Cooper and Edgett 1999), (Riedl 2011). The process depends on the abovementioned dimensions: a radical new service follows a different path than the incremental improvement of an existing service. However, the performance of the service development is heavily influenced by the nature of the development process and its execution (Cooper and Edgett 2009). Cooper proves empirically that companies that have short NSD-processes in place and therefore skip important activities have a higher rate of failure. The types of activities that divide success and failure most significantly are thorough market research and a business analysis, as well as the post launch analysis (Cooper and Edgett 2009).

A well-established NSD-process model was derived by Cooper from his well-known stage-gate model for new product development.

![Stage-gate model for NSD](image)

Figure 6 Stage-gate model for NSD, based on (Cooper and Edgett 1999).

This model has two advantages. It ensures that all activities are performed (definition of the stages) and that the results are repeatedly checked (gates), which means that bad development projects are stopped in between. This aspect will be explained later. The model relies on more or less stable business eco-systems and works well for larger companies where resource management and control are crucial. Smaller, agile companies that integrate the customers in the development process may need other models (Susman et al. 2006). Gustaffson and Johnson (2003) propose a modified approach that is less sequential and reflects better the different nature of services with respect to tangible products.
This model reduces the number of gates as they seem not to be crucial in service development, but it adds parallel gates that ensure the cultural and organizational fit which is more important for services than for products (Susmann et al. 2006). However, this model assumes still a rather stable eco-system and little collaboration and involvement of external partners.

Following typical dialectic thinking, overcome the product-service distinction by developing a so called Total Solution Development process (Susmann et al. 2006) that includes new services and new products and focuses on a new solution to the customer combing products and services (hybrid products).

Figure 7 Revised stage-gate model for services according to (Susmann et al. 2006)

Figure 8 Total solution development mode, taken from (Susmann et al 2006).
Susmann et al describe their approach as follows:

“The TSD model incorporates the key elements of both the stage-gate process and the new service model (e.g., Gustafsson and Johnson). Similar to Gustafsson and Johnson, and unlike stage-gate, it maintains the importance of identifying customer needs as the very first step in innovation. TSD goes even further as it recommends that a firm should segment customer needs prior to selection if possible. It incorporates the key roles of strategic, organizational change and culture fit. However, TSD makes explicit differentiation among new service, new product, and service/product combination, and recognizes the criteria used to select these three different types of ideas differ. Capability and competition are added as part of this gate, but mostly for new product or new product/service combination ideas.”

Similar to the stage-gate process and unlike Gustafsson and Johnson, TSD incorporates multiple gates in the innovation process. It should be noted, however, that different criteria might be used at the same gate; it depends on the nature of the innovation (service, product, or combination), as shown explicitly for the idea screening gate. Market test and launch have been divided into two distinct stages, with one gate between them.

Unlike either of the previous models, TSD explicitly differentiates among new service, new product, and a product/service combination. The combination does not have to be completely new, it could be a new service bundled with an existing product, or a new product added to a service already provided to existing customers. Many SMEs likely already have established products, and they could certainly explore how to add new services to these products to address customer needs that products alone cannot address. TSD espouses a strong and dynamic relationship between the firm and customers. Unlike the static relationship in stage-gate and quasi-static relationship in Gustaffson and Johnson, TSD suggests intimate collaboration with customers with continuous exchange of bi-directional information. External parties, other than customers, are explicitly incorporated into the entire process of innovation. They include potential partners, supply chain members, and competitors. Furthermore, TSD suggests the specific interactions between the firm and various external parties during different stages of innovation development” (Susmann et al 2006).

The TSD model is, similar to the stage-gate models, an iterative model that foresees loops and returns. Unlike the stage-gate approach it asks for work done in parallel in order to reduce the development time and to thus react on the abovementioned features of services. From an organizational point of view it requires continuous interaction with different partners. Internally, it needs a cross-functional team, like most authors suggest as well (Cooper and Edgett 1999).

Other process models ponder on the iterative nature of development processes, e.g. the model by (Riedl 2011).
This model emphasises the nonlinearity of the process through a continuous cycle and includes the enabling factors such as organization, teams, tools and culture. This integration in the organization and in the management structure is depicted by the model of the German industry norm DIN, taken from (Tilebein 2006).

Figure 9 NSD-process cycle, based on (Riedl 2011).

It becomes evident, that the engineering or development process itself is subject to project management, knowledge and innovation management look at the full process including decommissioning of the service. This is to some extend logical: a development project team will not remain active until the end of the life cycle of a service. Innovation management...
needs nevertheless to ensure that the end of the service is managed accordingly, e.g. by the right timing of the development of a succeeding service.

4.1.2. Conclusion on Service Innovation Architectures with Regard to Approach on MSEE SLM

The development of innovations is normally following a more or less predefined process model, starting from an idea and ending with the operations phase on the market. Even decommissioning can be considered as a part of the innovation process.

The first process models for the development of services were structurally similar to the well-established stage-gate models for new product development, however, differed in details. Research pondered on the differences and came up with new structures that reflected the fact that service innovations often affect the whole organization more thoroughly than product innovations.

Recent research is starting to integrate process models for services and products and combines sequential, parallel and feedback process structures with gating principles. As a starting point one can consider the following process steps or stages but keep in mind that they are not necessarily performed in a sequential structure (cf. chapter 4.1 and Deliverables D12.1 and D12.3):

- Idea management (Start of Life in the Company)
- Requirements analysis
- Service design
- Service test
- Service implementation
- Market Launch (Start of Life on the Market)
- Offering and Delivery on Market (Middle of Life)
- Decommissioning (End of Life)

The process steps named above can be subsumed in the three main phases “ideation”, “engineering” and “operations”. These three main phases can be linked with gates or decision points, that allow services to proceed from being an “idea” to becoming an object of “engineering” to finally being “operated” on the market. As mentioned above, the three phases not necessarily need to be passed through sequentially. With the gates between the phases feedback loops can be installed, giving the innovations frameworks an iterative character.

