



*D25.6*

*Approach for SSME (Service Science  
Management Engineering) in Manufacturing  
Ecosystems*

*M15 issue*

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### ***Deliverable Peer Review Summary***

<b>ID</b>	<b>Comments</b>	<b>Addressed (✓) Answered (A)</b>
1	There is no reference to WP 21 which normally must deliver the reference model	(✓) See refinement throughout the document and in Chapter 2
2	Describe the link between the components of the Conceptual Model and the methodology	(✓) See refinement throughout the document and in Chapter 3, section 3.1
3	Show more clearly results and conclusions in Section 3 and further work needed	(✓) See refinement throughout in Chapter 3 and addition of section 3.2

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## Executive Summary

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This deliverable is part of the WP2.5 ‘Service based Innovation Ecosystems’ of the MSEE project and belongs to task T25.4 ‘Specification and development of an approach for SSME (Service Science Management Engineering) in Manufacturing’. This task focuses on development of a methodology which supports the general characteristics a service-based manufacturing ecosystem has in order to support and enhance innovation.

To achieve this objective, the work carried out for this deliverable has focused on two aspects. On the one hand, the Conceptual Model that was roughly defined in Deliverable 25.1 has been extended and completed under the scope of Service Science Management Engineering (SSME). The main components of a service-based innovation ecosystem have been described in detail.

Based on the criteria and requirements drawn from this extended Conceptual Model description, it can be said that a MSE is a non-hierarchical form of collaboration where various different organizations and individuals work together with common or complementary objectives on new value added combinations of manufactured products and product-related services. Moreover, this type of collaborative network will have to be characterised by various features in order to be considered as a MSE:

- MSE has to be composed, apart from other type of resources, of virtualised tangible and intangible assets.
- Its aim is to perform service innovation in a collaborative way
- It possesses governance and management capabilities and it is able to measure its own performance
- MSE is supported on an ICT tool

On the other hand, in order to create and manage MSE that will perform service innovation, a methodology for their set up, management and governance is needed. That is why this deliverable offers a systematic set of steps, supported by different approaches and guidelines and based on the requirements set by the Conceptual Model.

In the first iteration of the MSEE project, the methodology has been designed considering some of the characteristics and requirements that the Conceptual Model sets. Firstly, the methodology is composed by several steps that correspond to the life-cycle of a MSE, namely, the creation, operation, metamorphosis and dissolution phases. Secondly, it integrates other requirements of the Conceptual Model when considering the tasks that need to be conducted in each step of the methodology. For instance, the innovation, collaboration and servitisation characteristics shall be considered when deciding the governance model or when defining the business model of the MSE. These characteristics are the key when defining the objectives and the strategy of a MSE.

The concretization of the Conceptual Model entails that different scenarios and alternatives might arise when creating a MSE. This shall impact on the management and governance model and, thus, in the methodology that shall help implementing these models. Therefore the methodology will be further developed in the second iteration cycle of MSEE project, and shall consider the above mentioned different scenarios and offer different guidelines in order to address them.

## 1. Introduction

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This deliverable belongs to task T25.4 ‘Specification and development of an approach for SSME (Service Science Management Engineering) in Manufacturing’. This task focuses on development of a methodology which supports the general characteristics a service-based manufacturing ecosystem has in order to support and enhance innovation.

Consequently, the main objective of this deliverable is to depict and describe a methodology that will allow service-based manufacturing ecosystems operate and perform service innovation.

Therefore, this deliverable covers the following aspects:

- In Chapter 2 MSE’s Conceptual model is extended under the scope of Service Science Management Engineering (SSME) and its main components are described in detail.
- In Chapter 3 a first approach to the methodology for creation, management and governance of MSE is offered.
- Chapter 4 synthesised the findings of the research carried out and outlines the following steps to be conducted in further deliverables.

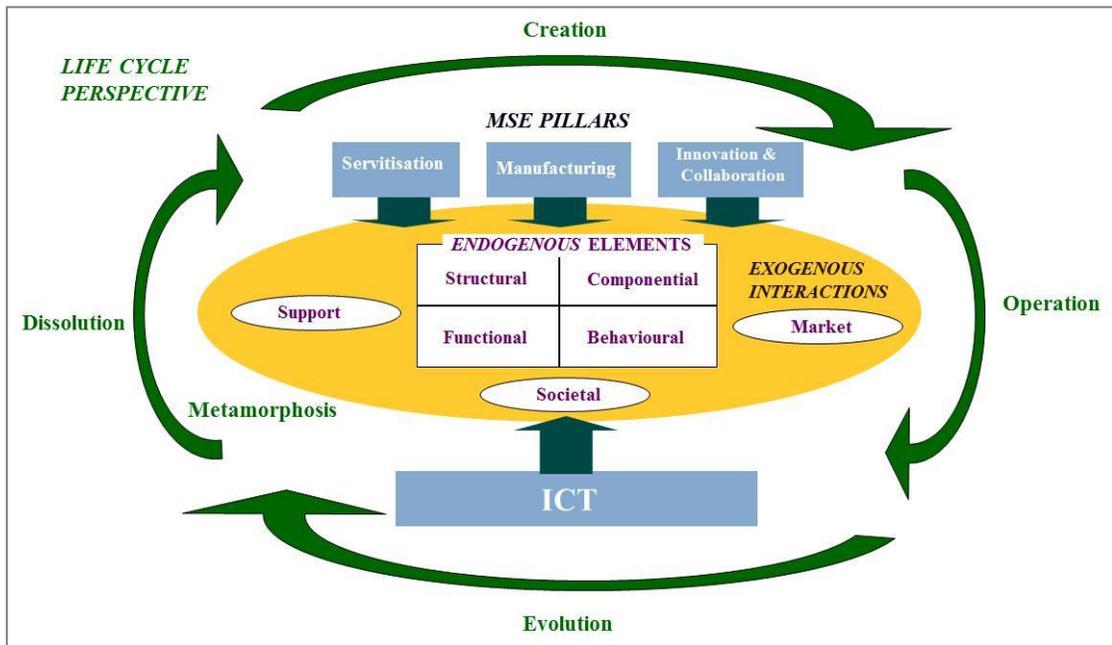
## 2. Definition of a MSE and its components (Conceptual Model)

Having in consideration the main objective of the WP25, in this section it is aimed to extend and complete the conceptual model for a MSE developed in Deliverable 25.1 under the scope of Service Science Management Engineering (SSME). In the mentioned deliverable, after a comprehensive review of the main collaborative networks and the identification of the requirements of a service based innovation ecosystem, a preliminary conceptual model for MSEE project was proposed.

