D21.1 – State of the Art report for requirements and innovation principles – March 2012 issue

Document Owner:	Ingo Westphal, BIBA
Contributors:	Giovanni Aiello, ENG; Manuel Hirch, DITF; Mike Freitag, IAO, Guy Doumeingts, VLab
Dissemination:	Public
Contributing to:	WP 21
Date:	30.10.2012
Revision:	Version 1.0

VERSION HISTORY

NO.	DATE	NOTES AND COMMENTS
0.1	28.02.2012	FIRST DRAFT
0.2	11.06.2012	INTEGRATION OF PARTNERS CONTRIBUTION
0.3	06.09.2012	UPDATE ACCORDING TO DISCUSSION IN THE WP AND IN THE CONSORTIUM, IN PARTICULAR INTEGRATION OF CONCLUSIONS.
0.4	20.10.2012	INTEGRATION OF COMMENTS FROM INTERNAL REVIEW

TABLE OF CONTENTS

1. Executive Summary

Servitization based innovation in Manufacturing Service Ecosystem is a comparable new approach. Many manufacturing enterprises have no or very limited experience regarding this approach. Therefore WP 21 is aiming at the provision of a *Reference Framework for Innovation Ecosystems* to manufacturing companies and their partners. This framework should offer case-specific support and guidance to the manufacturing enterprises and their partners.

The intention of this deliverable is to identify relevant requirements upon such a framework. This was based on a state of the art analysis that covers basic concepts of innovation, approaches for measuring innovation, other research initiatives, existing methods and tools.

It became obvious that there is a broad range of concepts and approaches for innovation and service innovation. Many of the authors pronounce the importance of inter-organisational innovation which maps with the MSEE approach. However, there are very few specific consideration regarding innovations that are based on the combination of physical product and services that were developed with partners from an ecosystem.

Since WP 21 should focus on the specifics of innovations based on servitization in a Manufacturing Service Ecosystem the framework will not cover all phases of an innovation process (“from idea to cash”). Rather it concentrates on the phases that support and determine the innovativeness (degree of novelty) and define the combination of physical product and service. These are the phases “providing conditions for innovations” and “ideation”. The subsequent phases that cover the realisation of the idea are less specific for the WP 21 context.

Summarised the analysis brought up following requirements:

- General requirements upon the framework like openness, adaptability, scalability, paying special intention to collaboration and interaction, support enterprise in achieving a common understanding of their innovative servitization activities.
- Ecosystem related requirements, like:
  - Support the management of some innovation-related aspects of the ecosystem, e.g. andling of intellectual property, inter-organisational workflows, identification of partners with certain competences.
  - Definition of roles and responsibilities so that the partners can assess their own role and the potential roles of the partners.
  - Consider concepts of using the ecosystem to gather the Voice of the Customer.
- Servitization related requirements, like:
  - Provision of concepts for the different options to combine physical products and related services to achieve servitization-based innovation.
  - Consideration of options for systemic innovations.
- Process related requirements, like:
  - Provision of performance indicators that can be used to assess the general capability for servitization-based innovation as well as the actual innovation performance in an innovation project.
  - Regarding the different organisational level (manufacturing enterprise, Manufacturing Service Ecosystem and Virtual Manufacturing enterprise) and their involvement.

- Method and tool related requirements like:
    - Provision of concepts for the characterisation and classification of application cases.
    - References to the many available services and tools, in particular for generating and sharing ideas.
    - Suggestion of standards for communication and exchange of this data.
    - Further aspects are: virtualisation, a platform that brings together members of the ecosystem, searching content in the MSE, voting and collaborative decisions on ideas, concepts for governance and rewarding, best practices.

A conclusion was that there are three dimensions that have an essential impact on innovation and corresponding activities in a Manufacturing Service Ecosystem:

- The current phase or step in the innovation process.
- The type of servitization based innovation that considers what is new and advantageous on the combination of physical product and service.
- The involvement of different members from the ecosystem.

These results provide input and orientation for the identification and evaluation of potential framework elements which is the next step in the WP 21 process.

This deliverable D21.1 provides the results of the first months of work in Task 21.1 that is called "*Collection and discussion of requirements and innovation principles in European manufacturing industry*". Task 21.1 is integrated in the work-package WP 21 ("*Reference Framework for Innovation Ecosystems*") with its objective to provide a concrete proposal for a Reference Framework for Innovation Ecosystems.

2.1. Objective of the deliverable

The objective of this deliverable is to provide a sound basis for the further considerations in WP 21. This foundation should cover following aspects:

- A first clarification of the term "Innovation Reference Framework".
- Definition of the used basic terminology in the context of Manufacturing Service Innovation Ecosystems.
- An overview over established concepts and principles to model, organize and manage inter-organisational innovation in particular service innovation.
- Analysis regarding implications for Innovation Ecosystems in MSEE.
- Requirements upon the Reference Framework for Innovation Ecosystems derived from the analysis results described in the in the lines above.

By providing this foundation the deliverable should support the identification of elements that are needed in the framework and considerations how they should be designed. In addition the results should support the communication between the different work-packages and Tasks in MSEE and avoid misunderstandings regarding the terms and concepts.

The objective is not to "re-invent" inter-organizational innovation or service innovation. Rather it should be analyzed what are the relevant aspects of product-related service-innovation in a manufacturing ecosystems.

2.2. "The setting" for the considerations in this deliverable

To ensure focussed and by this way efficient considerations the general setting for innovation in a Manufacturing Service Ecosystem should be described.

- The considerations should concentrate on ***manufacturing industries*** and ***servitization***. It is assumed there is a manufacturing enterprise that is looking for additional/ new business from servitization in relation to the manufactured product. There can be an already existing product or a new product that fits into the profile of the manufacturing enterprise.
- The servitization should be ***innovative***. It is assumed that manufacturing enterprise is not only looking for smaller improvements of existing combination of products and services. To achieve significant business effects the enterprise is aiming at new and/or significantly improved combinations of products and product-related services.
- The manufacturing enterprise is collaborating with partners to achieve the innovative servitization. In this way the innovation becomes an ***inter-organisational innovation***. It is assumed that innovations based on servitization require the combination of different competences. Usually a manufacturing enterprise cannot hold all the required service-related competences available on its own. Therefore it is necessary to involve partners.

- The environment for the collaboration is the ***Manufacturing Service Ecosystem*** (MSE).
  It is assumed that the manufacturing enterprise is part of an ecosystem where it can find the required partners and also other members of the ecosystem that can be relevant for the innovation, e.g. customers or research institutes.
- The Manufacturing Service Ecosystem should be developed into an ***Innovation Ecosystem***.
  It is assumed that the ecosystem could provide impulses and support during the different phases of an innovation process. The MSEE approach is to foster these options by developing the Ecosystem into an Innovation Ecosystem.
- The manufacturing enterprise and its partners from the ecosystem need concepts, methods and tools to achieve innovations based on servitization in a Manufacturing Service Ecosystem. The ***Reference Framework for Innovation Ecosystems*** should comprise some of these concepts and help to identify and specify the required methods and tools.

3. General approach for the Reference Framework

To identify the requirements upon the Reference Framework it is necessary to clarify what is meant by this term. Literature provides a broad range of "Reference Frameworks". For example, Google Scholar delivers about 17.700 results (without citations and patents) if one searches for "*Reference Framework*". Some of the authors suggested definitions for the term.

The general concepts of Reference Models und Frameworks were discussed for example in the ECOLEAD project. This discussion was part of the development of a reference model for collaborative networks.

Following definition was made for the term ***Framework***:

> *"In general a framework is a structure for supporting or enclosing something else. In the modelling area, a framework can be seen as an "envelope" that might include a number of (partial) models, collections of templates, procedures and methods, rules, and even tools (e.g. modelling languages)."*

The second part of the term is "***Reference***". A reference is something that something else can refer to. This can take place in two ways:

- Either as a comparison according to the defined characteristics of the reference (e.g. reference materials).
- Or to describe the link to a reference work, e.g. a publication.
- Or by using the reference as a generic pattern that can be used for the design of a specific instantiation.

For the Reference Framework in MSEE the first and last approaches are relevant, since the objective is to provide case-specific support to enterprises in a Manufacturing Service Ecosystem (MSE). A reference must have some "weight" and relevance so that it is accepted in the corresponding community. In the ECOLEAD project this was described as "authority". In some cases this is linked to the authority of the organisation that has suggested the reference. But it is also possible that the reference gained authority because it is plausible or because it has proven its suitability in various application cases. This is in particular the case when it is based on good or best practices.

The variety of Reference Frameworks provided by literature is broad: There are frameworks for software development (e.g. ZEND Framework), frameworks for modelling enterprises (Zachman Framework™ for Enterprise Architecture [http://www.zachman.com/about-the-zachman-framework]), and many others.

The main objectives that are mentioned in relation to many Reference Frameworks are to ***provide standards, guidance and support***.

For this reason there are several examples for Reference Frameworks on European level to harmonize and standardise activities in certain domains. Examples are:

- Reference Framework for Sustainable Cities [http://www.rfsustainablecities.eu].
- European Quality Assurance Reference Framework (EQAVET Reference Framework) [http://www.eqavet.eu].
- European Qualifications Framework for lifelong learning (EQF) [http://ec.europa.eu/eqf/home_en.htm]
- Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR) [http://www.coe.int/t/dg4/linguistic/cadre_en.asp]

Other examples that could be assigned to the category of standard- and guidance-oriented approaches are the Supply Chain Reference Model SCOR [www.scor.org] or the Value Chain Reference Model VRM (Value Chain Group [www.value-chain.org]) These approaches provide concepts, methods and sometimes even templates and tools.

There are also more ***abstract approaches*** that consider a reference framework as ***defined dimensions*** of a coordinate system to classify something, in particular application scenarios. This means the framework is defined by a ***set of axis***. An example for such an approach in the context of innovation projects is provided by Shenhar and Dvir [2007]. They regard a reference framework as "*a model for systematically assessing project uniqueness and understanding the key dimensions by which the project differed from those in their previous experience*" ("their" stands for "the project managers' "). Other examples are ARCON Model (A Reference model for Collaborative Networks) that was developed in the ECOLEAD project and the frameworks of Goldbrunner et al. [2005] and Hertog et al. [2009]. The approaches of Shenhar and Dvir, Goldbrunner et al. and Hertog et al. will be described in more detail in chapter 5.5 since they are directly related to innovation.

These approaches can also be integrated into the standard- and guidance-oriented approaches mentioned above as a basis for the definition of standards.

Summarized, the analysis of different existing Reference Frameworks brought up some typical objectives and characteristics:

- Reference Frameworks are generic patterns for the design of specific frameworks.
- They describe elements that are relevant for most of the application cases.
- These elements are intended to structure something based on defined dimension or to provide standards, guidance and support for something.
- Since they are generic patterns they should be open enough to cover a range of application cases in the considered area.
- As they are frameworks, they are generally describing the WHAT but are usually flexible regarding the HOW.
- Although providing openness they ensure consistency where needed.
- Reference frameworks help to obtain a better understanding of an application case. Amongst other things this is achieved by supporting the characterisation and classification of an application case.
- Beyond the provision of a better understanding of an application case, some Reference Frameworks provide also structured support for the actors in an application case. This could be for example methods, templates and tools.

Adopting these general objectives and characteristics to MSEE leads to following first rough characterisation of the Reference Framework for Innovation Ecosystems:

- The Reference Framework should describe the relevant elements of innovation and innovation processes based on servitization in MSEs. This should ensure that all relevant aspects are considered when it comes to planning and controlling of innovative servitization in a MSE.
- It should help manufacturing enterprises and their partners, in particular members of the MSE, to achieve a common understanding of their innovative servitization activities that represent application cases for the Reference Framework.
- The Reference Framework should support the classification of innovative servitization activities. This represents one aspect of the common understanding mentioned before.
- The Reference Framework should provide guidelines for the manufacturing enterprises and their partners.
- If possible the Reference Framework should support the innovative servitization activities with corresponding methods, templates and tools.
- The Reference Framework should make suggestions but leave enough open space for the manufacturing enterprises and their partners to find their own way of doing things.