It is important to emphasize, that there may be various influences from inside or outside the company affecting innovation processes. Talking about service innovations, conceivable influences are the company strategy regarding service and product business, the interplay with product life cycles and innovations or the fit with business organization (e.g. processes and structure).

4.2. Approach on SLM Framework for MSEE

In this chapter the MSEE approach on service life cycle is introduced. At first the three subsequent phases of SLM (service ideation, service engineering and service operations management) are derived from established innovation processes. After that the stage-gate-characteristics of the framework are explained.
4.2.1. The Phases of the MSEE SLM Framework

Tilebein (Tilebein 2006) proposes an innovation process framework consisting of the three subsequent innovation phases “service creation”, “service engineering” and “service management” (cf. Figure 10). A service life cycle framework also can be regarded as an innovation process, as an idea is developed to a marketable product being offered on the market.

As a derivation from this, the MSEE SLM should also be composed of the three subsequent phases “Service Ideation” (1), “Service Engineering (& Re-Engineering)” (2) and “Service Operations Management” (3) (as depicted in Figure 11).

![Figure 11 Architecture of MSEE SLM – SLM Phases, Artifacts and Outcomes](image)

This approach on a service life cycle framework is not only divided in chronological phases (horizontal axis) but also in three levels of abstraction (vertical axis), respectively with regard to the content within each phase.

**Level I** presents the three rather abstract and top-level phases of the MSEE SLM framework: Service Ideation, Service Engineering (& Re-Engineering) as well as Service Operations Management. These three phases serve as description of the pillar activities being done in service business, in order to being able to provide professional, innovative and high quality services to the customers. Thus companies have to fulfill activities in these three top level phases of SLM, in order to be able to provide services to customers. Service ideation is the basement for the creation of service ideas. These service ideas are the basis of service development projects. And service products as artifacts of service development are the objects being operated in service operations management. So if a company wants to provide a certain service offering to its customers, it has to start with a concrete service idea that gets transformed into a marketable service via service engineering. The three top level phases of the SLM are essential for service business.

**Level II** goes more into detail and gives an overview of the artifacts being in focus in the three SLM phases. Service Ideas are the artifacts originated in phase 1 (“service ideation”).
Accordingly, the service ideas provided by phase 1 are transformed into Service Projects in phase 2 (“Service Engineering”). The goal of phase 2 is to develop Service Products, which are the artifacts being handled in phase 3, i.e. Service Operations Management.

**Level III** shows the concrete outcomes of each SLM phase. Thus service ideation leads to various more or less attractive ideas for new services (from the point of view of a single enterprise). Then in the phase of service engineering a specific and approved service idea is becoming a service project. The objective of that service project is to develop a marketable new service product by means of service engineering. The results of successful service engineering projects are service products that can be provided for the service operations phase. Services in that third phase of the MSEE SLM framework are being offered to customers (by means of “service sales and marketing”) and finally delivered to the customers (“service delivery”). Thus it can be stated, that the sales and marketing of services and service delivery itself are the main value drivers within the operations phase of the framework (more details on that aspect to be seen in chapter 4.3.5).

**Example out of practice for MSEE SLM architecture**

A manufacturing company wants to expand its product related service offerings. In the first SLM phase of service ideation a lot of internal ideas for new services are collected. Furthermore, it is regarded, which new services have been introduced to the market by competitors. The result of service ideation are several interesting service ideas, such as new consulting services in order to improve the availability of the machines offered or an online spare parts platform, where spare parts can be bought by customers 24/7. It is decided that the spare parts platform shall become a service development project, as the spare parts supply is of higher strategic interest for the company at the moment as new consulting offerings. Thus the idea for the new spare parts online platform is transferred as the chosen idea (out of several) to become a service development project. By means of service engineering, the idea of the spare parts platform then is developed until the service product is completed and ready for market launch. Being launched on the market, the new service offering becomes part of the company’s service portfolio. The service is now in operations, customers finally can order spare parts via the online platform. The service has changed from being an idea initially to having become a marketable service product finally.

Evidently, between the three phases of the SLM framework there need to be “decision points”. With their help, one can decide whether a certain service idea is “worth” a development project (to be decided between the SLM phases 1 and 2) or if the results of a certain service project are “good enough” to be introduced to the market (to be decided between the SLM phases 2 and 3). To provide such decision points within the SLM framework, the idea of existing stage-gate development processes (cf. 4.1.1) shall be integrated in the next chapter 4.2.2.

In accordance with Cooper and Edgett as well as with Susman et al. (cf. chapter 4.1), there should be inserted “gates” in between the interconnecting points of the three MSEE SLM phases. More precisely there must be installed such gates between the phases “service ideation” and “service engineering” as well as between “service engineering” and “service operations management”. Furthermore there may be another gate, where it has to be decided if a service has to be taken out of the portfolio (i.e. end of life by service decommissioning). The following chapter illustrates the aspect of gates respectively decision points.

**4.2.2. MSEE SLM as a Stage-Gate-Process**
If we regard the three phases of the MSEE SLM as abstract but subsequent “stages” within the life of a service to be offered and delivered on the market, there need to be gates or decision points between the stages (cf. Cooper and Edgett or Susmann et al.). These decision points determine, whether one stage is accomplished or not by a service, and if a service can proceed to the next stage (or not).

The decision points or gates enable a company to change the status of a single service, for example from being a rough service idea to becoming a service project or from being a service project to becoming a service product (from the point of view of the second level of the SLM framework, cf. Figure 11). As already mentioned, the last decision point could be, to keep a certain service product in the company’s service portfolio or to decommission it.

The following Figure 12 depicts the MSEE SLM including the decision points named.

Figure 12 Stage-Gate-Model of MSEE SLM

Figure 12 spans the elements of the MSEE SLM framework as a stage-gate-model including its three prominent phases. The output of the phase “Service ideation” is a certain service idea that becomes subject of the decision to be taken in gate one (“G1”). Here an assessment takes place whether the idea provided is “worth” (in the broader sense, to be detailed in the next paragraph) becoming a service project in the subsequent SLM phase. If in G1 the idea is evaluated not being good enough for starting a development project, the company steps back to the phase of “service ideation” and needs to work on more promising service ideas (as indicated in the figure with the feedback loop from G1 to service ideation).