In this section, the main components of a service based innovation ecosystem will be described in detail and the complementarities with other tasks carried out within the MSEE project have been taken into account and integrated accordingly. The current results in SSME will be analysed to come up with ideas and concepts that need to be considered.

It is also expected that the results obtained from this development shall offer fundamental basis for the development of MSE management and governance methodology which will be described in next section in this deliverable.

The conceptual model took the basis of a customized definition of a Manufacturing Service Ecosystem for the MSEE project and from this definition, its components and specific characteristics were drawn Figure 1. The following figure show the global view of the conceptual Model of a MSE whose pillars, components and features will be described in detail in this section.



**Figure 1: Graphic representation of Conceptual Model for MSEE**

Aligned with the mission of MSEE’s ecosystem<sup>1</sup> - “work in a collaborative way to create new innovative and added-value combinations of manufactured products and product-related services”, the three pillars (innovation, servitisation and manufacturing) enable the ideation and development of new innovative services from a manufacturing environment, supported by endogenous and exogenous components of the ecosystem that will evolve along the ecosystem’s lifecycle.

<sup>1</sup> D25.1-SoA of Collaborative Networks for Service-Based Innovation Ecosystem

## 2.1. Approach to describe the main components of the MSE

At this stage, in order to provide a detailed and valuable description of the MSE components, a “crossed analysis” approach has been applied.

First, each component of the Endogenous and Exogenous perspective is evaluated against the three pillars innovation, servitization and manufacturing in response to its contribution or added value to one or all pillars. That is, identify the main components and their characteristics in order to achieve MSE’s objectives regarding innovation, servitization and manufacturing requirements. Based on this contribution, its functions in the ecosystem are described integrating also the knowledge developed in previous WPs within SP2 (i.e. innovation framework from WP21, tangible and intangible assets from WP22 and WP23, and so on) and also in SP1 (i.e. WP12).

Furthermore, the existing and needed interactions between endogenous and exogenous components also will be analysed in order to discover overlapping consequences in their functions and, more important, to align their contribution to the MSE’s mission. The main concepts and guidance coming from the SSME will be included in this analysis.

Since the MSE is supposed to evolve along different phases represented in its lifecycle, some of its components must be considered as evolving too. In that way, its evolution along the MSE lifecycle will be integrated in the conceptual model.

## 2.2. Description of the components in MSE’s environmental perspective

This section collects the main components of the environmental perspective (endogenous & exogenous) for the MSE’s conceptual model and they are analysed, through the approach described in section 2.1. Their functions in the ecosystem are described based on the following three evaluation criteria:

- 1- Its **contribution** or added value to the three pillars of innovation, servitization and manufacturing: these components are analysed considering their contribution to the three pillars of Enablers’ perspective and their function within the ecosystem is depicted based on the mentioned contribution.
- 2- Its **interactions** with other dimensions: by analysing the interactions between the MSE components, the identification of some rules or aspects to be considered in the management of MSE (section 3 in this deliverable) have arisen.
- 3- Its **evolution** along the MSE lifecycle will be integrated in the conceptual model

The endogenous elements represent the ecosystem from the inside that MSE should have according to the MSEE project. They are classified into structural, componential and functional dimensions. Added to these three categories, Governance and ICT components are also considered.

The progress of MSEE project will provide new insights and relevant developments that need to be considered for an improved characterization of the components analyzed in this deliverable. Extended definitions of all these components and their functions will be provided in a second iteration within the Deliverable 25.7, due in month 24.

**2.2.1. MSE components’ contribution to the enablers perspective**

Structural dimension

This dimension addresses the structure or composition of a MSE’s constituting elements, namely, its participants and the roles performed by those elements. The components to evaluate in this section are the **MSE’s roles** performed by different **MSE’s participants type**.

As mentioned above, these two components (1st and 2nd column of Table 1) are analysed considering their contribution to the three pillars of Enablers’ perspective (in rows) and these component’s function within the ecosystem is depicted based on the value they add to the MSE.

**Table 1: Components of Structural Dimension and their function within MSE**

ENABLERS' PERSPECTIVE	Components of STRUCTURAL DIMENSION (Endogenous)		Functions
	Role	Type	
<b>INNOVATION</b>	<b>IDEA CONTRIBUTOR<sup>2</sup></b> 	OEMs or SMEs that lead the MSE or the creation of a VME <i>According to D21.2 &amp; D21.4, the roles are:</i> <b>External pool of role owners:</b> customers, MSE business, suppliers, competitors, research partners, consultants <b>Internal pool of ROLE owners:</b> managers, employees, etc.	<ul style="list-style-type: none"> <li>Lead a new initiative of innovation</li> <li>Manage the taking up the idea and develop it further.</li> </ul>
	<b>INNOVATION COLLABORATOR</b>	MSE partners (OEM, SMEs or networked organisations) and customers	<ul style="list-style-type: none"> <li>Participate in Service ideation and innovation</li> </ul>
	<b>INNOVATION FACILITATOR</b>	Networked organisations, research centres, public entities	<ul style="list-style-type: none"> <li>Facilitate new ideas and the configuration of the initiative</li> <li>Identify new potential opportunities for innovation</li> </ul>
	<b>INNOVATION MANAGER</b>	OEMs or SMEs that lead the MSE or the creation of a VME. 	<ul style="list-style-type: none"> <li>Coordination of collaborative innovation processes</li> </ul>