The value of such a framework could be described with Adner's perspective on frameworks:

> " *... the value of most frameworks lies not in changing a manager's initial intuition but in clarifying the issues that arise when managers with different instincts try to debate the right course of action.*" [Adner 2006]

4. Methodological approach of this deliverable

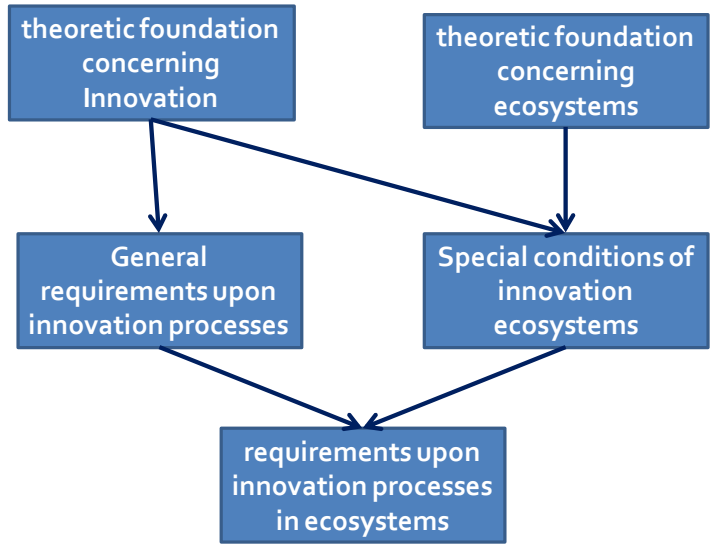
The challenge of this deliverable is to apply the concepts of innovation to the specific conditions of Manufacturing Service Ecosystems (MSE) and derive the requirements upon a Reference Framework for Innovation in a MSE.

The methodological approach is to do a state of the art analysis regarding innovation, innovation processes and corresponding frameworks. This analysis will focus on inter-organisational innovation and service innovation. In addition there will be short analysis of the concept of MSE. The theoretic foundation concerning innovation provides the basic terminology, concepts, and principles to do further analysis to derive requirements upon an Innovation Reference Framework. The analysis will consider publications, other research initiatives and already existing tools that support innovation processes.

In parallel the special conditions of ecosystems will be analysed to determine their implications for innovation processes.

Both analysis, the general view and the specific implications of ecosystem for innovation, will be used to determine the requirements upon a Reference Framework for Innovation Ecosystems.

The following graphic illustrates this approach.



Relation to other work-packages

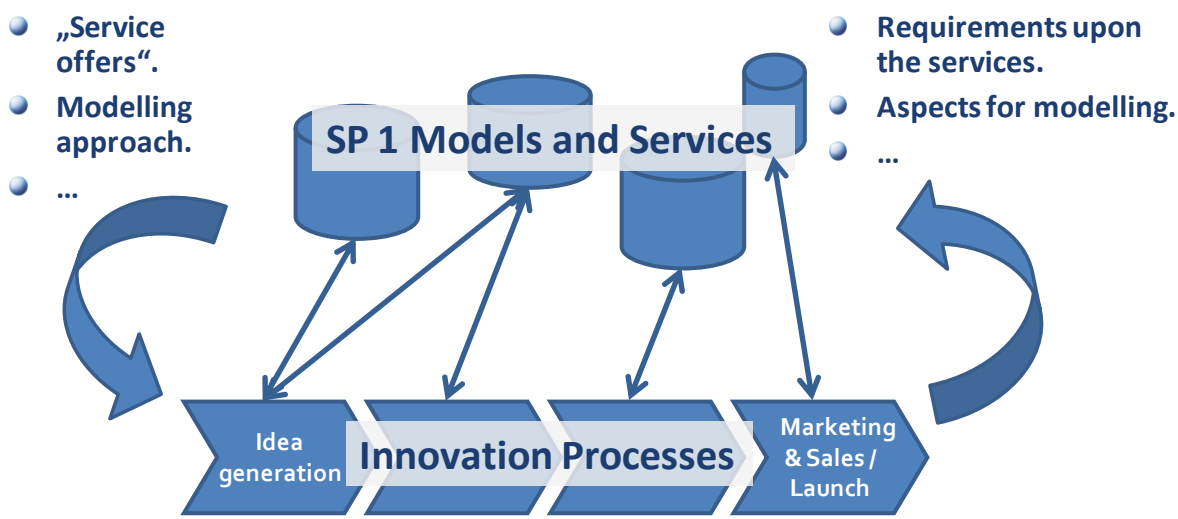
This work-package is related to the other work-packages in SP2 as well as to Models and Services of SP1.

In SP 2 it is linked to WP25 since this WP deals with exploitation, that means making use of innovation pieces and create something new (not necessarily innovative). WP21 is more about managing the innovation process.

WP26 is working on services. Therefore WP 21 has to provide input for this task.

Since Reference Frameworks comprise usually also aspects of modelling, the work-package WP 21 is related to work-packages of SP 1 that has the main responsibility for modelling. WP 21 will contribute specific aspects for modelling issues related to innovation. On the other hand it has to be ensured that WP21 provides an output that is compatible to the work in SP1 and that can be integrated into the overall concepts for modelling.

Another link between WP21 and SP1 are the services that are developed in SP1.



5. Concept of Innovation Ecosystems in MSEE – from idea to market

According to the methodological approach of this deliverable the first step is to clarify the theoretic foundation concerning innovation as well as concerning ecosystems. This should be done in this chapter. The following sub-chapter is discussing the basic terminology and concept regarding innovation to achieve a common understanding for the further considerations. The focus of this discussion is already directed to inter-organisation innovation as they are relevant for ecosystems and to service innovation since servitization is essential for MSEE.

After the more general discussion the specific conditions of ecosystems in relation to innovation and the resulting implication for managing innovation processes will be described.

Where possible, first conclusions regarding the requirements upon a Reference Framework for Innovation Ecosystems will be drawn.

5.1. Basic foundation for consideration upon innovation

Traditionally innovation processes are regarded as critical processes taking place in the 4 walls of every company. Protection of intellectual property, creation of internal knowledge that creates advantage over competitors and thereby added value clearly attributable to the company's own achievements, are some reasons (Gassmann 2010). In the past this approach was often leading to success since it was the basis of various big market players like Edison possessing one genius founding father [Chesbrough, 2010]. Nowadays big market players possess strong R&D departments with greater manpower and interdisciplinary exchange.

Circumstances of innovation generation have changed further: Time is a good rarer than ever – both in innovation development and advancement. From a one-time market launch of a "fixed product", understanding has shifted to continuous development of products and/ or services. The integration and development of services not only concerning the product or the established service itself but its environment/ mode of use, is a task that is hardly accomplishable by a single company. However it has become one criteria determining market survival.

Due to this, companies formerly counting as innovative when opening their own internal product and service generating structures for innovation cooperation have found followers in many branches [Gassmann 2010]. Knowledge clusters have been generated among manufacturers, their suppliers and clients. Besides, communication concepts have reached levels where place or time are no cooperation constraints anymore and where partners can communicate in a virtual sphere.

In this model of innovation generation which is chosen for analysis of "innovative service engineering" borderless cooperation and exchange of resources is a characteristic. So is common creation of new knowledge that is not referable to a single source anymore. The interaction among partners is the major source of innovation – and can lead to cost reduction and advantages in development time: common sources and individual strengths are shared and used by all partners

5..1.1. General terms of innovation

There are several definitions for innovation. A general one with a broad scope is provided by the OECD [OECD 2005] in the Oslo Manual:

> *"An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organisation or external relations".*

Following attributes were mentioned in most definitions for innovation:

- New.
  The source of the term „innovation“ is the Latin term “innovatio” which stands for novelty, alteration, renewal or introducing something new [see for instance www.duden.de].
  It is not always easy to determine if something is “new”, actually it depends on the subjective perception. It is essential that the customer considers the development as new or fundamentally changed [Schneidweiler and Musmacher 2011]. Even if the solution can be already established in one branch or country it can be regarded as new in another branch or country [Fischer 2006].
- Improved.
  Improvement in comparison to what was already available before. This improvement is perceived by the customer of the innovation. Usually the innovation provides added value in comparison to what was available before.
- Beneficial.
  There should be a benefit for the “creator” of the innovation, the innovator. In business usually market success is regarded as the decisive benefit. Thomas Alva Edison who has registered more than 1.000 patents made the following statement: *“the real challenge in innovation was not invention - coming up with new ideas – but in making them work technically and commercially”* [quoted in Tidd/Bessant 2009]. That is why some authors define innovation processes as “from idea to cash”.

Innovations that are covered by this definition can be differentiated and classified in various ways. Established approaches for differentiation are:

1. The type of innovation.
2. The degree of novelty and impact of innovation.
3. The trigger or driver of innovation.

5..1.2. Types of innovation

The type of innovation describes generally the WHAT, the object that is being innovated. That means the type considers the content of innovation. It describes what is new or improved. Several authors [Eschenbächer 2009,Geoffrey 2004, Granig 2007] make a differentiation between the following types of innovation:

- Product innovations.
- Service innovations.
- Process innovations.
- Other innovations (e.g. organizational innovations, business model or marketing innovations).

Product Innovations fulfill a new customer demand or an already existing demand in a new way [Hauschildt and Salomo 2011]. This can be regarded as an improved effectiveness. The same applies to service innovation. That is why service innovation is sometimes regarded as a special type of product innovation (see for example the OECD definition above). However, in this delivery “product innovation” is considered as related to a physical product while service innovation is related to activities or achievements that are delivered to a customer and cannot be “put on a shelf”. A more detailed description of service innovation will follow in a separate sub-chapter.

On the other hand, Process Innovations are aiming generally at the efficiency of the production process of a product. This means the innovation helps to produce the product in a cheaper, more secure or faster way or in a better quality [ibd.]. This can be transferred to the process of supplying a service (e.g. applying new methods and technologies for a cleaning service), however the border between the service as such and the process to perform the service is sometimes more difficult to determine.

Usually the customer that receives the output of the process does not recognize this innovation as such but only the effects of it, e.g. faster delivery, improved features or lower price. For services the process is often characterizing the service and is perceived by the customer (e.g. the noise and the dirt during a cleaning service).

In some case are product and process innovation are strongly dependent. Therefore they are sometimes summarized as Technical Innovation [Haritz 2000]

The other innovations like organizational innovations, business model or marketing innovations should not be considered in more detail in this deliverable, since they not directly related to servitization. However, in some cases these innovations can have significant impact on the success of a product or service. An example is Apple's proprietary App Store where Apple and the developers share the revenue from the sold application for the Apple products.

Another approach to differentiate types of innovation is:

- Autonomous Innovation versus
- Systemic Innovation.

Chesbrough and Teece [1996] have defined the difference. While autonomous innovations "*can be pursued independently from other innovation*", the benefits of systemic innovations "*can be realized only in conjunction with related, complementary innovations*." As an example they chose lean manufacturing that requires interrelated changes in product design, supplier management, information technology etc. They pronounce that this difference has implication for the required organizational design.

For Behnken [Behnken 2010] the motivation for the concept Systemic Innovation is the question how the innovation is being created and it is close closely linked to the thought of innovation network. Systemic Innovations consist of different complementary and compatible technologies that are provided by a network of contributing partners. As a consequence they are characterized by numerous interdependencies between the elements in the system and require therefore much coordination. Their successful establishment can be triggered by different factors:

- Individual engagement of a single big business player followed by its individual supply network:
  Nokia i.e. triggered Finland's focus on development of telecommunication equipment and establishment of an ICT cluster comprising in 2005 approximately 6.000 companies [OECD 2008; Trade Policy Working Paper No. 73].
- Strategic governmental support for establishment of systemic innovation networks:
  Central government in Finland i.e. has supported a shift from resource based economy to knowledge driven economy since the 1980s: Funds were dedicated to combined research projects of industry and academia in order to foster cooperation, the telecommunication market was deregulated and opened to foreign investment, a common mobile telephony standard was developed together with Sweden, Norway and Denmark [OECD, 2008].