We assume the service idea was evaluated being “worth” proceeding. After having passed G1, a service project is set up in order to develop a service product out of the service idea by means and methods of service engineering. Practically this means that the company now provides with budgets and manpower in order to drive the engineering project. After that engineering phase, gate two (G2) comes into play. Here a review takes place whether the results of development work are “good enough” (in the broader sense) to be offered on the market as service products. If in G2 the results of development are evaluated not being good enough for being offered on the market, the company steps back to the phase of “service
engineering” and needs to emphasize service development (as indicated in the figure with the feedback loop from G2 to service engineering).

After having passed G2 the service product can be taken into operation by the company. That means that the service now can be offered on the market and can be delivered to customers. As part of service operations management (SOM), companies constantly need to monitor whether their service offerings still fit customers´ requirements and are delivered with satisfactory quality and productivity. Therefore another decision point (G3 in Figure 12) makes sense addressing the phase of service operations. With this gate, companies may check continuously, whether the performance (e.g. quality and productivity) of the services offered and delivered on the market is acceptable.

Here four different decisions can be the result of G3:

- In the best case, the service performs well and thus can remain in the service portfolio unmodified (Decision 1).
- If there are minor changes to be done, for example in order to slightly alter marketing material, this happens within a continuous improvement process (that has to be established in service business) and without taking the service offering out of operations (Decision 2).
- If bigger deficits occur, for example if some aspects of service performance are not satisfying any more, a service re-engineering project needs to be set up in order to fulfill major changes (Decision 3, as indicated in the figure with the feedback loop from G3 to service engineering). Within such a project concrete deficits can be focused and mended. If a service to be re-engineered has to be taken out of operations may vary from case to case in practice.
- The result of the decision also may be to decommission the service (Decision 4), for example because of customers not asking for it any more. In that case, the service will be taken out of service portfolio and must not be offered on the market from now on (as indicated in the figure with the arrow from G3 to service decommissioning).

As also indicated in Figure 12, the company´s strategy may have major influence on how SLM is performed, that means what happens within the three phases of SLM and in what way decisions take place in the decision points. For example, service life cycle management might be affected only by service strategy, meaning the kind of strategy mainly aiming at service business. But it is also imaginable that the strategy of product business has additional effects on SLM. Furthermore, if there is an integrated approach on strategy, aspects of service and product strategy need to be taken into account concerning the SLM framework.

Concerning the three decision points respectively gates of the MSEE SLM framework, it may be a quite company specific question in practice, on the basis of what criteria it has to be decided if a service passes a certain gate or not. Every company applying the SLM framework in practice needs to answer the following three questions in order to define the decision criteria of each gate:
G1 question: Which criteria does a service idea need to fulfill in order to become a service project?

G2 question: Which criteria does the result of a service project need to fulfill in order to become a service product (as part of the service portfolio)?

G3 question: Which criteria does a service product need to fulfill in order to become re-engineered or decommissioned?

conceivable criteria referring to G1:
- general attractiveness of service,
- feasibility,
- fit concerning service portfolio,
- fit with regard to service strategy
- etc.

conceivable criteria referring to G2:
- market potential,
- customer interest,
- strategic importance,
- portfolio fit
- etc.

conceivable criteria referring to G3:
- typical KPIs of continuous controlling of service operations management, such as
  - customer satisfaction,
  - quality,
  - productivity,
  - profitability
- etc.

Table 1: Decision Criteria for SLM Framework

4.3. Description of the Phases of the MSEE SLM Framework

In this chapter a closer look will be taken on the inner architecture of the MSEE SLM framework.

The following Figure 13 gives an overview of the detailed architecture of the MSEE SLM framework. The three main phases of SLM (“service ideation”, “service engineering” and “service operations management”) consist of various components.

Figure 13 Overview of MSEE SLM Reference Framework
The three main phases of the MSEE SLM framework can be divided into sub-phases, which may in turn consist of modules. Here concrete tasks to be done during the service development process are detailed. To clarify the sub-phases of the framework, additional dimensions are being introduced – the “roles” and the “methods & tools” dimension.

As part of the MSEE SLM framework, the six sub-phases of – for example – service engineering can be viewed from the “roles” and from the “methods and tools” dimensions, addressing the following two questions:

- By which **roles** (e.g. of the employees of a company) do the development tasks have to be fulfilled?
- Which **methods and tools** are available in order to support the development tasks?

The following chapters explain how the framework works in detail.

Therefore at first the focus is put on the three phases of the MSEE SLM. After that, the modules or sub-phases of the SLM phases are detailed. In a last step the dimensions “roles” and “methods and tools” are elaborated.

In the following chapter we begin to analyze the phase of service ideation.

**4.3.1. The SLM Phase of “Service Ideation”**

“Service ideation” is a hardly describable phase at the beginning of the SLM framework. The reason for this is, that the phase of service ideation does not have an explicit beginning, thus it is quite delimitable. Service ideation should always and continuously take place in companies, which want to focus service business.

Service ideation is rather a **state of mind** closely linked to perception than a typical SLM phase, such as for example service engineering. In the open-mindedness of the ideation phase companies need to aspirate various influences coming from the surroundings of the enterprise that may have effect on their service business or at least should be respected within it.

These **idea providing influences** may be changing customer needs, new emerging technologies, transformations of the company environment, and other causes or drivers of change. For service ideation they serve as **triggers** or **stimuli**.

In the phase of service ideation the companies need to **filter a variety of information and opportunities**. This context can be illustrated with a **funnel of perception**, as depicted in the following Figure 14:

![Figure 14 Funnel of Perception for Service Ideas](image)
One the upper side of the funnel, all influences and effects from outside are received and get into it. Inside the funnel they are getting **processed and distilled**. On the bottom side of the funnel promising service ideas are “spit out” then. These ideas are interesting for the company as they seem to have an attractive market potential. This conceivable market potential is quite obvious, however, a deeper analysis of it does not take place necessarily. The service idea and the **market potential** linked to it are estimated as being worth to **start an engineering project**.