<sup>2</sup> “Since everyone can have good ideas, this process should as non-hierarchic as possible, the roles and responsibilities arise e.g. from the creativity method and should activate individual skills.” (D21.2-Report about the Elements of the Reference framework (M9) & D21.4 Reference framework model for a sustainable service innovation ecosystems

<b>SERVITIZATION</b>	<b>SERVITIZATION COORDINATOR</b> <sup>3</sup> 	<p>OEMs or SMEs that lead the MSE or the creation of a VME</p> <p><b>Three steps of servitization</b><sup>4</sup>:</p> <ul style="list-style-type: none"> <li>▪ Step 1: identification of the type of service,</li> <li>▪ Step 2: adjustment of the service engineering process</li> <li>▪ Step 3: selection of appropriate methods and tools</li> </ul>	<ul style="list-style-type: none"> <li>▪ To coordinate/manage the development of new services.</li> </ul>
	<b>SERVITIZATION PARTICIPANT IN SERVICE ENGINEERING</b>	<p>MSE partner</p>	<ul style="list-style-type: none"> <li>▪ To participate and contribute to the Service engineering process for MSE<sup>5</sup>: <ul style="list-style-type: none"> <li>- Idea management</li> <li>- Requirements analysis</li> <li>- Service design</li> <li>- Service Test</li> <li>- Service Implementation</li> <li>- VME creation &amp; Launch</li> </ul> </li> </ul>
<b>MANUFACTURING</b>	<b>VME PLANNER</b>	<p>Manufacturer MSE partner OR Service MSE partner</p>	<ul style="list-style-type: none"> <li>▪ To coordinate the activities that facilitate the creation of a VME, such as the identification of the necessary competencies and resources, the selection of appropriate partners, etc.</li> <li>▪ To coordinate the VME during its</li> </ul>

<sup>3</sup> “Service ideation and innovation are closely linked to a state of open-mindedness.” (D21.2 & D21.4 - BIBA)

<sup>4</sup> “How to define the right process and how to select appropriate methods & tools?” With these three steps of servitization (D12.3: 18-20 – Fh-IAO)

<sup>5</sup> Service Engineering process model presented in the MSEE deliverable D12.1: Idea Management, Requirements analysis, Service Design, Service Test, Service Implementation, Market Launch. (Also mentioned in D12.3 – FhG-IAO)

			<p>life cycle in order to fulfil its goals.</p> <ul style="list-style-type: none"> <li>▪ It may also coordinate the relation between the VME and the MSE.</li> <li>▪ To coordinate the collaboration</li> </ul>
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## Componential dimension

It focuses on the tangible/intangible components that ecosystem needs within MSEE project's focus. Under this dimension, a MSE should consider tangible and intangible assets as components that:

- 1) facilitate the internal operability of the MSE (T/I assets that will be shared by MSE's participants or new ones) and,
- 2) will be part of the VMEs, that means, virtualized T/I assets. Their role in the servitization process will be analysed.

The MSEE project considers as tangible assets, *whatever kind of physical objects with economic value; manufacturing assets and product assets, are considered [mostly] tangibles, where manufacturing assets are used in processes that an organization performs in order to create product assets.* Accordingly to this statement, in the deliverable D23.1-OMS Modeling Suite Design, the Tangible assets should be properly defined and managed to achieve the best results in terms of products life cycle management and overall performances of an organization. It is important to note the use of the term tangible and intangible as adjectives and not as nouns, taking into account that in-/tangible assets are often confused with e. g. tangible products and/or intangible services.

For MSEE, the classification made is the following:

- **Manufacturing assets:** they can either persist in time (object-like, materialized) and be owned by a single system (e.g. producer or customer) OR happen in time (process-like, serviced) and instantiated as a result of two interacting systems (e.g. provider and consumer).
- **Business assets:** that are exposed to system-external markets/partners and they are composed system-internally by tangible assets
  - Products are tangible, materialized, physical objects e.g. for manufacturing; classical products (e.g. cars, machineries as a product, medical stents, motorcycle helmets, ...) but also raw materials and intermediate products, which can be seen as products of somebody else. Products are outcome of a single (production) system.
  - Extended-hybrid Products are tangible, serviced, physical objects with service components that support the respective core-product (e.g. drilling machinery with maintenance contract)
  - Virtualised-functionalised knowledge assets and competences (& Services), which are servitized intangible assets (see D22.1).
  - Knowledge assets and competences, which are owned intangible assets (or services) (see D22.1).

Tangible assets are classified considering their role in the virtualization process:

### Transformation:

- Machinery
- Tool

### Object:

- Material
- Substrate

As for the Intangible assets, in this group, the ontology developed compliant with the results achieved in D22.1 enables the description of virtualized Intangible Assets. The Taxonomy for Intangible assets proposed is:

*Technical knowledge assets:* they are defined as Knowledge Assets embedded in the organization related to products, machines, fixtures, tools, processes and quality. In addition, we consider in this class also the Information systems and SW of an organization, considered as Assets that it has at its disposal to incorporate and concretely realize its Knowledge. In general, we include for example in this category formalized or informal technical know-how, drawings, projects, but also maintenance techniques and methods and Knowledge about manufacturing and assembly processes.

*Human assets:* they are defined as “skills and experience of employees”. For example, Human Assets include “know-how, technical expertise, and problem solving capability, creativity, education, and attitude”. This category includes elements that, tacit or explicit, are referred only to the people who works in the organization. Education, Creativity, Attitude, Specific job experience, Training, Matriculation number.