While in the case of Finland, systemic innovation in telecommunications sector was pushed forward by government and industry in parallel [OECD 2008], either the one or the other side pushing can also lead to successful implementation. One example for a highly innovative

cluster starting as private initiative is Silicon Valley in California resulting from business activities of former Stanford University students. The foundation of a European aircraft manufacturer – Airbus – in the 1970s on the other hand was an entirely politically motivated decision serving to break American monopoly and therefore financed by taxes.

Coming back to the basic understanding of Systemic Innovation and the example of lean manufacturing, it becomes obvious that this type can be a combination of different interwoven type of innovations, e.g. product, service, process and organisational innovations. Usually this requires the involvement of different partners, so this type of innovation can generally by supported by the approach of Manufacturing Service Ecosystems.

5..1.3. Degree of novelty and impact of innovation

Several authors [Vahs and Burmester 2005, Hauschild and Salomon 2011] differentiate innovations also be the degree of novelty. The degree of novelty is strongly linked to the impact an innovation has for the innovating enterprise and on the market. Generally innovations are differentiated according to two categories of novelty and impact:

- Incremental Innovations.
- Radical Innovations.

Incremental innovation means innovation in steps over a longer period of time. Usually the application scenarios for these innovations are known and established in existing or related markets. In many cases they are a reaction on changed demands in the markets.

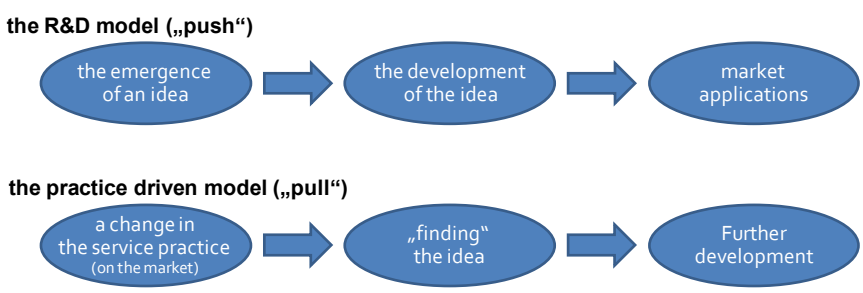
In contrast, radical innovation literally describes a drastic change caused by a product or service, that didn't exist at all before. They are characterised by a strong degree of novelty and significant changes for the user, this is the reason why they are usually offering good chances and prospects. The development radical innovations require usually higher resources, in particular financial investment. These higher investments and their novelty are usually involving more risks than incremental innovations.

5..1.4. Trigger or driver of innovation

Another aspect that characterises innovation is the trigger or driver at the starting point of innovation. Usually two drivers are differentiated:

- Innovations as a result of market pull.
- Innovations as a result of technology push.

The following graphic illustrates these different triggers:



(adapted from Toivonen [2009])

Market pull means that the enterprise has identified a certain customer need that offers the opportunities for new product or services. The information is usually gained through market observation or market research or contact with customers, e.g. from sales or customer service. The challenge is to listen to the potential customer (existing and new) and analyse the Voice of the Customer. If the driver is market pull this leads typically to focused research. This means that the resources for the innovation project are provided to find an innovative solution for an indentified requirement and that the market is identified and a corresponding market potential exists.

Technology push is generally the other way around. A developed product/service/technology generates its own demand i.e. by creating modes of application. Dependently ideas are developed in a more continuous manner and resources are provided although the final output is not defined yet and the market for the potential new product or service has still to be indentified or developed. In this case the demand for the new product or service has to be stimulated/generated.

Promising seems to be a combined pull and push situation– i.e. customers requesting mobile internet and companies researching on more bandwidth in mobile phone connection leading to touch screen technology. This idea is in some case related to the term "Open innovation" that will be discussed in more detail later in this deliverable. According to McAfee [2009] roughly 20% of enterprises have opened their innovation generating process so far and gained around 20% of additional innovations.

5.2. Service Innovation

MSEE is aiming at innovations that are based on servitization, that means the combination of a physical product with product related services. The manufacturing enterprises are generally familiar with product innovation. The second "component" of servitization based innovation is less common and established. Therefore this section should be used to provide more detailed considerations on service innovation.
Service Innovation is regarded as an important option to improve competitiveness and as an important source for growth [Chesbrough and Spohrer 2006; OECD]. In particular in Europe with comparatively high wages, social and environmental standards service innovation is in many cases an important option to gain advantage over competitors.

A pragmatic definition of service innovation is provided by Toivonen and Tuominen [2009]:

> "*A service innovation is a new service or such a renewal of an existing service which is put into practice and which provides benefit to the organization that has developed it.*"

It is not just a "clever new idea" but also the development and implementation of a service that is accepted by the customers and so provides revenues as benefits for the service provider. Other definitions or descriptions pronounce that service innovations are not just incremental improvements of existing services offer a "*new core benefit or a new delivery benefit that revolutionizes customers' access to the core benefit*" [14].

For some authors the output of service innovation can be measured as broadening or differentiation of the range of services offered [Meyer 2009].

Service innovation can cover both:

1. Services that could be offered and sold as an independent, intangible product, "stand-alone" service. For examples maintenance or repair services.
2. Services that are provided to the customers to support sales for another service or physical product or to improve customer satisfaction. The customer is not paying for the service as such. Examples are: Flexibility at the hotel counter are services in web-

shops like recommendations and evaluations of other customers or suggestion of related products (cross-selling) [Scheidweiler and Musmacher 2011].

Another differentiation could be done according to the ***degree of standardisation*** [den Hertog 1999]. On the one side there are highly standardised service products like car washing or serving fast-food. On the other side there are more customised services like consulting that usually require stronger interactions with the customers. This has implication for risks and the revenue, in particular when different partners are involved in the service provision.

Generally there are some differences between physical products that have also an impact on the corresponding innovations, for example the customer involvement in the service. This difference can be observed in the description of different dimensions of service innovation from den Hertog, van der Aa, and de Jong [Hertog et al. 2010]:

3. ***New Service concept or offering***. An innovation in this dimension changes the content and the value the service provider offers to the customers.
4. ***New customer interaction***. This considers the way the customer is involved in the provision of the service.
5. ***New value system or set of new business partners***. This innovation is about a new combination of contributions (service functions) from partners (e.g. combination of web-services).
6. ***New revenue models***. The success of some service is based on new models to distribute costs and revenues between the partners and on new models to charge the service to the customers.
7. ***New delivery system: personnel, organization, culture***. This dimension is about how the process of service provision is organised and supported by conditions in the enterprise. In many cases this is an additional innovation that is related to innovations that belong to the other dimensions. This is important since the process of providing the service if often regarded as a part of service quality.
8. ***New delivery system: technological***. This innovation is based on applying new technologies to provide the service. A very important technology is for example ICT and the internet that has changed many services dramatically, e.g. online booking of flights and hotels.

An innovation can take place in one of these dimensions but it can also cover a combination of different dimensions.

Some characteristics of service innovations are specifically relevant for Manufacturing Service Ecosystems (MSE), in particular as in this context service innovation is part of the servitization and take place in ecosystem:

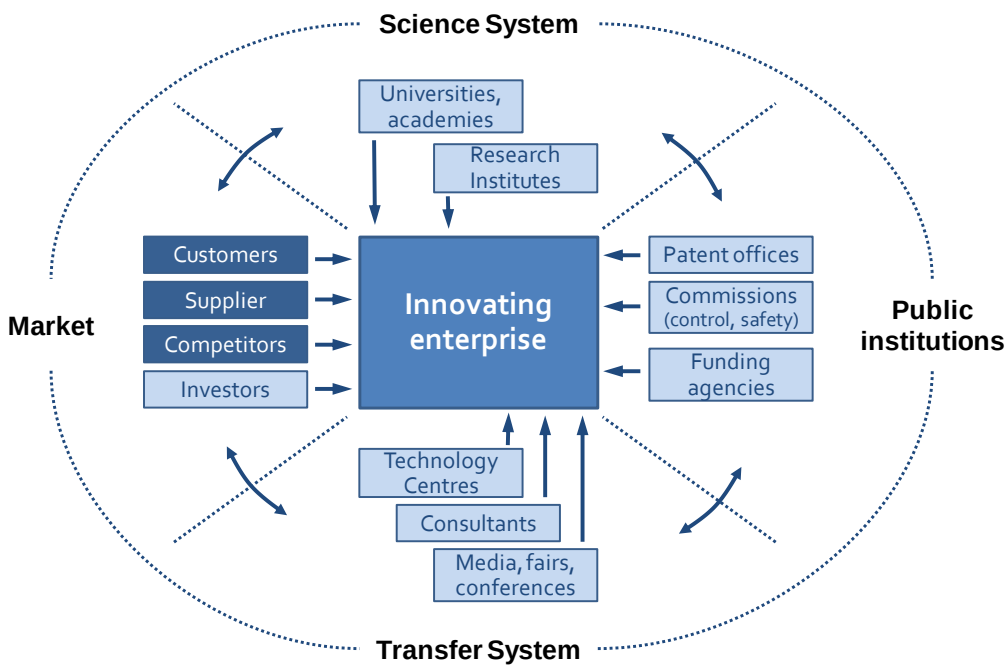
- Service Innovation can take place for different types of service and in several dimensions. Some of these dimensions are directly linked to collaboration with partners and customers. This offers a range of opportunities for an MSE.
- Knowledge can be regarded as one of the main inputs to service innovation [Meyer 2009]. The knowledge can be internal as well as external. For MSE it is usually essential to make external knowledge accessible for the partners.
- Service Innovations are generally more suitable for a trial and error approach: “understand, try, improve” [Schneidweiler and Musmacher 2011]. The reason is that they usually tie up less money and that they can be adapted more flexible than a physical product. This is an advantage when it comes to collaboration in an ecosystem with the related uncertainties due to less formal structures. If there is a need for corrections of a service this would be less costly than the correction of a physical product like a machine.

- Generally technology plays a less important role in service development than in the development of physical products. On the other hand the human relation to customers is much more important for success that it is the case for physical products [Kuepper 2001]. For MSE this means that the focus have to be directed to relations to customers in the ecosystem. If the ecosystem is mainly involved in the development of the service and the physical product is primarily developed be the manufacturing enterprise than the exchange/transfer of technology is less important. Nevertheless, technology is relevant for innovations in the dimension of technological delivery system.
- Literature describes that service innovation can be imitated faster than product innovations [Kuepper 2001]. This leads to an advantage of the servitization approach of MSEE: the combination of product and service could by an approach to reduce this risk of imitation.

5.3. Inter-organisational Innovation

An important characteristic of MSEE is the collaboration in an ecosystem. For that reason inter-organisational innovations should be considered in more detail.

Every innovating enterprise has relationships to other enterprises organisations, at least to its customers. This is illustrated in the graphic below. However, this does not mean that every innovation is an inter-organisational innovation. Rather, inter-organisational innovations require direct influence of the other organisations on the novelty and improvement of the product and service.



[Borchert et al. 2011]

The motivation to involve other organisation in the enterprise's development is generally caused by severe competition on a global level and more complex products that are based on a variety of complex technologies. The enterprise cannot provide all specific competence on its own and needs contributions from partner these competences. The relation is no classical customers-supplier-relation but a kind of collaborative co-creation. Enterprises that have chosen the way of inter-organisational innovation usually expect some of the following benefits (see e.g. [Halin 1995], [Borchert 2006], [Borchert et al. 2011]):

- ***Get access to resources and knowledge***: In some cases the enterprise is not able to provide the required people with appropriate knowledge, the financial resources, or the technological resources (e.g. special machines and tools). In other cases the enterprise is generally capable to provide these resources but this would be economically disadvantageous.
- ***Speed up processes, shorter time to market***: Due to the increased capacity and the routine of the specialized partners the innovation process requires less times.
- ***Sharing risk***: Since the required contributions are spread on the partners. In this way the contribution of each partner is limited / smaller that doing everything on its own.
- ***Imposing own/common standards***: Different competing standards can be very expensive for the suppliers. Involving other enterprises in the development can help to promote a certain standard. DeBresson and Amesse describe that „*Many networks of innovators are keenly concerned about imposing their architecture and standards*“ [DeBresson and Amesse 1991, p. 373].
- ***Making best use of the output of the innovation process***: In some cases innovation processes produce side-products that cannot be utilised by the enterprise but by its partners.