Although service ideation does not have a concrete point of start, there are moments, when a concrete service idea (or a collection of ideas) is **handed over to the service engineering phase** in order to develop new marketable services (this happens by passing gate 1 in the stage-gate-model). However, after that, service ideation does not end, as it needs to be carried out all the time.

When a collection of service ideas is handed over to the first phase of service engineering, “**idea management**”, it comes to a structured **collection** and subsequent **evaluation** of the service ideas provided by the phase of service ideation. Figure illustrates the context:

As described in Deliverable D12.1 and D12.3, important activities in the field of idea management are the conduction of feasibility studies, the creation of business cases and the validation of conceived market potentials.

### 4.3.2. Roles in the SLM Phase of “Service Ideation”

As depicted in Figure 15 (see following chapter 4.3.4) the role of the “idea contributor” is important for the phase of service ideation. The “idea contributor” can be regarded as the employee or organizational unit that brings into play an attractive idea for a new service.

The service contributor not necessarily needs to be an employee of the company being regarded. It is imaginable that the idea contributor is a **customer**, prompting for a certain service offering that hopefully solves a certain problem for him. For example, a customer could claim a new service offering as follows from a machine providing company: “I want you [i.e. the machine providing company being talked to] to offer a new training service for my machine operators that enables them to produce more output while avoiding waste.” Here the company receives a clear idea input respectively service proposal from its customer. Moreover, as indicated in Figure 15, the role of the idea contributor can also be obtained by **MSEE business partners, suppliers or research partners**.

### 4.3.3. The SLM Phase of “Service Engineering”

Service engineering has already been explained in antecedent deliverables of the MSEE project work (cf. Deliverables D12.1 and D12.3). In D12.1 the general idea of service engineering was introduced: Service engineering is a research discipline that has been formed in the mid-nineties of the last century mainly in Germany and Israel. It can be understood as a technical discipline dealing with the systematic development and design of new services. For this purpose service engineering provides appropriate models, methodologies and tools (cf. D12.1). In D12.1 and D12.3 the process phases of service engineering were detailed and explained. Accordingly service engineering consists of the six sub-phases “idea management”, “requirements management”, “service design”, “service test”, “service implementation”, and “market launch” (as shown in the center part of Figure 13 or as introduced and explained in D12.1 and D12.3).
In this deliverable D14.1 the dimension of “roles” will be detailed with respect to the three phases of the MSEE SLM framework. In the next deliverable of WP14 “methods and tools” will be provided for all phases of the MSEE SLM framework.

### 4.3.4. Role model for the SLM Phase of “Service Engineering”

In organizations, the division of work between employees or organizational units among one another is often defined by means of roles.

Roles bundle one or more tasks and can be assigned to one or more employees or organizational units. For example, in the role model illustrated in the following Figure 15, the owner of the role “Service Manager” is responsible for a set of tasks: He has to evaluate proposed service ideas on a strategic level, to come to a decision quickly, to allocate resources for the service development project, and to control if the decision is executed effectively. The role of the Service Manager can be assigned to a single person as well as to an organizational unit like a committee, an expert team, a board of directors, or others.

![Role Model for the “Service Engineering” Phase of MSEE SLM Reference Framework](image)

**Figure 15 Role Model for the “Service Engineering” Phase of MSEE SLM Reference Framework**

Consistent with the “Service Engineering” phase of the MSEE SLM Reference Framework, figure 15 depicts an array of roles, which can be assigned either to an internal pool of potential role owners (examples for possible functions and positions at the bottom of the figure) or to an external pool (indicated at the top of the figure). For a specific company, role assignment as well as task definition for roles should match the company’s parameters of processes, organizational structure, and competences of employees or organizational units, respectively.

In brief, the roles illustrated in Figure 15 may contain the following tasks:

- **Idea contributor:** Feeding in ideas (by crossing the company boundary to the environment, if necessary)
• **Idea**
  Collection, preliminary assessment, and forwarding of selected ideas to decision maker(s)

• **Service**
  Strategic prioritization of ideas, approval of resources for trialing / implementing the idea concept, controlling of the Service Engineering results

• **Requirements**
  Identification and integration of customer and company requirements for the new service concept

• **Service**
  Conceptualization of the new service process, information and decision flows, stakeholders, roles etc.

• **Service**
  Checking the service process, e.g. by means of a pilot project.

• **Service**
  Conducting the internal roll-out, feedback evaluation and optimization of service process

• **Service Engineering**
  Supervision and controlling of the Service Engineering project

• **Service Engineering**
  Structuring the Service Engineering project on the levels of process barriers, requirements fulfillment, and management of stakeholders’ interests

• **Service**
  Conducting the market launch and marketing/sales activities

Depending on the company’s specific design of working tasks, work processes, and organizational structure, role concepts should be tailor-made solutions to be suitable to day-to-day business requirements. Moreover, the successful implementation of role models often requires a change of behavioral patterns, fields of responsibility, and cultural aspects. The underlying change process should be actively managed and monitored.

### 4.3.5. The SLM Phase of “Service Operations Management”

It is a key objective of Deliverable D14.1 to characterize the main components of the phase “service operations management (SOM)”. As SOM must be more than just “service delivery”, a framework needed to be detected from literature, from which a model for SOM could be derived. The modules concerning service engineering are to be regarded mostly as subsequent and chronological process modules. In contrast, the majority of modules focusing service operations management need to be seen as functional building blocks that are of interest for service business permanently.

As foundation for the MSEE SOM framework a famous and well established classic model out of business management literature was used: Porter’s “Value Chain” (Porter 2001), as depicted in Figure 16.
The basic conclusion of Porter’s approach is that there are primary and secondary activities to be performed by a company in order to bring value to its customers and to do business in a profitable way.