*Organisational knowledge assets:* they are defined the Knowledge Assets embedded in the organization related to practices, routines, politics, methods or simply competences that refer strictly with organizational issues themselves such as production, logistics, HR management, R&D, problem solving and innovation, marketing and sales and government. So, we include for example in this category procedures and rules, formalized or informal, such as business processes, service formats, but also production schedule methods, HR management politics, logistics capabilities, R&D competences and so on.

*Relational assets:* they are defined as relational assets that “are in the relationships between an organization and its external stakeholders”. These relationships can include “official relationships such as partnering or distribution arrangements as well as non-formalized relationships such as relationship with customers or suppliers”. Some examples of Relational Assets could be corporate reputation, brand image, corporate image, maintenance and customer supply contracts, people-based customer relationship, customer lists and website that can attract customers and provide routes for placing orders, advantageous supplier relationships and so on.

The analysis will be made following the approach specified in the previous section (2.2.1) but only under the servitization perspective.

**Table 2: Components of Componential Dimension and their function within MSE**

ENABLERS' PERSPECTIVE	Components of COMPONENTIAL DIMENSION (Endogenous)		Functions
	Tangible	Intangible	
<b>SERVITIZATION</b>	Transformation: - Machinery - Tool Object: - Material - Substrate	TECHNICAL KNOWLEDGE ASSETS HUMAN ASSETS ORGANIZATIONAL KNOWLEDGE ASSETS RELATIONAL ASSETS	<b>MSE is responsible for:</b> Deciding which T/I assets are valuable for the MSE in order to achieve its objectives Identifying any missing assets when is required <b>The function of T/I assets is:</b> facilitate and feed the creation of VMEs within the MSE

### Functional dimension

This dimension addresses the activities and processes (base functions/operations) available at the MSE and the execution of time-sequenced flows of operations related to the different phases of the life cycle of the MSE. It includes the operations and processes that guide the setting up of the MSE, MSE operation handling, the management of tangible and intangible assets, management of innovation within the MSE, MSE evolution and MSE dissolution.

Most of the components have been analysed following the approach described in the beginning of this section 2.2. The component MSE Operation Handling has not been included under enablers perspective because we consider it is transversal to all of them. It will include set of methods, recommended practices and supporting tools to deal with the MSE's operation in order to effectively cover the large set of activities and events that happen during the operational phase of the MSE. It will also cover the Performance Measurement of MSE which includes the following activities: identify KPIs of the MSE, measure performance, monitor performance, and propose corrective actions. Therefore, MSE Operation Handling and their activities will be further described in section 3.

**Table 3: Components of Functional Dimension and their function within MSE**

ENABLERS' PERSPECTIVE	Components of FUNCTIONAL DIMENSION (Endogenous)		Functions
	Processes	Activities	
<b>INNOVATION</b>	<b>Service Innovation Process</b>		<ul style="list-style-type: none"> <li>▪ Foster and facilitate the identification of new ideas and to tackle new business opportunities</li> </ul>
<b>SERVITIZATION</b>	<b>Service Engineering Process</b>	<ul style="list-style-type: none"> <li>- <b>Requirements analysis</b> VME requirements definition: involves a definition of a rough structure of the potential VME, identifying the required competencies and capacities, as well as the organisational form of the VME and identification of corresponding roles. At this stage is important to define the partnership form, which is typically regulated by contracts and cooperation agreements.</li> <li>- <b>Service design</b> (ToolBox SP1) Service design: From Innovation management to the SLM Toolbox where the service is designed.</li> <li>- <b>Service Test</b></li> <li>- <b>Service Implementation</b></li> </ul>	<ul style="list-style-type: none"> <li>▪ MSE support the servitization</li> </ul>
	<b>Creation of VME</b>	<ul style="list-style-type: none"> <li>- <b>Consortia formation:</b> <ul style="list-style-type: none"> <li>○ Assets search and suggestion: this step is devoted to the identification of potential assets/partners, their assessment and selection.</li> <li>○ Negotiation: iterative process to reach agreement and align the needs with offers. It can be seen as a complementary step in the process and runs in parallel with them.</li> <li>○ VME composition: in which the organisational structure and assignment of roles VME members is defined.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Setting up the processes, mechanisms and tools to carry out the creation of a VME</li> </ul>

		<ul style="list-style-type: none"> <li>- <b>VME launching</b> <ul style="list-style-type: none"> <li>○ Detailed VME planning: once assets/partners/partners have been selected and collaboration agreements are reached, this step addresses the refinement of the VME plan and its governance principles.</li> <li>○ Contracting: it involves the final formulation and modeling of contracts and agreements as well as the contract signing process itself, before the VME can effectively be launched. In other words, this step is the conclusion of the negotiation process.</li> </ul> </li> </ul>	
	<b>Governance of T/I assets</b>	<ul style="list-style-type: none"> <li>- T/I assets collection and assessment</li> <li>- T/I assets planning and management</li> <li>- T/I assets evaluation</li> <li>- T/I asset modification/removal</li> </ul>	<ul style="list-style-type: none"> <li>▪ To organize and manage the Repository of assets in order to put these assets at MSE’s disposal and reach its strategic objectives.</li> </ul>

## Governance and Behaviour dimension

This dimension addresses the principles, policies and governance rules that drive or constrain the behaviour of the MSE and its members. Components of this dimension shall be governance principles and rules. These components will provide support on internal bylaws or regulations, contracts and agreements and trust management.

Some specific examples of these components have arisen in the analysis made in Section 2.2.2, interactions with other components.