The exchange and generation of knowledge is a key element of inter-organisational innovation. However, this requires openness of all partners. They have to be open to:

- Accepting and applying the knowledge of partners.
- Sharing knowledge with the partners.
- Generating new knowledge in a collaborative way.

The internet provides new opportunities to retrieve, share and generation knowledge in collaboration with others. Keywords are for example ***Netnography*** [v. Kozinets 2006] (online ethnography in particular to analyse customers and how they act by using the internet) and ***Crowdsourcing*** [Howe 2006] (delegate tasks to a big group of users in the internet to receive their contributions as input for the innovation process).

However there are also some challenges related to inter-organisational innovation (see e.g. [Howaldt and Dammer 2011], [Fischer 2006], [Adner 2006], [Borchert et al. 2011]):

- ***Interdependencies in actions and decisions***. The enterprise has to coordinate its activities with partner and cannot act completely independent anymore.
- ***Dependency regarding know-how***. The enterprise relies on the know-how of the partners. As a consequence the own know-how in these areas/topics is not challenged anymore and gets lost over the time.
- ***Results are not owned exclusively.*** The enterprise looses the exclusive right/ownership on certain results, in particular intellectual property rights. These results and the benefits have to be shared with the partners.
- ***Extra effort for coordination.*** Collaboration with partners has to be managed and requires coordination. Since the partners are usually legally independent and have their own structures and processes this causes usually a higher effort than enterprise-internal coordination.

5..3.1. The approach of Open Innovation

A special type of inter-organisational innovation is the approach of Open Innovation brought up by Henry Chesbrough in 2003:

> *"Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology."* [Henry Chesbrough]

Open innovation is a paradigm stating that enterprises should use both external and internal ideas in order to tailor external and internal paths to the market. This way, enterprises will enrich their technologic know-how. Typically, in an open innovation scenario, an enterprise A needs innovation and an enterprise B sells to enterprise A the license to adopt the suitable innovation. In 0, authors define the gap between closed innovation and open innovation approaches: closed innovation implies that the organisation produces innovation by using internal resources only, on the other hand the open innovation is collaboration oriented (value co-creation is performed by involving resources of other organisations) and facilitated by modern collaboration tools. Therefore, there are many differences between closed innovation and open innovation approaches, as shown in Figure 1.

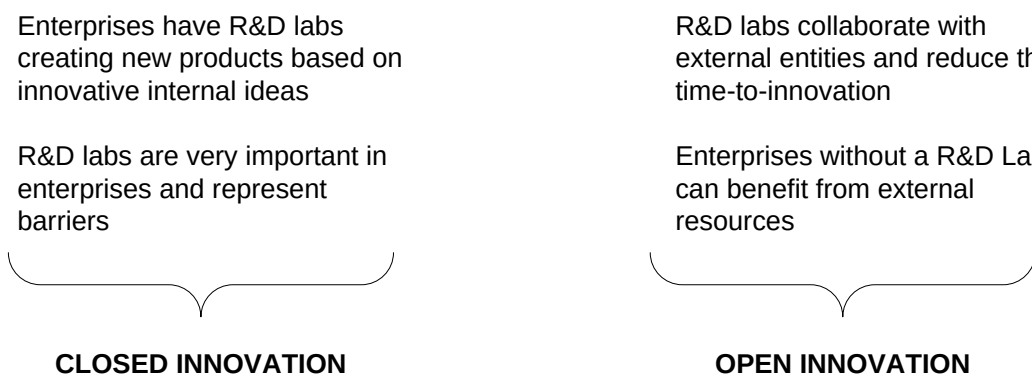


Figure 1 – Differences between closed and open innovations

In **Error! Reference source not found.**, authors describe how to bring open innovation to services and define two complementary types of openness: "*outside in*", in which a firm adopts external ideas and technologies (i.e. innovation) in its own business; and "*inside out*" in which a company "sells" its own ideas, technologies or processes (innovation) in order to be used by other enterprises. Specific services of MSEE platform should support such an innovation. In 0 two case studies are presented:

Bringing the Outside In: Some companies, like LEGO, have had great success in letting customers create designs. The LEGO Company included the LEGO Mindstorms, in which programmable motors were integrated with the plastic parts. LEGO opened up its software so that anyone could modify it and watched what customers decided to create. LEGO company noted that an entire middle-school curriculum was defined in the United States in order to teach children robotics, using LEGOs. In this way, LEGO products have given rise to a services industry focused on middle-school science and technology education.

Taking the Inside Out: Amazon.com. Some great retailers having their own web site realized that Amazon knew a lot about running a retail website and wanted to get the Amazon.com know-how.

Amazon decided to take the Inside out from the firm and sell it to other companies, in fact Amazon saw a new business opportunity to create more value from its knowledge of Internet retailing and website infrastructure. Furthermore, Amazon offered to host these third-party

sites on its own servers, thus becoming the infrastructure supplier to those retailers. This was a powerful way for Amazon to get paid for its knowledge -- taking the infrastructure it had built for itself out into the marketplace so other companies could utilize it.

MSEE innovation ecosystem must be based on above mentioned principles. In particular, tools, methods and services must be defined in order to let MSEE companies have exchange with members of the Manufacturing Service Ecosystem (MSE) to apply an open service innovation approach that provides added value.

5..3.2. Collaborative Interactions in inter-organisational innovation processes

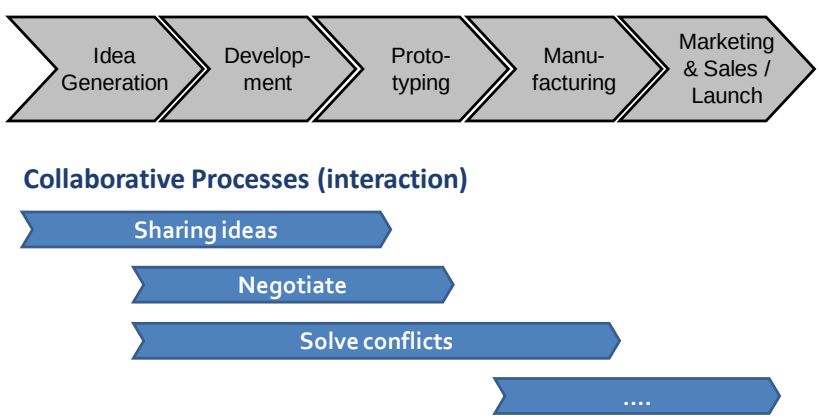
Inter-organisational innovation and in particular the approach of open innovation require evidently interaction of the involved partners. Interaction is the opposite of pure sequential activities, each activity is done by one partner without direct feed-back loops ("throw-over-the-wall" approach). Rather interactions can be regarded as ***reciprocal micro-processes*** *between partners that are elementary for the accomplishment of the tasks in the processes* [Weber 2007]. The action of one partner is influenced by the action or actions of other partners. In many cases interactions are not formally defined but are regarded as an implicit part of the value creation processes. As simple example is a brainstorming for idea generation in the early phase of an innovation process. The partners have to share their ideas, listening to other ideas and use the other ideas to give a feed-back and impulses to the other partners. A brainstorming would be less successful if the partners do not listen and react on the impulses they receive from other partners.

Generally interactions can be related to physical objects, financial resources, human resources, legal issues, and information [Weber 2005]. For the context of innovation in Manufacturing Service Ecosystem (MSE) the most relevant aspects are interaction in relation to information. There are different types of interactions related to information that are usually taking place in collaborative processes:

- Coordination (e.g. synchronizing activities, adjusting plans).
- Exchange of Information (e.g. sharing ideas, exchange and combine product data).
- Negotiation (in particular to reach commonly accepted decisions).
- Solving conflicts (e.g. common identification of conflicts and development of solutions, this is usually linked to negotiations).

All these interactions are based on communication, either face-to-face or via IT.

Collaborative innovation Processes in a MSE depend on these interactions, since they can only be formalised partly due to the special character of innovation. Therefore interactions should be regarded in the Reference Framework too.



5.4. General success factors for innovation

Literature has also investigated success factors for innovation. The identified success factors can be used to derive requirements upon an innovation framework for MSEE.

Behnken [2010] has analysed various meta-studies on success factors (Balachandra/Friar 1997, Montoya-Weiss/Calantone 1994, Henard/Szymanski 2001). Another more recent study was published by Booz Allen Hamilton in 2005 ("Mastering the Innovation Challenge: Results of the Booz Allen Hamilton Innovation Survey" [Goldbrunner et al. 2005]. This study revealed also aspects that critical for the innovation performance.

Since WP 21 is aiming at fostering innovation in Manufacturing Service Ecosystem the focus at should be directed on success factors that are related to improved conditions for innovations. Therefore success factor like product advantage in comparison to other products from the viewpoint of the customers, product innovativeness, or market potential should not be considered explicitly in this place. Looking from this point of view at Behnken's analysis and the study of Booz Allen Hamilton following corresponding success factors can be derived:

- Strategy regarding innovation.
- Knowledge about the market and the customer (gaining customer insight e.g. by collaborating with customer, making employees customers, in particular for consumer items, understanding customer experience and customer economics).
- Customer and market orientation.
- Capability to develop markets.
- Appropriate organisational conditions: expertise of employees, timing, project management, support from management, motivation and commitment of project team, ability to cooperate, in particular collaborating in networks, cross-functional teaming, freedom to pursue ideas, and innovation friendly incentives.

Behnken is describing that research found out that the relevance of the different factor depend on the development path of the enterprises, technologies, and the products. Therefore the factors can regarded as dynamic. On the other there is such a broad range of innovation scenarios that a "one-fits-all" solution won't work. These are two of the reasons why the identified success factors should not be regarded as "universally valid".

Nevertheless, some requirements can be derived for WP 21: The framework has to regard innovation strategy, the building up of knowledge about market and customers and appropriate organisation conditions.

5.5. Approaches for Innovation Reference Models and Frameworks

Literature provides already some approaches for references that can be regarded as frameworks or potential parts of framework. The approaches can generally be assigned tow two categories. One category comprises approaches that describe the main dimensions of frameworks. The other category describes innovation processes and innovation management processes.

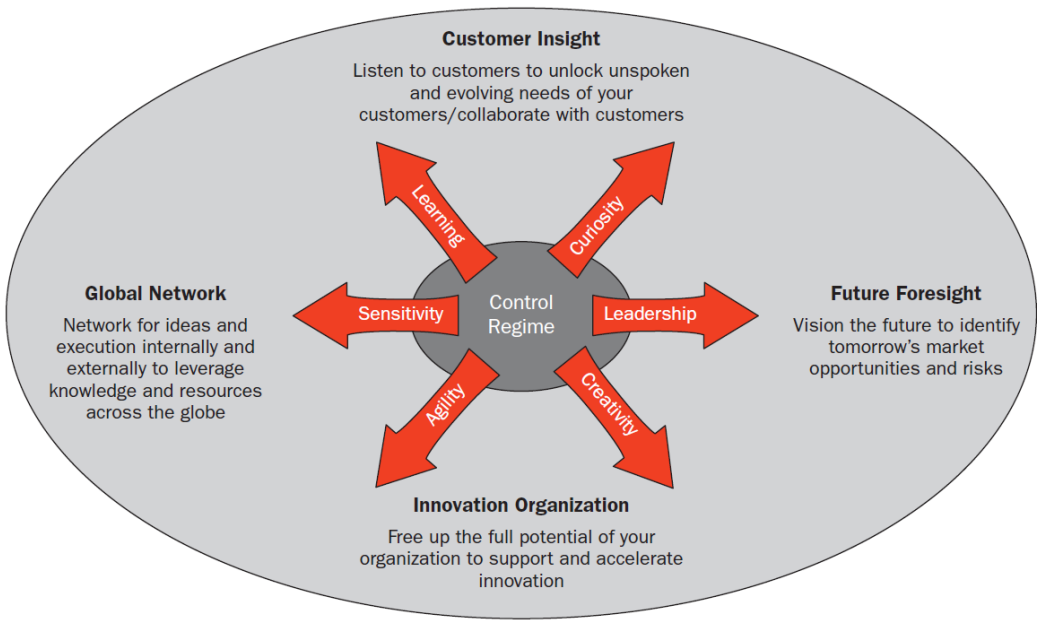
5..5.1. Approaches for innovation framework dimensions

As described in the introduction frameworks can be regarded as a set of axis that describes the mains aspect that determine innovation process or have an impact on it. As discussed in the previous chapter, open innovation networks foresee a flexible structure, easily joinable by

new partners and supportive regarding contribution to product and / or service innovation. The question is to which extend a network can increase its degree of innovativeness.