Primary activities are the activities that create the customer value, respectively the value the customers pay for. However, a company cannot perform primary (i.e. value creating) activities without having accomplished support activities such as human resource management or procurement before or focusing them in parallel.

Also the way of representing Porter’s idea of the value chain – the figure in arrow form – has become well established for showing what has to be done in a sequential or in a rather parallel way in order to produce customer value.

This way to think as well as its graphical representation seems to be appropriate for a first approach on MSEE SOM. However, this constellation of a value chain rather represents the product business of company than the service business.

This can be proven by looking at the primary activities in the arrow, which are very product or material focused. First material resources have to be bought and brought to the production site (“inbound logistics”), then the “operations” take place. “Operations” here must be understood in the sense of producing goods such as machines. The results of the operations phase are then sold to the customers (“marketing & sales”). Service only then occurs as the last primary activity, for example in the context of repairs or spare parts business.

To derive the MSEE SOM model, the service element of the product value chain has to be focused. Here we can make use of another result of management research: in literature another version of the value chain exists, having been adapted especially for service businesses (Altobelli and Bouncken 1998). Figure 17 illustrates the modified value chain for services:
In comparison to Porter’s product-centric value chain the order of the primary activities has now been slightly changed. The support activities named are the same as in the original figure. However, value creation with services typically begins with customer “acquisition”, that means sales and marketing activities. If acquisition was successful, inbound logistics take place. Here for example materials needed to deliver the service are provided. Then during the “contact phase” the service is produced and delivered to the customer. Though, this service specific value chain still is complex. Therefore for the purpose of the MSEE project a simpler model for service operations management (SOM) was derived from the value chain. Figure 18 depicts its structure:
The primary activities “Service sales & marketing” lead to the acquisition of customers respectively service projects. After the acquisitions phase the service needs to be delivered to the customers. This happens within “service delivery”.

The support activities for SOM have been changed in comparison to the support activities of Porter’s value chain or the value chain for services (cf. Figure 16 or Figure 17). With respect to the architecture of the MSEE SLM framework and its stage-gate-character, there remain two significant support activities, “service portfolio management” and “service operations controlling”.

Within “service portfolio management” the various service offerings of a company (i.e. the service portfolio) are to be managed. As part of this activity area there are three main tasks to be fulfilled. Firstly, new service development projects must be initiated if the service portfolio is estimated incomplete or needs to be broadened. Secondly, a continuous improvement process for service business needs to be installed. Furthermore, if service offerings are...
detected that are not needed any more, for example due to bad performance or lacking customer interest, they have to be decommissioned.

**Portfolio management** therefore is the crucial link between strategy and development processes. It is vital to allocate the resources according to strategic considerations. Portfolio management is a dynamic decision making process and an important management task that has three goals (cf. Cooper and Edgett, 1999):

- To maximize the value of the portfolio (e.g. based on estimations like net present value methods)
- To achieve the right balance of projects with respect to important aspects, such as risk, market, target group and timeline.
- To ensure that projects represent strategy. If for example the strategy foresees smart phone apps, then such projects have to be chosen, even if they are weaker than other projects. This principle is called “strategic bucket”. It assigns a budget on top of a certain sector, market or technology and then fills it with projects to be funded.

The task of “**service operations controlling**” is to provide recommendations for “service portfolio management”. For example by monitoring KPIs concerning service quality and productivity, service operations controlling can provide implications for service portfolio management. That means service operations controlling can help to decide whether a service needs to be improved or should be taken out of the portfolio. Moreover, service operations controlling is in charge of monitoring and controlling the primary activities of the service operations management (SOM) phase.

The following Figure 19 sums up the context of SOM and emphasizes the important role of service operations controlling:

![Figure 19 Role of Service Operations Controlling within SOM](image)

4.3.5.1 **Service Sales and Marketing Module**

“Service Sales and Marketing” plays a vital role in SOM as it brings the service offering to the customers. According to the state of the art of research referring to service sales and marketing, the following process steps of the module can be derived (as depicted in the following Figure 20):
A qualitative implementation of sales and marketing in SOM influences future profits of service business. If sales and marketing does not work properly, services will not be sold to customers effectively.

In the first process step, marketing implementation, the marketing concept for the service offerings needs to be implemented. About this subject of service marketing there are a lot of research implications available (e.g. Meffert 2006; Wirtz 2012; Davis 2005; Fitzsimmons and Fitzsimmons 2010, Grönroos 2007, Vargo and Lusch 2004).

Market reaction registration is another important part of service sales and marketing. Here the general situation of the market is analysed (i.e. competitors, suppliers, trends, external influences etc.). Market observation has to be accomplished before marketing implementation starts but also in the aftermath. So, first of all market has to be analysed, and then, according to that marketing strategy and its implementation. After implementation the market observation should be continued. As usual competitors will try to use the same or improved idea, especially if it will show good results.

At the same time a clear sales implementation has to be chosen. Here the target group, target market and prices have to be defined. These points have to be calculated and measured very precisely in order to meet the market needs with the company’s price and quality proposition. It can be improved, depending on competitors return actions, but not to the prejudice of profits. Consequently there is a connection to the support activities. For example service operations controlling may give feedback with regard to quality questions, service portfolio management being in charge of the improvements may have a close look on the competitive environment and the own sales activities.

However, sales success also depends on customers’ positive reaction on the marketing and sales strategy during and after bringing services onto the market. If they will not be properly prepared and implemented, the start of sales can be slowed down significantly or even be totally unsuccessful.

4.3.5.2 Service Delivery Module

The service delivery module displays how a service offering is delivered to the customers. The following Figure 21 illustrates the main process steps of this module (as proposed in literature, e.g. Barros and Kylau 2011; Dawson 2007):
The most important aspect in order to deliver a service well and in time is to **plan resources**. This has to be made early, subsequent to the services marketing and sales phase. All necessary contracts with suppliers have to be signed, as “resources” implies both types, external and internal ones.