### ICT:

This dimension includes the technical information infrastructure supporting the MSE and underlying IT paradigms. Under this dimension a MSE should consider the management systems and collaboration tools, Business Intelligence tools and platforms that shall support other dimensions and pillars.

### **2.2.2. Interactions with other components**

The MSE's components are also analysed in order to identify any relation or interaction with the other components of the Environmental perspective which are: support, market, ICT, governance and societal. This exercise will allow us to describe some guidelines or rules that will be included in the Methodology of MSE management in Section 3 of this deliverable. The most relevant interactions we have identified are showed in the following table:

**Table 4: Interactions between functional components and other components**

Role	Interactions with other components				
	Support	Market strategy of the ecosystem	Societal	Governance	ICT structure
<b>Service Innovation Process</b>	Research centres, universities	N/A	N/A	Incentives and rewarding policies, trust management, confidentiality rules, IPR protection	N/A
<b>Service Engineering Process</b>	External consultants that provide Service Engineering methods and tools	Coordination whit marketing and external relations "manager" for the identification of new T/I assets for the MSE	N/A	IPR and patents management, Trust management	SLM Toolbox

<b>Creation of VME</b>	External consultants as legal experts	N/A	Facilitator/Inhibitors: Governmental organisations, interest groups and regulatory bodies	Trust management, confidentiality rules, IPR protection Contracts and agreements Conflict resolution	SLM Toolbox
<b>Governance of T/I assets</b>	N/A	Coordination with marketing and external relations "manager" for the identification of new T/I assets for the MSE	N/A	Criteria/policies regarding the appropriateness of T/I for the fulfillment of MSE's objective/mission (which T/I are relevant for the MSE). Criteria/policies for evaluation of T/I assets performance. Conflict resolution (if there is any breach in the agreements regarding the use of T/I assets by MSE members or VMEs)	SLM Toolbox

### 2.3. Main conclusions of the analysis

Following the plan devised in the D25.1-SoA of Collaborative Networks, this section includes a revised description of the components of the MSE's Conceptual Model in order to provide more complete definitions of their main functionalities within a MSE. The analysis made in this report reveals that the components need to be defined according to how the innovation and servitization is deployed by the ecosystem and how the manufacturing concept is present within it.

Components of structural dimension shall facilitate the idea generation of new service based innovation and monitor the process guarantying a collaborative participation in the service ideation process. Different roles described in Table 1 can be played by the same participant or not. Nevertheless, it is recommendable the existence of all of them in order to guarantee the completeness of MSE's functions.

Within the componential dimension, some questions have arisen concerning the double functionality of T/I assets within MSE. On the one hand, it is important to note that tangible and intangible assets, property of MSE participants, will be needed as part of the ecosystem

to guarantee MSE operation. Therefore, in the next iteration of this deliverable, basic components will be analysed and described accordingly. On the other hand, as T/I assets will be virtualized in the MSE, the semantic characterization has been used to describe their function as appears in the Table 2.

The Table 3, functional dimension, includes processes and activities which are considered as elementary for the effective operation of the MSE. As long as the project (and the outcomes of related tasks mentioned along this section) progresses and the use cases evolve, some new processes could be identified. In that case, they will be included in the next iteration of this deliverable.

The described components are linked to the enabler’s perspective. Nevertheless, the linkage with other endogenous components or with other perspective’s components is also possible and needed. Most of these interactions have been identified in the functional dimension due to the fact that processes and activities need to be supported by other components. From this analysis, the necessity of new rules and principles to be defined in the methodology of MSE management (Section 3 in this deliverable) appeared.

Developing a conceptual model for MSE is a complex task that certainly has to evolve as the project does. It cannot be addressed at a first attempt. Therefore the proposed approach here was to produce a first characterization of main MSE’s components through the proposed analysis criteria taking into account the enablers’ perspective and complementarities between components. When more specific components appear from particular classes of MSE or new scenarios are considered, a complementary description shall be provided. Last but not least, as far as MSE’s lifecycle is considered, the conceptual model and their components shall also evolve. The analysis will be developed and included in the next version of this deliverable.

### 3. Methodology for management and governance for Manufacturing Service Ecosystems

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#### 3.1. Introduction to the methodology and its steps

In order to create and manage Manufacturing Service Ecosystems, a methodology for their set up, management and governance is needed. In the present section this methodology is developed, aiming to provide the conceptual background and methodological guidance to organisations that aspire to create and manage a MSE. Therefore, a systematic set of steps is offered, supported by different approaches and guidelines and based on the requirements set by the Conceptual Model defined in Section 2 of this deliverable.

Based on the criteria and requirements established in the Conceptual Model and in Deliverable 25.1, it can be said that a MSE is a non-hierarchical form of collaboration where various different organizations and individuals work together with common or complementary objectives on new value added combinations of manufactured products and product-related services. Moreover, this type of collaborative network will have to be characterised by various features in order to be considered as a MSE:

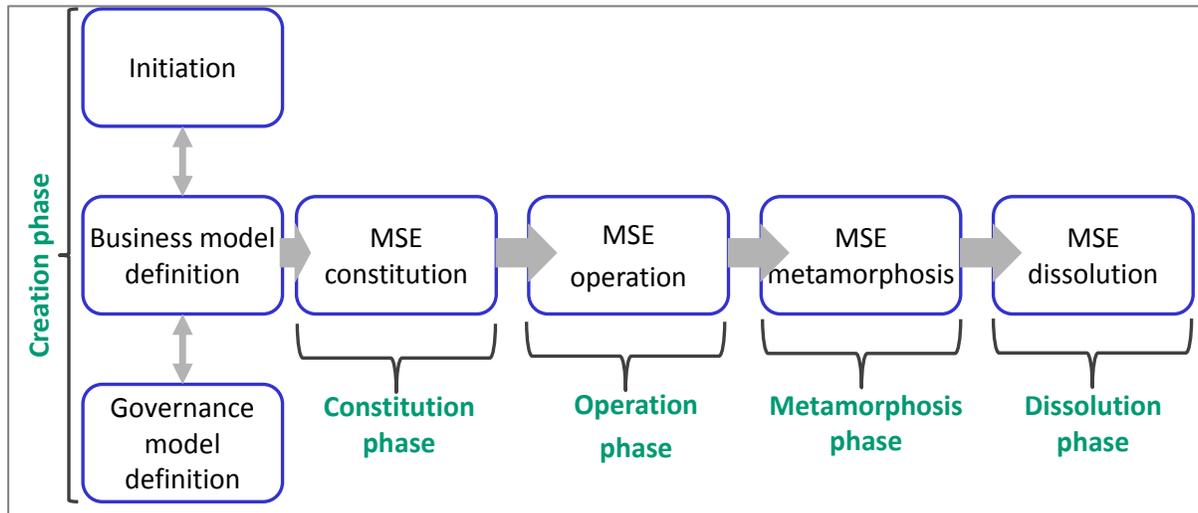
- It has to be composed, apart from other type resources, of virtualised tangible and intangible assets.
- Its aim is to perform service innovation in a collaborative way
- It possesses governance and management capabilities and it is able to measure its own performance
- It is supported on an ICT tool

Hence, it is crucial to understand and take into account these characteristics in order to design a methodology for management and governance of MSE. In this way, it will be ensured that the methodology fits with and answers the requirements and needs that the Conceptual Model defines for a MSE.

Based on the Conceptual Model, it has been defined that the methodology shall be composed by several steps that correspond to the life-cycle of a MSE, namely, the creation, operation, metamorphosis and dissolution phases. The first three steps (initiation, business model definition and governance model definition) address to the MSE creation phase, whereas the other steps of the methodology correspond to the operation, metamorphosis and dissolution phases of a MSE.

Additionally, the first three steps of the methodology can be characterised as strategic in relation to the typology of decisions that they entail. On the contrary, the decisions to be taken in the constitution, operation, metamorphosis and dissolution steps fit better with the tactical and operational typologies.

The figure below shows that the methodology is composed by several steps; initiation, business model definition and governance model definition steps might run in parallel and be closely interrelated, whereas the next steps are successive.



**Figure 2: Methodology for management and governance of MSE**

The description of each of the components of the Conceptual Model that is carried out in Section 2 is the basis for the development of the methodology for governance and management of MSEs. In section 2 components that should be part of a MSE are described.

The description of the components of the Conceptual Model entails that different scenarios and alternatives might arise when creating a MSE. This shall impact on the management and governance model and, thus, in the methodology that shall help implementing these models.

Therefore the methodology, that is described in this section and that will be further developed in the second iteration cycle of MSEE project, shall consider the above mentioned different scenarios and offer different guidelines in order to address them. This task will be carried out in the second iteration cycle of MSEE project and explained in Deliverable 25.7, due in month 24.

### 3.1.1. Initiation

The creation process of a MSE starts when one or more organisations (Driver or Drivers) identify the need or opportunity for the creation of a MSE. The creation phase includes activities such as the identification and evaluation of the opportunity to create a MSE, the definition of the strategy and business model of the MSE and the establishment of MSE’s governance model.

The initiation step encompasses several activities, from the identification of a business opportunity, an innovative idea or market need, to the definition of the strategy of the MSE. Therefore, when the Driver(s) identifies an opportunity to innovate in manufacturing sector and to create new value added product-related services shall assess the possibility to tackle this challenge in a long-term collaborative way or by other means. This requires an evaluation of the potential benefits and costs of a MSE.

Once the decision to create a MSE is taken, its strategy shall be defined so that the MSE is able to differentiate from its potential competitors and establish a sustainable business model. It also involves assuring that all the members of the MSE share a common vision and objectives.

Therefore, the MSE shall define several questions in order to set its strategy:

- Its **mission**: why does the MSE exists
- Its **vision**: what does the MSE want to be
- Its **objectives**: what does the MSE want to achieve.

Concepts such as collaboration, servitisation, innovation and collaboration shall pervade the process of defining MSE’s strategy.

For the next issue of this deliverable the following questions will be addressed and answered:

- What is a MSE created for?
- Who creates an MSE? Who defines its strategy?
- Which key aspects (innovation, servitisation, collaboration...) should be taken into account when defining the strategy of a MSE?
- Which are the strategic partners of the MSE? How to select them?
- How to align MSE’s strategy with the strategies of its members?

### 3.1.2. Business model

Once the strategy and main objectives of the MSE have been defined it is necessary to define its business model. This step is crucial in order to define how the MSE creates, delivers and captures value and how financial viability can be depicted. The business model is like a blueprint for a strategy to be implemented through organisational structures, processes and systems<sup>1</sup>.

The Business Canvas (figure 3) includes a visual template with nine “building blocks”. Each “building block” of this model is to be analysed and developed in order to create a complete picture of the business model.