Framework of Goldbrunner et al.

Goldbrunner et al in 2005 discussed some ideas to support innovation processes within a single company. The following graph depicts their view on it:

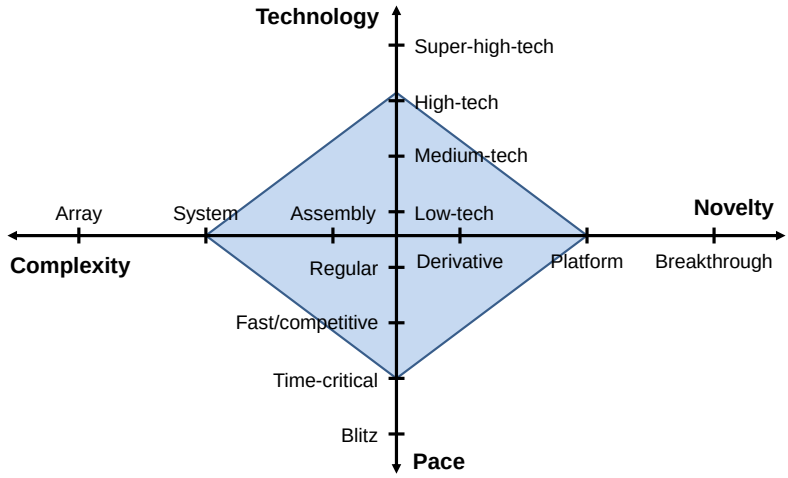


Source: Booz Allen Hamilton [Goldbrunner et al. 2005]

The main dimensions a control regime should aim at are the customer insight, the future foresight, the innovation organisation and the global network. The authors explain that innovation is not only built upon analytical capabilities. Instead, soft aspects like curiosity, the wish to learn, cultural sensitivity, agility and courage to take leadership need to be spread among employees. The company's management needs to organize a balance between these aspects. The question is now to which extend this understanding can be transferred from single company to open innovation network level. Some attributes are easily transferrable from single company to network context. Cultural sensitivity is already set in a global network context by Goldbrunner et al.. Respect naturally is the basis for cooperation in an international network and the more aware partners are the less probable is the occurrence of misunderstandings. The innovation factors curiosity and wish to learn (from each other) are equally transferrable. If not permanently requesting to come to know more, there is no need for partners to exchange and cooperate with others in a network. Agility, which is closely linked to flexibility and adaptability, goes together very well with the open network concept. By being open, the network tries to maintain agility. Only the innovation factor leadership needs clarification. Within an open network, partners are considered equally capable to contribute. Leadership can therefore not be allocated to a particular actor within the network permanently. However within particular tasks it is questionable whether self-organization may actually lead to establishment of flexible leadership patterns, every participant of the network can incorporate if its contribution reasons the take-over of responsibility. Still the term of leadership is one to be considered further when analysing functioning open innovation networks.

Framework of Shenhar and Dvir

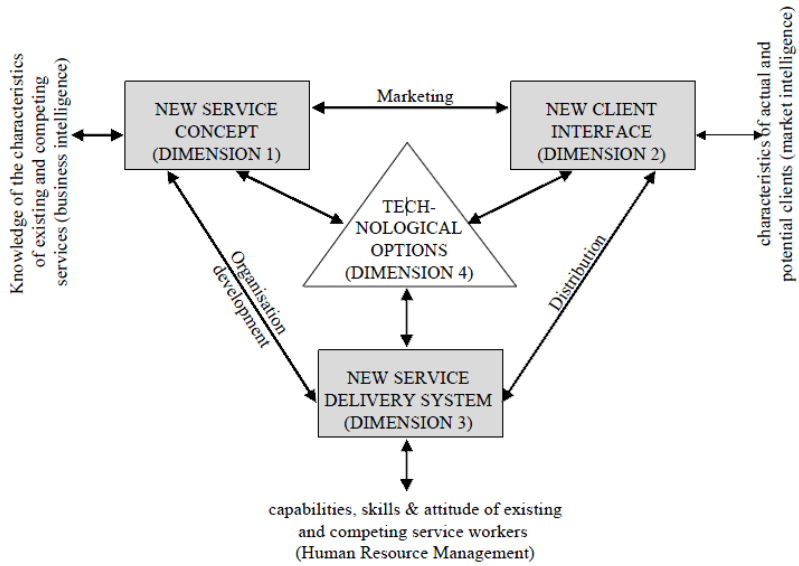
As with regard to a framework serving the open innovation network to be successful in the market, there are further frameworks from single company context, which are considered useful.



Shenhar and Dvir [2007] in their NTPC model name four critical categories, in terms of risk and success, relevant to an innovative service. One concerns the time frame: in order to reach the market among the first, so that the innovative character still surprises customers in a positive sense, the innovation needs to be developed in time. Actually, as soon as sensible it shall be presented to the customer - of course not before testing has ensured smooth functioning. There needs to be a particular degree of novelty as well as a certain amount of complexity. The approach needs to be thorough – the service shall to be thought along the context, it is offered – if possible, ways to extend it in the future need to be ensured. Also technology included into the service and used i.e. to provide the service needs to be on adequately high level. Regarding quality, speed, appearance, customer's expectations need to be met in order to ensure satisfaction and positive publicity. All these factors fit any service developed; it needs to be at a level that ensures market acceptance (and willingness of customers, to pay for it). The fact that the innovator is an open network still makes it a suitable approach.

Framework of Hertog et al.

There is another scheme used by P.d. Hertog et al. when talking about service innovation. It makes clear that besides offering new features of the service itself, which requires as a pre-step analysis of all competing services, three other dimensions are relevant. The following figure depicts the idea:



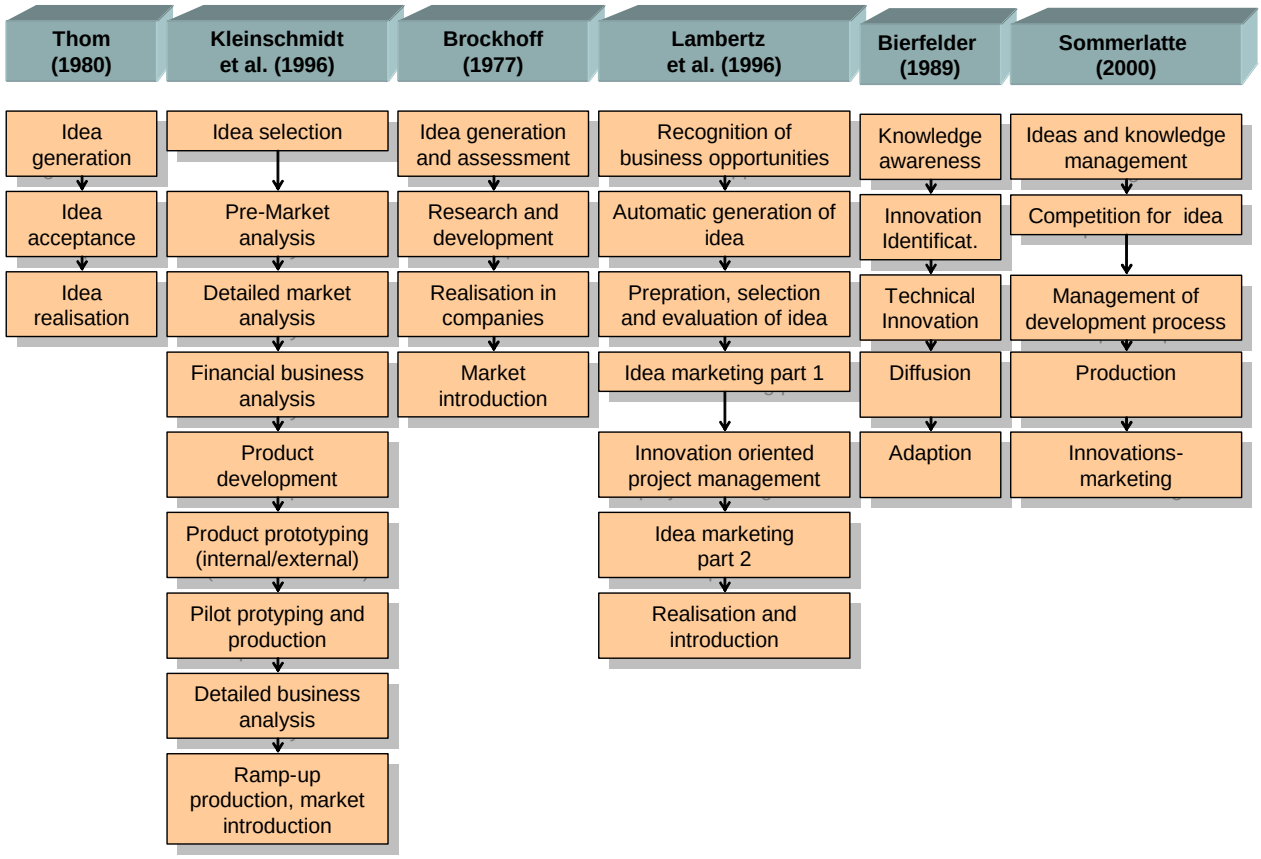
Hertog 2009, *A four dimensional model of service innovation (copyrighted by Dialogic)*

The second dimension mentioned by Hertog which is closely linked to a thorough market analysis as well, refers to renewal of the interface addressing the client. In this way, customer's awareness of the new service is increased or in some cases created. The idea behind is that content and cover of an innovative service need to be changed to facilitate good marketing. The third dimension fitting into this concept of changed cover is to rethink the service delivery and therefore the distribution system. It is the next pillar the company can use, in order to communicate innovations successfully to the customer. Last but not least there is as mentioned before, the technological basis that needs to fulfill highest demands in order to convince anybody from an innovative service. It is in the heart of every service innovation.

As with regard to the four dimensions, particularly analyzed by Hertog in the context of service innovation, a very thorough communication among partners in an open innovation network needs to be ensured, in order to harmonize the strategy of implementation of the innovation. Particularly when addressing the customer like suggested by Hertog et. al in a "multi layer" approach via communication through interface, delivery system and technology, harmonization is crucial. The client needs to have a feeling of trust to the service provider and therefore needs to consider the open innovation network as one unit. The principle "with one face to the customer" is a crucial precondition when transferring Hertog's concept to the open innovation network successfully. If this precondition is met, a (single) thorough strategy for customer service and communication implemented by all partners within the open innovation network is considered useful.

5..5.2. Models for innovation processes and innovation management processes

Innovation management assumes that innovations can be organized in a focussed way. The idea to define stages within the innovation generation has multiple approaches. Existing and established models for the innovation management process are depicted in the following graph [Eschenbächer, ProVE 2004]:



Thom's approach as one of the early to describe innovation management is a very general model focusing on the idea as main driver of the innovation and how to push it forward. Kleinschmidt et al. on the other hand describe the role of a critical analysis of the idea and name the many critical factors like market conditions, financial opportunities and technical constraints that need to be taken into account in order to create the security needed to "dare" market introduction. This need for security depicted in Kleinschmidt's model trying to increase the probability of market success reflects a change in the perception of market reality as mentioned in the introduction of this chapter. Innovation networks in this context offer room for development of common structures for control and quality management and facilitate availability of adequate means. Modern IT offers new possibilities – Lambertz et al. in 1996 already mention the step of automatic generation of ideas in their model.