Within the next module, the service is delivered respectively **provided** to the customer.

After the service is done **customer feedback** has to be collected (cf. Cook 2004; Hill 2007). The form of the feedback depends on the marketing strategy, personal preferences etc. Using remarks and offers of consumers is an important tool of service innovation. Here there is a **connection to the support activities**: continuous improvements and service operations controlling. Customer feedback can be taken into account in advance in order to analyse expectations and to implement improvements. Another important step is **employees’** respectively **staff feedback**, because the people who perform the work often know better what is going wrong than for example managing staff.

### 4.3.6. Roles in the SLM Phase of “Service Operations Management”

On the level of primary activities, the “Service Operations Management” model of the MSEE SLM Reference Framework contains the modules “Service Sales & Marketing” and “Service Delivery”. The modules consist of four phases each, representing the process of planning, implementing and feedback analysis for each activity focus (see Figure 20 and Figure 21). Matching theses premises, Figure 22 illustrates the role model, which allows for the spectrum of tasks in each phase to be assigned to one or more individuals or groups of process participants.
Reflecting the Service Operations Management phases, the roles bundle the following tasks:

- **Marketing Implementer**: Based on the Market Launch-activities from the preceding role “Service Facilitator”, here marketing activities for the new service or solution are initialized.

- **Sales Implementer**: Preparation and conduction of sales activities with respect to the new service/solution.

- **Implementation Reaction Analyst**: For both marketing and sales activities, feedback of the market (e.g., responses to advertising, development of sales performance figures) is collected, aggregated, and evaluated.

- **Resource Planner**: For successful service provision, the required resources (e.g., capacity, budget, infrastructure) have to be planned proactively.

- **Service Provider**: Service/solution provision is established and integrated in the day-to-day business of the company.

- **Delivery Feedback Analyst**: Corresponding to the marketing and sales phases, feedback from both external and internal stakeholders is collected and evaluated.

Compared to the role model of the Service Engineering module, the assignment of role owners to the roles depicted here is more specific: as marketing, sales, and service provision are the genuine tasks of the correspondent enterprise departments, the pool of potential role owners should be transparent, although responsibilities for the new services or solutions have to be appropriately assigned to the role owners. Moreover, marketing and sales activities may to some extent be delegated to external consultants or external marketing/sales provider, and customers may play a substantial role in the analysis and feedback activities as well.
4.4. Integration of Service and Product Life Cycle Management (SLM & PLM)

In the chapters 3.1.2 and 3.2 the objectives of PLM and SLM were described. According to the particular objectives of both, PLM and SLM, an integrated objective may be constituted, for companies that manage both life cycles.

The integrated management of product and service life cycles (PLM & SLM) is about the whole life of both, products and services, starting from product or service ideas, leading to their various conceivable interactions and ending with their decommissioning.

Important elements of this “management” are the planning, controlling and monitoring of all business processes relevant for the products and services being regarded and having a certain interplay. The main objectives of PLM & SLM are to increase integrated product and service quality and to boost company profitability. A working system of PLM & SLM should also lead to a higher innovativeness and flexibility of corporations.

The objectives of an integrated PLM & SLM approach may sound reasonable, however, the alignment of PLM and SLM is not trivial in practice. There are a lot of questions concerning their interplay which complicate the derivation of generic implications for all manufacturing companies to be addressed.

One major objective of deliverable D14.1 is to reflect the most important relations of product and service life cycles in the daily practice of manufacturing companies. In the following chapters it should be discussed, which different ways of integrating SLM and PLM are conceivable (at least on paper).

In general there are the following constellations to be regarded:

- Length of SLM and PLM in comparison towards each other
- Degree of interplay / interaction between SLM and PLM
- Degree of integration of management of SLM and PLM

From these three perspectives recommendations may be derived for the application of the MSEE SLM framework in practice. Firstly, as part of this deliverable D14.1, the relation of lengths of PLM and SLM will be observed in the next chapter. The degrees of interplay and integration between SLM and PLM will be regarded in the subsequent deliverable D14.2.

4.5. Length of PLM and SLM

Probably the most prominent question in practice regarding life cycle management in manufacturing companies is whether the product or the service life cycle is lasting longer.

In concrete there are three ideal typical alternatives imaginable, as shown in Figure 23:
The basis of the three alternatives presented above is the following simplification: It is assumed that the utilization of a product on the market by its owner (i.e. the customers of a product producing company) ends at the same point of time as the company stops to offer the product on the market. That means that the end of the offering of the product also constitutes the end of being installed or existent on the market.

In Alternative A the product life cycle outlasts the length of the service life cycles. That means that one certain product remains the same over time, whereas the services offered relating to the product change from time to time. In a first period a “service 1” is offered being related to the product. Concerning that “service 1” a certain service life cycle management (“SLM 1”) takes place. At first the idea for “service 1” comes up, then it is engineered and introduced on the market (i.e. beginning of life). Here it gets operated, that means it is offered to customers. Later – due to various conceivable reasons – “service 1” is taken out of the service portfolio and gets decommissioned (to be understood as end of life of the service). A simple reason for the decommissioning may be, that customers are not interested any more in using that service.

As a substitution the company now offers a new “service 2” which was created, developed and launched. “Service 2” also gets managed from its beginning of life until its end of life. Maybe in the aftermath, “service 2” gets replaced by a “service 3” after a certain time span and so on. However, it is still the same product being servitized by the changing service offerings from time to time.

Example for Alternative A: A machine and suitable tele-services. Ten years ago tele-service was based on modem technology with slow data transfer, later tele-services were enabled by isdn, which allowed faster data transfer. Nowadays even mobile data networks are conceivable as foundation for tele-service offerings. In this example the machine’s product life cycle lasts longer than the life cycle of the tele-services offered. The modem-based service first was introduced, operated and then after a certain time span got decommissioned when isdn technologies allowed advanced tele-services. The isdn-based tele-services had an analogue life cycle, as they probably would perish when more attractive technologies occured which allowed faster internet connections and better machine monitoring.