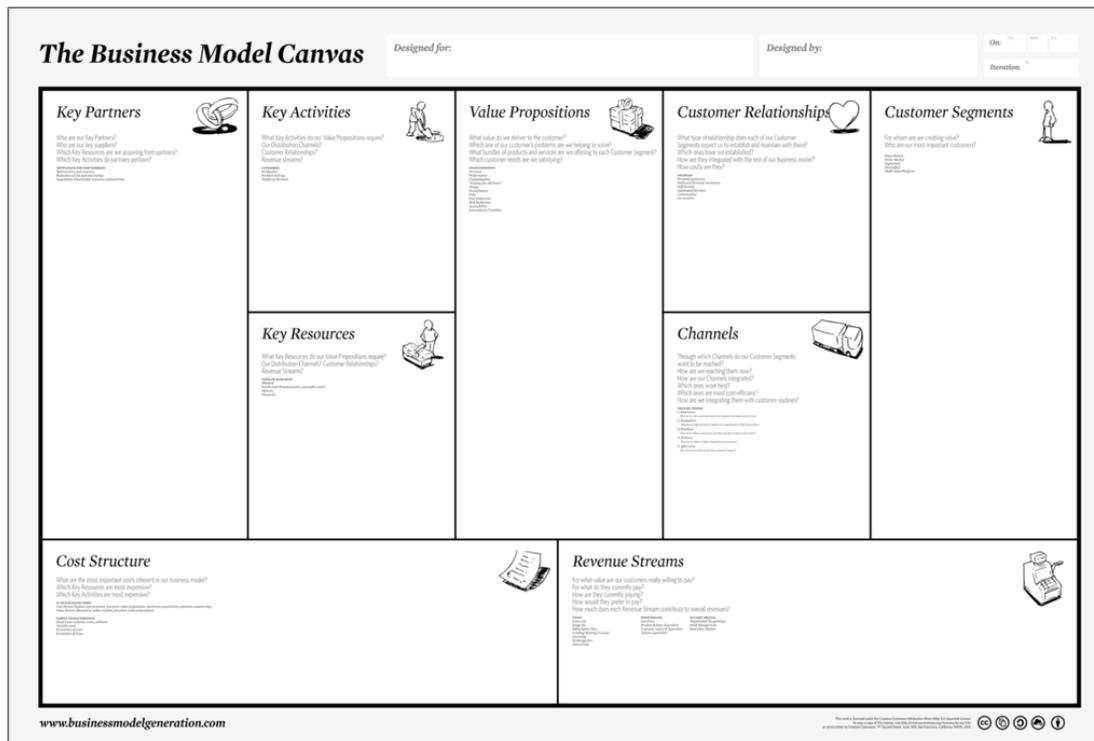


Figure 3: The business model canvas (Osterwalder & Pigneur, 2010)

For MSE’s, however, it is proposed to analyse and develop the following “building blocks”:

- **Value proposition:** products, product-related services or services a MSE intends to offer. The value proposition will define the overall view of products and services that represent value for a specific customer segment and it will describe how the MSE differentiate from its competitors.

Each MSE that is created shall have its own value proposition.

- **Key activities:** the activities necessary to implement the MSE’s business model. These key activities shall be: tangible and intangible assets governance, innovation management, VME creation and MSE’s performance measurement.
- **Key resources:** the resources crucial to create value for the customer. For MSE, these resources are the virtualised tangible and intangible assets that will be put at MSE’s disposal in order to facilitate service innovation.
- **Financial viability:** on the one hand, the costs related to the creation and operation of the MSE shall be considered (cost structure). And, on the other hand, the description of the expected income needs to be taken into account (revenue flows).

For the next issue of this deliverable the following questions will be addressed and answered:

- Why it is important to define a MSE’s business model?
- Who defines a MSE’s business model?
- Which key issues should be taken into account when defining the business model of a MSE?
- Which are the key activities that the MSE should perform in order to achieve its value proposition and objectives?
- Which are the assets that the MSE needs in order to conduct MSE’s key activities and achieve its value proposition?
- How will the MSE be financed?

### 3.1.3. Governance model definition

After defining MSE’s strategy and business model, MSE’s governance model and operation rules shall be established. This will lead to the definition of the MSE’s decision-making model, including governance rules or policies, bodies and roles. This definition shall be divided into strategic, tactical and operational levels, in order to decide which type of decisions and, thus, rules are needed to govern the MSE.

The governance model shall be strongly related to the operation of the MSE and its rules and policies shall impact on the definition of the governance processes that will be implemented during the operation of the MSE. Therefore, special emphasis shall be laid on the governance rules, policies and guidelines of the key activities of the MSE, such as the governance of tangible and intangible assets, the innovation process, the creation of VMEs and the measurement of MSE’s performance.

For the next issue of this deliverable the following questions will be addressed and answered:

- What kind of governance model is needed according to MSE’s strategy and objectives? Who decides upon this issue?
- Which types of decisions are taken within the MSE?
- How are decisions taken within a MSE?
- Who takes the decisions?

- Which are the criteria for membership acceptance and expulsion?

### 3.1.4. Constitution

At this stage, the formal creation of the MSE is required. If a legal entity like an association is selected, such legal entity needs to be created.

Furthermore, even if some members of the MSE have already been recruited and participated in the MSE creation phase, at this stage other relevant organisations shall be invited to become member of the MSE. These organisations shall be relevant for the fulfilment of the MSE's strategy and possess the capacities and capabilities to help the MSE achieving its objectives.

Finally, the ICT infrastructure that will support the main activities of the MSE shall be also defined and implemented.

For the next issue of this deliverable the following questions will be addressed and answered:

- Which legal entity should a MSE need, if any?
- Which ICT infrastructure is the most appropriate in order to achieve MSE's goals efficiently?
- How should a MSE populate its ICT infrastructure?
- How should T/I assets be stored within the ICT infrastructure?

### 3.1.5. Operation

This section defines the conceptual and methodological approach needed in order to operate in the MSE. For the management, govern and control of the MSE key activities will have to be conducted and implemented through key processes. Therefore, the operation of the MSE is where the right conditions and tools will be implemented in order to achieve the goals of the ecosystem.

Hence, this section will address MSE's key activities and their operational rules, whereas key processes are detailed and modelled in Deliverable 25.4 and 25.5. MSE's key activities shall be:

- Conducting service innovation in a collaborative way.
- Governing and managing tangible and intangible assets.
- Facilitating the creation of Virtual Manufacturing Enterprises.
- Measuring its own performance.

Other aspects, such as membership management or how to govern the relationship between the MSE and the VMEs, shall also be considered.