In the following paragraphs some models that contain special aspect should be described in more detail.

The Stage-gate® approach

A well established approach for managing complex development projects is the stage-gate® approach as is depicted in the following picture. It divides the process and certain packages (stages) which have to be performed sequentially. However, the tasks and activities within one stage can be in parallel or sequential, whatever is best suited. When this approach was introduced the "new thing" was the change from milestones to gates. While a milestone could be passed that project has to "go through" a gate to leave a stage and enter the next. To open the gates it need a consensus decision by the steering group of the project.

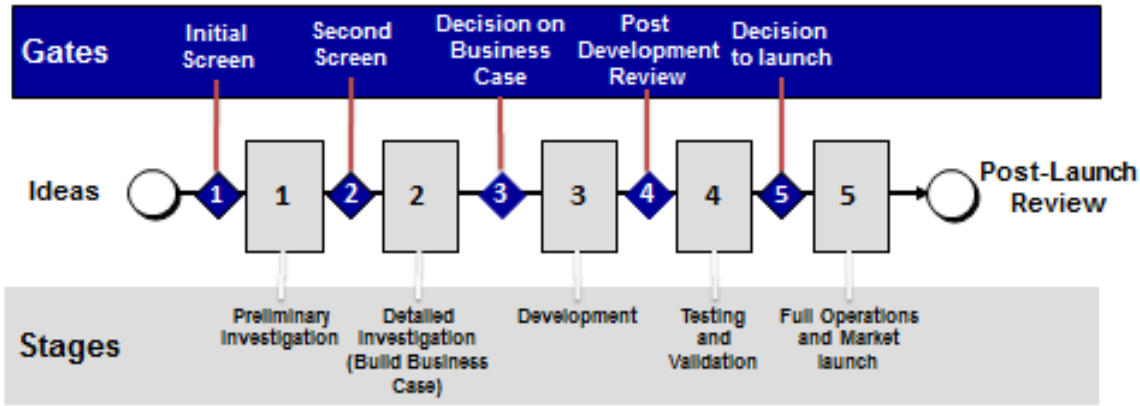


Figure 2: Example for a Stage-gate model for the service sector [Perseus 1999])

DITF Model for managing innovation processes

The following graph introduces a model for innovation management that was developed by DITF and has comparable phase than the models above: creation of ideas, development cycles and production and marketing.

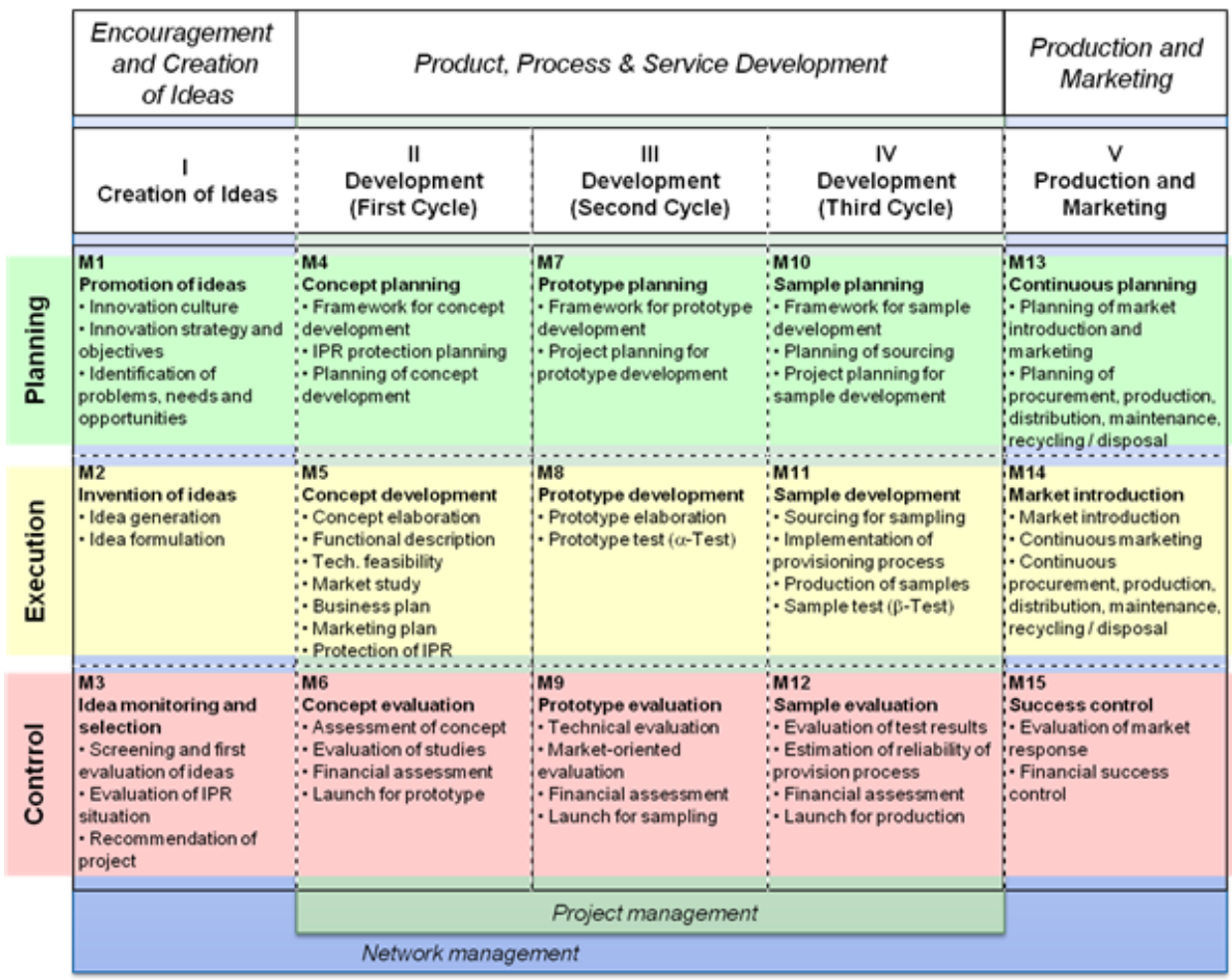


Figure 3: DITF Model for managing innovation processes

The approach is aligned to project management, since each phase comprised activities for planning, execution and control. In parallel to all phases there is a need for managing the

network. The terminology "development cycles" underlines that the development does not take place in a strictly sequential way but requires some loops.

Model of Haritz

The model provided by Haritz [2000] is generally built upon the same components. The additional and interesting aspect is that it illustrated the different triggers for the process according to the approach of market-pull and technology-push. The whole process is divided on the first level into a creation cycle and a market cycle. On the second level the creation cycle is divided into a phase of invention and a phase of realisation. The generation of ideas is not explicitly mentioned.

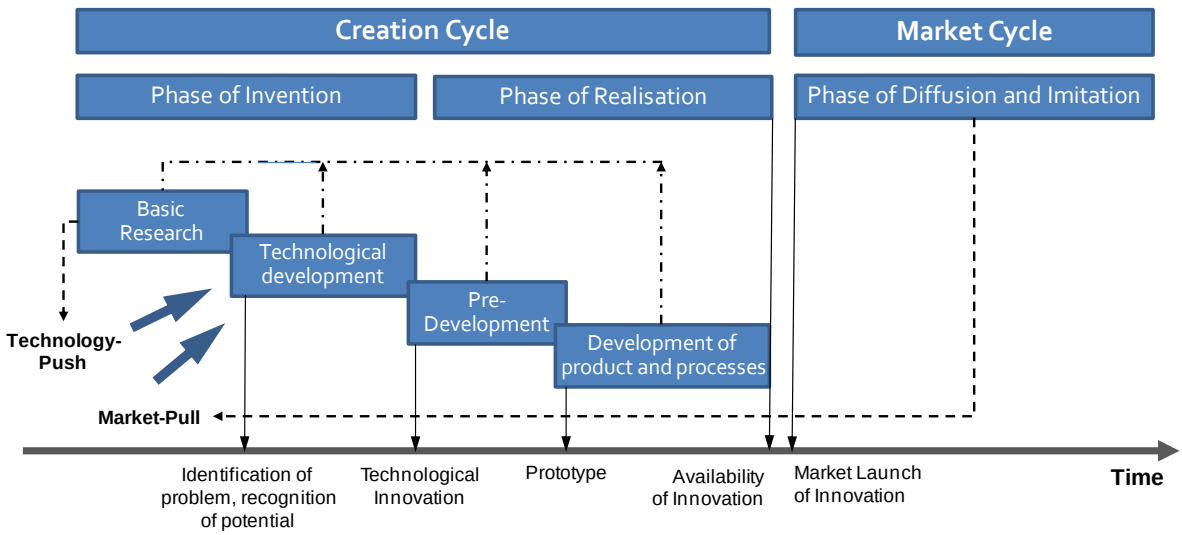


Figure 4: Haritz's model for the phases of an innovation process [Haritz 2000]

Generic overview over innovation cycle by Behnken

A very condensed overview over the main steps from ideas to innovation is provides by Behnken [2010]. The process of innovation generation is less understood as a one dimensional top-down development process but rather as a never ending development cycle, in which market introduction of a product or service immediately leads to renewal and the start of a next phase of the cycle. After maturity follows immediately a phase of renewal, indicating the permanent need for further development close to the market, in order to be successful. This overview shows the difference between invention and innovation. The invention needs exploitation to become an innovation.

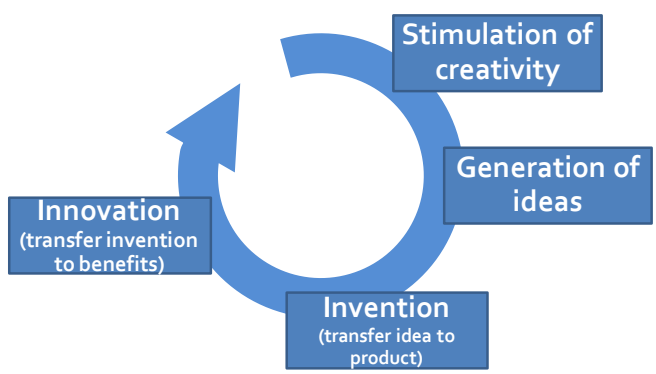
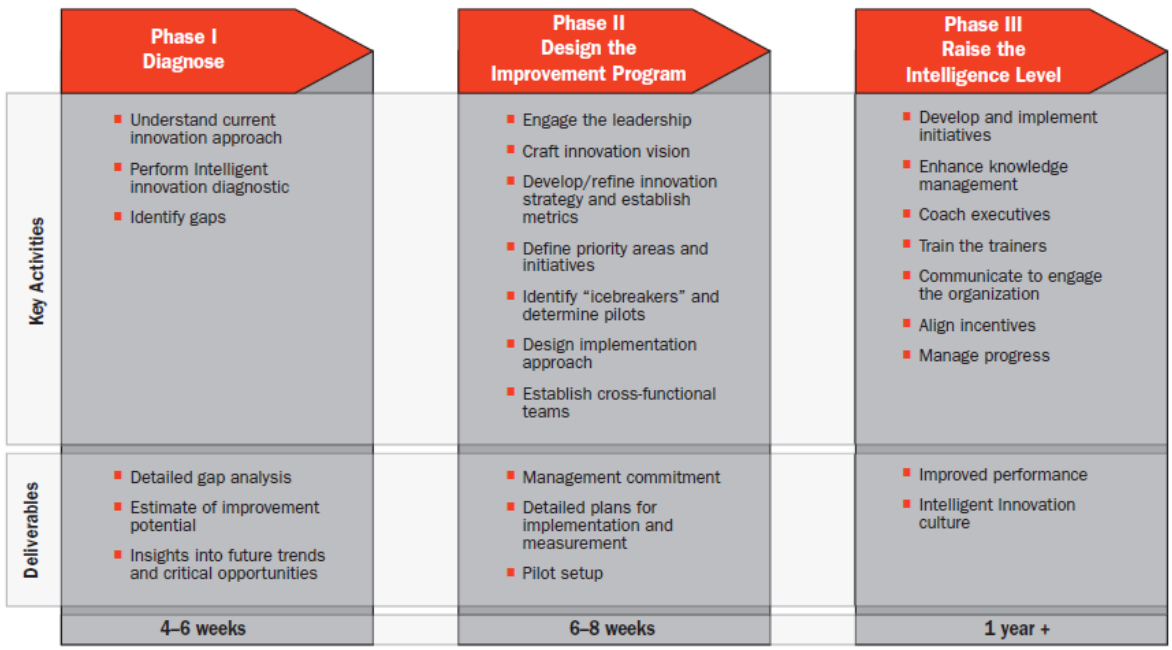


Figure 5: Innovation Cycle according to Behnken (adapted from [Behnken 2010])

5..5.3. Models for processes to improve innovation capability

Process models for innovation start usually with the ideation phase with activities like recognition of opportunities and idea generation (see sections above). However for specific condition of an MSE there is another relevant process that runs in parallel to processes described above. There is a need for a process that provides the appropriate conditions for the collaboration on innovative servitization in a MSE.