In contrast to that, Alternative B depicts the situation that product and service life cycles are equally long. Both start and end simultaneously, that means that their beginnings and ends of
life take place at the same time. This alternative may occur, when a service is tailored for a certain product and does not fit for other product offerings (for example subsequent ones).

**Example** for Alternative B: let us make the assumption, that a repair and spare parts service is tailored just to fit a certain series of Apple’s iPhone models (e.g. the new iPhone 5). These repair and spare parts services only may be applied for iPhone 5 and make no sense for preliminary or subsequent iPhone models (for example because the spare parts of the other models are too different). So the service component is highly dependent on the product itself. The services may be offered from the point of time when the first iPhone 5 is launched on the market until the time when this specific iPhone model is not used any more by no customers (this may take a while). With the end of life of the product on the market also the end of life of the repair and spare parts service offering takes place. In general the Alternative B may describe the relation of lengths of high tech products and specific related services.

An alternative explanation for Alternative B (on a meta-level) is more complex, as to be shown in the following: in the past decades cars (i.e. the products) were composed of mechanical components to the greatest possible extent. Therefore also the product related services such as repair and maintenance were oriented to a high degree towards mechanics. That circumstance implied, that service personnel or staff needed to be very skilled in mechanics. The human resources (“mechanics”) in the car workshops mainly worked with screw drivers and other typical mechanical tools.

In contrast to the situation in the past, in recent years the cars produced by the automotive industry became more and more mechatronic instead of just mechanical, as electronics started to play a more prominent role. In consequence, the former pure mechanical services do not fit any more for cars (i.e. products) with a lot of mechatronics inside. Therefore, for the new products, new appropriate services needed to be introduced, such as repair and maintenance for mechatronic components. Also the service personnel needed to adapt its skills for services that became more and more oriented towards mechatronics. Nowadays schools and universities focus that challenge and form alumni being able to work as mechatronic technicians or engineers.

**Alternative C** illustrates the opposite of alternative A. Here the service life cycle is lasting longer than the one of the product. In concrete that means that the service stays the same, whereas the product being addressed with the service changes from time to time. This Alternative C may for instance occur on the B2C market of the automotive industry. Car owners may buy the same **obligatory car insurance policy** (as a typical product related service) from a (car) insurance company independent of the specific car model to be insured. So probably the insurance policy would be the same for a Volkswagen model Golf VI or a Volkswagen model Golf V etc. As we see here, the life cycle of the service component (insurance policy) lasts longer than the life cycles of the products the product-related service is aiming on.

Another example for Alternative C coming from automotive industry is about spare parts. If we consider that a certain amount of spare parts does not change from one series model of a car (e.g. Volkswagen Golf V) to the subsequent series model (here: Volkswagen Golf VI), that means that the associated spare parts service stays the same (also its supply chain processes), although the primary products respectively the cars it aims upon do change. From the point of view of life cycle management the service life cycle (spare parts service) lasts longer than the life cycle of the products.

An alternative explanation for Alternative C (on a meta-level) could be as follows: Let’s regard the services of petrol filling stations as product-related services for cars. For decades the service of providing gasoline stayed the same (of course with slight modifications with regard to the composition of the gasoline to be offered), whereas the cars to be provided (or
servitized) with gasoline changed from time to time. Their life cycles often were shorter than the life cycle of the service of gasoline provision that for the most part still is the same nowadays.

**Criticism with regard to ideal typical lengths of PLM and SLM**

To illustrate ideal typical alternatives of the lengths of PLM and SLM it was assumed, that the utilization of a certain product (by its owners) on the market ends at the same as the offering of the product on the market is terminated by the producing company.

In reality, however, customers of a certain good or product still would use it, although it is not offered any more by its producer. For instance, there are thousands of Volkswagen Golf III on European streets yet, though the production and sales of the series model were stopped by Volkswagen in the early 2000s. Due to that reason the Volkswagen car workshops still need to be prepared to repair a damaged Golf III and be able to provide spare parts. In many cases services have to be offered as long as an installed base of the products exists on the market.

In consequence that implies that the life cycles of current products and related (specific) services need to be managed proactively by companies as well as the still meaningful service life cycles relating to products, whose product life cycles already have ended in the past from the producing company’s point of view with respect to production and sales. Thus, in the daily practice of producing companies a lot of life cycles, both of products and services, need to be managed simultaneously. However, how many companies out there are already doing so?

### 4.6. Modification of MSEE SLM Framework According to Type of Service

The MSEE SLM framework must not be regarded isolated, but with respect to all relevant context or circumstances. Very probably the framework needs to be adapted in practice, in order to respect the characteristics of different types of services.

In chapter 4.6.2 an approach is proposed on the adaptation of the MSEE SLM framework in order to be able to pay respect to the characteristics and implications of certain service types. Therefore, in the next chapter 4.6.1 various conceivable typologies for services are presented. On the basis of such a typology, the MSEE SLM framework should be able to be modified.

#### 4.6.1. Typologies for Services

In literature various alternatives for a typology of services have been discussed. The objective of a typology is to classify services with respect to their characteristics. With such classes of different service types it is then easier to focus their specific peculiarities which then need to be taken into account during service engineering and service management. An important question to be answered is which typology should be used in MSEE as foundation for the adaptation of the MSEE SLM framework.

A very prominent typology for services is coming from Fähnrich and Meiren (2007) and is shown in Figure 24.
Fähnrich and Meiren (2007) differentiate services with the help of the two dimensions “variety” and “contact intensity” of services. As result there are four different classes of service types illustrated. “Customer-focused services” such as training are coined by a high contact intensity between service provider and customer, however, they are poor in variety. “Knowledge-focused services” as consulting are also very contact intensive, yet their complexity or variety is much higher. “Flexibility-focused services”, for example the repair of a machine, are coined by a high variety (e.g. variety of problems to be solved by repair services), and are rather low with regard to contact intensity. Process-focused services such as transportation do not have a lot of varieties and are not very contact intensive.