For the next issue of this deliverable the following questions will be addressed and answered:

- How is the MSE managed? Who manages the MSE?
- Which are the key activities and key processes? Which are their operational rules?
- Which are the auxiliary activities and processes?
- How to identify and select new members?
- How to create VMEs? Who? Which rules and procedures have to be followed?
- What is the relationship of the MSE with "its" VMEs? How to manage inheritance?

- How to manage MSE's performance? How to suggest and implement improvement measures?

### 3.1.6. Metamorphosis

One of the goals of measuring MSE's performance is to detect when the MSE is not achieving its objectives. This might be due to a change in the environment where the MSE is operating or if the MSE decides to face new challenges.

Hence, the metamorphosis does not involve small modifications in the MSE. On the contrary, it will derive on a revision of MSE's strategy, business model and governance model.

For the next issue of this deliverable the following questions will be addressed and answered:

- How does a MSE identify the need for a change in its strategy, objectives, etc.?  
Which KPI should a MSE measure in order to so?
- Which tools can support the MSE to carry out this task?

### 3.1.7. Dissolution

In spite of being defined as long-term business networks, it might be decided to cease MSE's operation and dissolve the ecosystem. This decision might be taken when an ecosystem is not profitable or efficient anymore, when a market is shrinking or when MSE members are not interested in continuing their collaboration.

The dissolution shall affect and have impact on several key issues, mainly on the dissolution of shared assets, the knowledge inheritance and IPR.

For the next issue of this deliverable the following questions will be addressed and answered:

- How are shared assets divided among MSE members?
- How is MSE's knowledge captured and saved?
- How to manage MSE's IPR?

## 3.2. Main conclusions of the analysis of the methodology and its steps

The detailed description of the Conceptual Model in Chapter 2 has set the grounds for the design of the methodology and for offering a first approach to it. Firstly, the different steps described in the methodology are based on the life cycle phases of MSEs. Therefore, initiation, business model definition and governance model definition steps of the methodology correspond to the creation phase of the MSE, whereas the other steps (constitution, operation, metamorphosis and dissolution) correspond to the operation, metamorphosis and dissolution phases of a MSE.

The methodology focuses on the description of a systematic set of steps that need to be followed in order to create and operate a MSE. This process is similar to the process that other collaborative networks conduct for their creation and operation. However, the methodology for management and governance of MSEs need to address and take into account specific characteristics and requirements in order to enable the fulfilment of MSEs' objectives.

Consequently, the research questions that are posed for each of the steps look at the main characteristics established in the Conceptual Model. In addition, the research carried out shows that the methodology has to address the following:

- There might be different scenarios regarding the creation of a MSE. From MSEE project perspective, two different scenarios shall be considered. On the one hand, the creation of a MSE shall be promoted, developed and controlled by the Driver or promoter of the MSE. In this case, the Driver shall control the whole process of creation of the MSE and establish the strategy, business and governance models according to its principles. The MSE shall still be a collaborative network in its operational phase, but have a more hierarchical character in its creation phase.

On the other hand, the MSE shall be promoted in a more collaborative way, where one or several Drivers decide to create a MSE, including in this process key partners that shall also be members of the MSE.

These two different scenarios will clearly impact in the management and governance model of the MSE, and therefore, in the implementation of the methodology. This issue will be further analysed and developed in the second iteration of the MSEE work and will result in the description of the mentioned methodology according to these different approaches.

- The Conceptual Model has defined components of the MSE. These components are necessary in order to comply with the MSE key characteristics: its collaborative nature, its focus on service-based innovation in manufacturing, the importance of the tangible and intangible assets for the MSE and the need to be implemented through IT tools. Nevertheless, depending on the conditions in which the MSE is created (two aforementioned scenarios) the specifications of each of these components shall be different and, thus, so their management and governance shall be.

To conclude, a first approach to the methodology has been designed but further analysis of the potential different scenarios need to be considered in order to have a more detailed and precise content to for the management and governance of MSEs. To do so, the following activities shall be conducted in the future within Task 25.4:

- 1- Based on the feedback from the use cases and the integration with other WPs of MSEE project, the components of the MSE shall evolve and upgrade. These results shall be included in the definition of the final version of the methodology for management and governance of MSEs.
- 2- The two potential scenarios that have been identified shall be further analysed and described and their impact on the Conceptual Model and the Methodology shall be explained accordingly.
- 3- Both concepts will be improved and updated, offering different alternatives depending on the chosen scenario. Also, the research questions posed in Section 3 shall be answered according to the two potential scenarios that have been mentioned.

#### 4. Conclusion and further steps

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In conclusion the current version of the “Approach for SSME (Service Science Management Engineering) in Manufacturing Ecosystems” includes the following achievements:

- Detailed description of the Conceptual Model defined in Deliverable 25.1 and of its components. Specific integration work has been conducted in order to make the most of the synergies with WP12, WP21, WP22 and WP23 and to offer an integral picture of how a service-based manufacturing ecosystem shall support and enhance innovation.
- First approach to the design and description of the methodology for management and governance of MSEs. This has been done considering some of the characteristics and requirements that the Conceptual Model has set.

The conducted work has shown that different scenarios might arise when creating a MSE and that the characteristics of their components might vary in each case. Thus, the methodology and principles that will guide the management and governance of MSEs shall be flexible and easily adaptable to different scenarios. There is still research to be done in order to understand and appraise these scenarios.

Additionally, links with WP12, WP21, WP22 and WP23 will be reinforced and at the same time, content for WP26 and the use cases development will be provided. Moreover, feedback is expected from the development of the use-cases, which will be integrated and used as input for the next version of the approach for SSME in manufacturing.

## 5. References

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<sup>1</sup> OSTERWALDER, A. & PIGNEUR, Y., Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Wiley, 2010