Goldbrunner, Hauser, and List have suggested a process that is aiming at these conditions. They suggest a three step process to "bringing intelligent innovation to life" and to increase innovation performance. The improvement of the innovation performance should be assessed according to three aspects: hit rate, efficient development and time to market.



Source: Booz Allen Hamilton [Goldbrunner et al. 2005]

The process is generally designed for improving the innovation performance of a single enterprise. It is not aligned to the specific condition of a MSE. Nevertheless, it shows the relevance of working on the conditions for innovations and it contains some elements that could be relevant for MSEs, for example:

- Understanding the innovation approaches of potential partners in the ecosystem.
- Analysing gaps regarding the innovation capability.
- Engagement of leadership of the partners.
- Establishment of cross-functional and cross-organisational teams.
- Enhancement of knowledge management.

So, a requirement upon the Reference Framework of WP 21 is to cover the process of providing conditions for innovation in the MSE.

5.6. Measuring Innovation

Performance indicators that are chosen to monitor and control processes represent the important and critical aspects of the processes. Therefore the analysis of indicators that are

suggested/established in the context of innovation could provide input to derive requirements upon the Innovation Reference Framework.

The considerations upon performance indicators that are related to innovation were done in cooperation with WP 13. Therefore the detailed discussion could be found in Deliverable 13.1. Nevertheless some basic results are repeated in this place to enable conclusions regarding requirements upon the WP 21 framework.

In this work-package the focus is directed to manufacturing enterprises and Manufacturing Service Ecosystem. Therefore it considers innovation indicators on the level of organisations (microeconomic level). On this level there generally two majors aspects that are relevant for the MSE:

- The ***general innovation capability***, that is in particular relevant for the assessment and selection of partner for the innovation process. The general capability could also be used for a self-assessment (comparison with benchmarks or analysis of internal improvements over time) when a company wants to improve its "attractiveness" as partner in the ecosystem.
  Usually these indicators refer to experiences in the past.
- The ***project-specific innovation capability and performance***. The indicators provide an MSE or a Virtual Manufacturing Enterprise (VME) with transparency concerning the project-specific innovation capability and performance. This enables and supports the tasks of governance and control of the activities in the Innovation Ecosystem.

These two major aspects are covered by seven categories of innovation like depicted in the following figure.

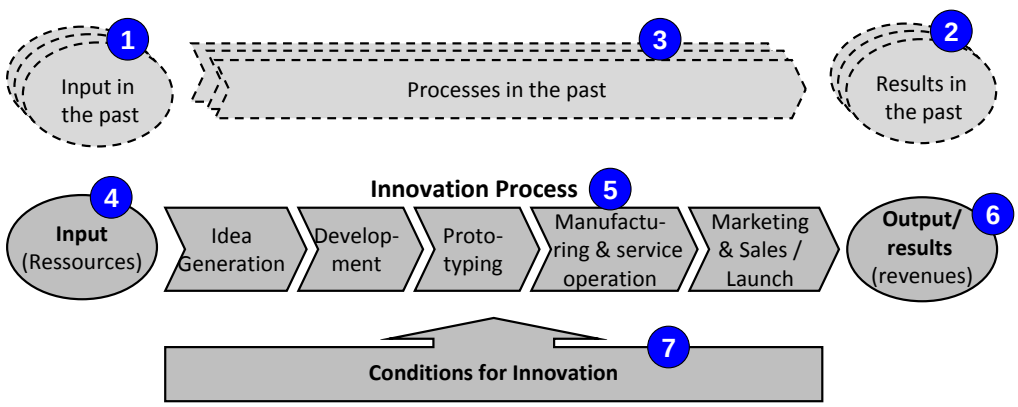


Figure 6 – Categories of innovation indicators related to the innovation process

The categories are:

1. Indicators for the generally provided input for Innovation Processes.
2. Indicators for the achieved overall output of Innovation Processes.
3. Indicators for the general performance of Innovation Processes.
4. Indicators for the input provided for a specific Innovation Processes.
5. Indicators for the performance of specific Innovation Processes.
6. Indicators for the achieved output of specific Innovation Processes.
7. Typical indicators regarding the provided conditions for Innovation Processes.

A more detailed discussion of these categories as well as examples for corresponding innovation indicators could be found in the Apendix to this document (and in the same was in D13.1).

Conclusion regarding the measuring innovation in Innovation Ecosystems

The basic approach of the Manufacturing Service Innovation Ecosystem is to make use of the different competences and the capacities in an ecosystem. The non-hierarchic structure generally can support the creativity that is needed in the phase of idea generation.

In this way the ecosystem can be regarded as a condition for innovation. Therefore the indicators from category 7 that regard the conditions for Innovation Processes have to be checked for their applicability and adapted for the application in a MSE.

Since manufacturing enterprise has to select appropriate members from the ecosystem as partners for the innovation it is important to assess the general innovation capability of potential partners. Consequently the indicators from category 1 to 3 are relevant for this partner selection. It has to be analysed which indicators of these categories fit best and if adaptations or additions are needed.

Collaboration is essential for the MSE approach. The category 5, performance of specific Innovation Processes, already provides some examples for indicators that are related to the interaction with others. For the controlling of collaborative innovation process in a MSE corresponding indicators are needed.

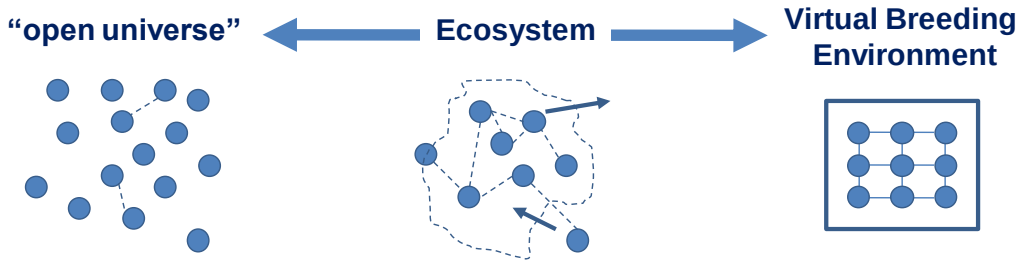
5.7. Servitization in an ecosystem as an environment for innovation

The basic approach of the MSEE concept is to make use of a Business Ecosystems to achieve service innovation. To identify the relevant elements and aspects of the Innovation Framework it is necessary to have a clear understanding what this ecosystem is and how it could be characterised.

Different authors have characterised Business Ecosystems [e.g. Moore 1993 and 1996; Iansiti and Levien 2004; Power and Jerjian 2001; Peltoniemi and Vuori 2004]. Some characteristics are:

- A community of organisations and individuals that interact.
    - “Business Ecosystems ... are essentially communities of entities with differing interests bound together in a collective whole”. [Iansiti and Levien 2004, p. 9]
    - “An economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world.” [Moore 1996]
- The partner are (legally) indenpendent.
- “Shared fate” [Iansiti and Levien 2004, p. 17].
- Self-organized with decentralised decision making.
- Evolution / co-evolution and emergence (mainly based on interaction).

For MSEE the Ecosystem is an organisational structure that is located between a formally defined and governed network (like a Virtual Breeding Environment – VBE [ECOLEAD]) and the “open universe” of all potential partners for collaboration that are generally unconnected.

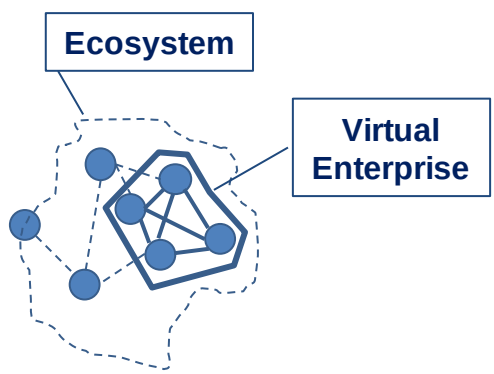


This leads to a more specific description of ecosystems that needed for the considerations in this work-package:

- Formalisation: Weak formalisation. The members generally recognise that they are part of an ecosystem. Usually there is an established communication. Since there are in most cases no written “contract paragraphs” there should a least a kind of “common sense”.
- Types of relationships: There are general patterns of relationships, every partner is at least connected to one other partner, however, these relations can be quite week.
- Openness and Stability: The ecosystem is evolving; some organisations leave the Ecosystem while other join it. Joining and leaving does not necessarily require formal processes or approval.
- Hierarchy and governance/ control: The ecosystem is characterised by decentralised self-organisation and self-control according to common or complementary objectives. Since the members are independent the structures are principally non-hierarchic.
- Competition: Competition is possible; however there is usually a general win-win-situation.

Transferring this to Manufacturing Service Ecosystem (MSE) the conditions could be described more concretely.

- The members of a MSE can be suppliers and customers as well as research institutes, public institution and consultants but also competitors and enterprises from other branches (in particular from service industries).
- Members of the ecosystem can set up a Virtual Enterprise (VE) to make use of business opportunities. These VE can be regarded as an element of the ecosystem. However, due to it characteristics, in particular the formalisation and the openness (joining or leaving the ecosystem), in MSEE it is not regarded as an ecosystem itself. The ecosystem benefits from the VE since the experiences gained in the VE are available in the ecosystem and stay there when the VE dissolves.
  The same applies to supply chains that can be formed of the members of an ecosystem but are no ecosystem in the sense of MSEE.



- The inhabitants of a business ecosystem choose or accept to be a member of the Ecosystem. Unlike the inhabitants of a biological ecosystem the organisations and individuals take a conscious choice.
- Business is driven by VE (other options like single supply chain are also possible but not in the focus of MSEE), the Ecosystem as such is not doing business.
- Manufacturing enterprises can become part or make use of an already existing ecosystem or initiate a new ecosystem.
- An Ecosystem usually lasts for a longer period of time. There is usually no defined moment in time when the ecosystems ends. However, if the partners do not interact anymore, the ecosystem dissolves.
- Unlike a biological ecosystem a business ecosystem does not necessarily need to have geographic borders, also these borders could be quite fuzzy in biological ecosystems to. The borders of an MSE are determined by the business. There could be for example geographical borders as well as technological or market related borders.
- A MSE is characterised by interactions that are motivated by common benefits (win-win-situation). This is comparable to biological ecosystems.
- An MSE is subjected to evolution. The changes can be slow but also very dynamic. It can be expected that MSE that are aiming at service innovation will be very dynamic.

The second essential characteristic of the MSEE concept is ***servitization***. Servitization describes the transition from a mere physical product to a combination of physical product and associated services. The combination is also called "Extended Products" (EP) [Thoben ...]. The change process towards EP that can be regarded as trend was described e.g. by Vandermerwe and Rada [1988]. Usually the servitization causes changed or new relationships to customers and suppliers.