The different occurrence of variety and contact intensity may lead to different requirements in business practice with regard to all phases of the service life cycle. During the development of services with a lot of variety, for instance, the focus has to be put on other aspects as in the case of low variety services. The management of many different service modules might be a big challenge here.

Besides the above mentioned typology of Fähnrich and Meiren (2007), also other typologies are imaginable, which differentiate with respect to the chronological allocation of the service offering (i.e. pre-, at- and after-sales services) or with regard to the kind of value that is created (i.e. standard technical service such as spare parts and repair vs. value services and technology based services such as internet platforms, consulting or tele-services). One also could differentiate according to the kind of customers to be served, for example, consumer services (B2C) vs. business services (B2B).

Also possible, but very company specific, is a differentiation in standard or individualized services and also mass customized services. Here the typology is based on the extent of customer integration into value creation (cf. Fließ 2009).

In order to modify the MSEE SLM framework it must be decided which service typology is the most appropriate.
To modify and adapt the proposed MSEE framework for service life cycle management is a complex task. Therefore a defined procedure is needed, in order to allow repeatable results.

The following

Figure 25 proposes an approach on a four step procedure, which shows how the MSEE SLM framework might be modified with respect to certain types of services.

![Figure 25 Modification of MSEE SLM Framework according to Type of Service](image)

The procedure for adapting the MSEE SLM framework should be divided in the following four subsequent process steps or activities:

- Identify service type,
- Respect characteristics and implications (of certain service type),
- Adapt framework (with respect to characteristics and implications) and
- Apply framework (in practice).

One service may differ from another service with respect to a variety of characteristics. Based on – mostly two – chosen service characteristics service typologies can be spanned. Within such a typology, various types of services can be allocated. Service typologies are the means to express in what way and to what extent services are different towards each other.

At first, as the first step to be taken towards a modification of the MSEE SLM framework, the type of service to be taken into account needs to be defined. To find out how a certain service is classified, chosen typology schemes (cf. chapter 4.6.1) can be used.
From the characteristics and peculiarities of a certain service type implications can be derived to be abided by practitioners. These implications may refer to the engineering as well as to the operations phase of the service life cycle management framework.

On the basis of the allotted service type the SLM framework can to be adapted. For instance, for certain service types a differing approach during service development is more promising than for another service type. Also parts of the service operations phase may differ.

If we take an internet-based service, for example a spare parts platform of a machine producer, all service process steps are clearly defined, standardized and supported by means of IT and internet technologies. Here, during development a lot of attention has to be paid to process design and the alignment of gateways. Media disruptions need to be avoided. Furthermore, data bases need to be integrated and the IT services should run flawlessly.

In contrast, if we consider a technical consulting service, other aspects become more important during the engineering phase. Here, interaction and communication aspects, often subsumed by the term “soft skills”, play a major role for the service offering to be developed. IT and internet support are not as important instead, as service delivery mainly is enabled by staff people.

Depending on the type of service to be developed or managed the proposed MSEE SLM framework might be applied with a modified version of itself.

4.7. Conclusion on Chapter 4

Chapter 4 provided a bright inside into the derivation of a generic SLM framework for the MSEE project (to be regarded as a top down approach). The framework being introduced consists of the three phases “service ideation”, “service engineering” and “service operations management”. Each of the three phases were described and the roles in charge of fulfilling tasks in the context of service business were presented.

We also discussed which conceivable relations of SLM and PLM might exist in practice. The prominent question of “what life cycle is longer?” (the one of services or the one of products) was answered by an ideal typical illustration of all imaginable combinations. Several examples and explanations were provided, however, in business practice it is not trivial to perform a mixed multi life cycle management of services and products depending on their particular and temporal positions in their life cycles.

It was also presented, that for applying the generic MSEE SLM framework in practice, modifications need to be carried out, in order to provide a framework that fits the specific characteristics of a certain service type. The open question here is which available typology for services should be used or if a MSEE specific typology should be elaborated. The open questions will be answered in the subsequent deliverables.
5. Summary and Outlook

Deliverable D14.1 provides an overview of life cycle management. At first, the state of the art of product life cycle management (PLM) is presented. Then, service life cycle management (SLM) is introduced.

On the basis of the PLM and SLM principles a generic framework for SLM is proposed which is in the context of the MSEE project and respects the antecedent project work accomplished. The MSEE SLM framework consists of the three axis “phases”, “roles” and “methods and tools”. The main phases of the SLM reference framework (ideation, engineering and operations management) were illustrated and detailed (first axis). Furthermore the second axis “roles” was detailed. It was clarified by the role models provided, which roles inside and outside a manufacturing company are necessary in order to implement the proposed service life cycle management. It seems that companies that do not have implemented a SLM yet, could start implementing it with the (human) resources they already have in their service business.

Furthermore a first approximation was undertaken with regard to the question how PLM and SLM interact typically and in practice. The prominent question of “what life cycle is longer?” was answered with a top down perspective. However, the management of their interaction in business practice probably is much more complex than the ideal typical approach that was presented.

Moreover it was regarded, how the MSEE SLM framework could be adapted with regard to different types of services to be managed with it. A short introduction was provided to imagine, which kinds of typologies are already available (e.g. in scientific literature). A procedure on how to apply the SLM framework was also proposed, although before we can utilize it, we have to decide how to classify the typologies for services.

With regard on the deliverables to be elaborated in the nearer future (e.g. within WP1.2 and WP1.4), the following outlook on subsequent project work shall be provided:

- The third axis of the MSEE SLM framework will be presented in detail. The most important methods and tools for the three phases service ideation, service engineering and service operations management will be provided and templates will be attached.

- A detailed analysis will take place concerning the interaction of PLM and SLM. The most important aspects of “both worlds” will be distilled and used for observation. It is an important objective to provide first implications for companies that are in the focus of the MSEE project.

- It will be discussed and decided which typology for services to use in order to adapt the MSEE SLM framework. Proposals will be provided, how the SLM framework can be modified according to a certain type of service.
6. References