Conclusions regarding the impact of ecosystems' characteristics and servitization on innovation

Servitization and collaboration in an ecosystem have an impact on innovation processes. These can be summarized as follows:

- Servitization means change. A manufacturing enterprise extends the share of value provided to the customers that is generated by services. This means the company is doing something new or something in new way. In this way servitization as such can be regarded as a kind of innovation for the enterprise itself and for its customers. This change in the innovation process requires special attention.
- Servitization is not a mere service innovation as described above. Rather the service innovation has always to be linked with the physical product. This provides additional options for innovation. The different options to realise this link have to be analysed.
- In many cases servitization change the relation to customers and suppliers. This has to be already regarded in the early phases of the innovation process.
- The ecosystem approach provides appropriate conditions to build up new or adapted relations to customers and suppliers. The framework should cover these relations into the ecosystem.
- If the manufacturing enterprise involves the ecosystem the innovation processes become inter-organisational. Since the members of the ecosystem are generally

independent from the manufacturing enterprise the collaboration is to a certain degree non-hierarchic with a low level of formalisation. This requires a suitable management of the innovation processes.

- Although innovation process need a high degree of freedom and flexibility that is generally supported by the ecosystem approach some formal issues have to be regarded and are a special challenges in an ecosystem. In particular the sharing of risks and benefits has to be regarded before significant investments are done and valuable results are generated.

5.8. EUROPEAN initiatives on Innovation and implications for MSEE

The EUROPEAN commission and national governments have supported several activities that should foster and promote innovation in EUROPE. This chapter gives a rough overview over current or recent activities and projects related to the context of innovation. The objectives and approaches of these initiatives will be analysed to derive requirements that are relevant for the innovation framework of MSEE.

5..8.1. PRO INNO Europe®

A well established initiative is PRO INNO Europe [www.proinno-europe.eu]. The mission statement is ”*new and better innovation policies for Europe*”. It is aiming at a series of products and services to support the showcasing and exchange of better practices in support for innovation that will be developed under the PRO INNO Europe initiative 2009-2012, notably by the INNO-Nets and INNO-Actions. Results should provide a horizontal support function to synthesize the results of PRO INNO Europe projects, and to communicate them in an efficient manner to innovation policy and support stakeholders.

- Organisation of 4 Annual Partnering Events during 2009-2012 to facilitate the networking of all PRO INNO Europe stakeholders and to exchange knowledge and good practices.
- Establishment of an on-line repository of elements of better practices and results from PRO INNO Europe projects, to help extract and validate the lessons learned with regard to innovation support measures and services and to facilitate their transnational transfer.
- Continuous and systematic promotion and dissemination of the results and tools generated under PRO INNO Europe, e.g. through a printed Newsletter published 3 times a year.
- Hosting, maintenance and management of the PRO INNO Europe public Web portal and Extranet.
- Fostering cross-fertilisation and efficient exploitation of synergies with other European, national and regional innovation support initiatives, notably the Europe INNOVA initiative and the Enterprise Europe Network.

Although PRO INNO Europe putting some emphasis on the macro-economic level, it provides also input for consideration on the micro-economic level of MSEE.

Derived requirements	• There is a need for information on best practices. This information should be available online. • Networking and exchange of experiences and ideas is essential. The ecosystem could provide a basis for this.

Derived additional conclusions	• ---

5..8.2. Innovation Union Scoreboard / Inno Metric

The Innovation Union Scoreboard (IUS) [www.proinno-europe.eu/metrics] is part INNO-Metrics in the PRO INNO Europe initiative. The overall ambition of the Innovation Union Scoreboard is to inform policy discussions at national and EU level, by tracking progress in innovation performance within and outside the EU over time. Policy makers should be provided with statistical and economic analyses that show characteristics, performances, and trends of innovation systems. The IUS will check 27 EU Member States based on 3 main types of indicators and 8 innovation dimensions, capturing in total 25 different indicators.

Like PRO INNO Europe the IUS is looking mainly at the macro-economic aspects. Nevertheless, this can be used to derive some requirements and conclusions for MSEE.

Derived requirements	• The framework should consider the assessment of conditions for innovations and of innovation performance. There is a need for corresponding metrics / performance indicators.
Derived additional conclusions	• Usually there are two perspectives to assess innovation performance: A macro-economic view (e.g. region, country, EU, business area) and a micro-economic (enterprise level). The Ecosystem covers aspects of both views, e.g. providing conditions for innovations could comprise elements that are usually relevant for macro-economic view.

5..8.3. INNO-Partnering Forum

The main task of this project that is also part of PRO INNO Europe was to establish a cooperation platform between the authorities, which are responsible for promoting innovation in Europe.

A part of this cooperation platform should be meetings of high-level representatives, to facilitate strategic discussions. Another important point was to test methodological approaches and international practices.

One aim was the development and testing of new approaches to support innovation in SME to be more effective and policy recommendations have to be proposed on how innovations agencies can accelerate the take-up of the most advanced support systems for innovation SME. The INNO-Partnering Forum can be an aid for public innovation agencies and other organizations to identify and develop synergies among each other.

Some of the results are:

- The project establishes the INNO-Partnering Council, a mutual learning and cooperation platform between public actors responsible for innovation support in Europe. The "Council" is composed of around 20 high level representatives from CIP-EIP eligible countries and it will meet twice annually during the project duration.

- The project facilitates cooperation between innovation agencies as well as other public organisations assigned with the responsibility for designing and implementing innovation support measures across Europe.
- The project identify and test promising methodological approaches and international practices (eg. peer-reviews of specific instruments, twinning/ transferability exercises, organisational assessment methods, management practices, etc) with a view to help public organisations to support innovative SMEs more efficiently and effectively.

Derived requirements	• There is a need for a platform that brings together members of the ecosystem to collaborate on innovation.
Derived additional conclusions	• There is obviously some support from public organisation for enterprises in their innovation processes. Generally it could be helpful for Manufacturing Service Ecosystem to make use of this support.

5..8.4. LABORANOVA

LABORANOVA [www.laboranova.com] was an EU integrated project that provided workers with the possibility to share, improve and evaluate ideas in a systematically way. It aims in particular at the early stages of innovation. The research project was made up of three branches:

- *Ideation Space*: it increases ideas management thanks to a collaborative workflow that improves the cognitive capacity.
- *Connection Space*: it connects and links all people by selecting their know-how.
- *Evaluation Space*: it continuously monitors the ideas through prediction markets and decision support systems.

The objective was to provide methods and tools that guide and support innovators, teams and companies within the development and management of innovative ideas and concepts.

Derived requirements	• The framework has to consider the sharing and management (incl. evaluation) of ideas on an inter-organisational level.
Derived additional conclusions	• The framework can refer to existing tool.

5..8.5. EPISIS

The request was made primarily to the PRO INNO Europe project EPISIS [www.proinno-europe.eu/project/episis] was to facilitate trans-national cooperation between policy makers in Europe. This will be accomplished by identifying emerging needs for service innovation and ease the design and testing of new policy concepts.

A policy-oriented conference should be organized as well, to simplify the exchange of ideas and information. For a successful transfer of knowledge in the service area is the development of a strategy necessary.

The European policies and activities have to be developed, to support innovation management in forms of service innovation and concentrate more on innovation management. For this purpose, the policy framework must be reviewed, in order to understand better the barriers of innovation

The objectives pursued by EPISIS can be divided into 3 categories.

- The main policy level objective is to advance a renewal of innovation policy by emerging policy challenges for service innovations.
- The main strategic level objective is to improve the understanding of service Innovation and to provide tools and means for value creation through service innovation in different businesses.
- The main operational level objective of the project is to develop and renew policy tools and measures in the field of service innovation.

Results of EPISIS:

- Useful tools in Analysis of company's current situation, Development of service strategy, Evaluation of service potential, Design of service process, Evaluation of customer satisfaction, Product Service System, ServLab, Regulatory framework method, Service Balanced Score Card method, The KIT model and Bar Code technology.
- Knowledge Transfer in Service Business Development.
- Good Practice Examples: Vaillant, Germany ; Parken Zoo in Eskilstuna, Sweden ; Zwick, Germany ; MT Unirepair, Netherlands ; Process Vision, Finland ; WMA Schmidt & Bittner GmbH, Germany ; Kalevala Koru, Finland ; EBV Elektronik, Germany.

Derived requirements	• Provision of best/good practices to support innovating enterprises, e.g. methods to analyse the enterprise's current situation.
Derived additional conclusions	• ---

5..8.6. AVALON

AVALON [www.avalon-eu.org] stands for "*Multifunctional textile structures driving new production and organizational paradigms by textile SME interoperation **A**cross high-added-**VAL**ue sect**O**rs for knowledge-based product/service creatio**N**"*.

As a cross-sectoral project, AVALON covered medical, automotive, aerospace, and process technology applications. It's a Product and Service Network focusing on three constituting elements, namely organisational, ICT, and knowledge networking. Highly specialized products as well as associated services were provided and aligned by means of appropriate management, modelling, and technological infrastructures. Topics addressed are:

- Network set-up, operation, and decomposition.
- Application of dedicated innovation-related methods and innovation processes for products and services.

- Comprehensive ICT support for pro-active collaboration, knowledge sharing, and ad-hoc communication.

With respect to MSEE, it has to be highlighted that IT-service design and deployment in AVALON was covered by a holistic MDA-like model-driven approach. Service orchestration and delivery was tackled by an online marketplace on network level.

Derived requirements	• The framework should at least cover three to four dimensions: ICT, organisation (of partners and activities/processes in the network), and knowledge (explicitly!).
Derived additional conclusions	• Business-ICT-Alignment can profit from service orientation • Successful applied knowledge management in networks is more than applying service-oriented ICT means, platforms, and marketplaces.

5..8.7. Contex-t

It's a product-centric development network for a niche market in architectures. The contex-T network [www.contex-t.eu] was different from generic business environments in terms of strong collaboration between the stakeholders, dynamically assigned roles in the network, and systematic online knowledge exchange.

Derived requirements	• The framework should support both, intense collaboration on singular topics as well as brought initiatives (Scalability).
Derived additional conclusions	• There need to be non-centralized mechanisms to harmonize surprisingly heterogeneous networks.

5..8.8. OpenGarments

The whole title of this project is "*Consumer Open Innovation and Open Manufacturing Interaction for Individual Garments*" [http://www.open-garments.eu]. It is a European research project funded under the 7th Framework Programme (NMP Project 213461).

The overall objective of Open Garments is the Manufacturing Service Provider (MSP) Business Model enabling individual garments. This model enables a new way of design, production and sales of consumer designed and configured garments, based on the provision of individualised services and products to customers and partners. This allows new product designs, a much more customer satisfaction, and an improvement of the stability and competitiveness of SMEs.

Derived requirements	• The framework should foster the integration of customers or even open online communities

Derived additional conclusions	• Micro Firms have to be considered as core members of manufacturing service ecosystems • The need for flexibility of networks is sometimes overrated as trust, reliability, and planning security seem to thrive industrial consortia

5..8.9. SmartNets

SmartNets is a European Commission Research 7th Framework Small NMP project. The whole title is: *The Transformation from Collaborative Knowledge Exploration Networks into Cross Sectoral and Service Oriented Integrated Value Systems*.

SmartNets provides technical, organisational, procedural, knowledge-oriented, and formal means to describe, conceptualize, handle, design, realize, and manage products and services in cross-sectoral and flexible environments. Tangibles and Intangibles are formalized and thus managed by means of IT-driven collaboration platforms. Services and Products are aggregated dynamically, depending on the very need of respective customers (b2b, b2c). The core challenge of the project is to master the conversion of development oriented networks into production networks.

Derived requirements	• The framework should reflect that innovation covers everything from development to production. • The framework should recommend systematic approaches for modularized innovation-related activities.
Derived additional conclusions	• In innovative consortia a continuous transformation of organisation, ICT, knowledge etc. is going on. There is no steady state.

5..8.10. Bivee

BIVEE [www.bivee.eu] stands for *Business Innovation and Virtual Enterprise Environment*. It is a European research project with funding from the European Commission. The main objective is "*to develop a conceptual reference framework, a novel management method and a service-oriented ICT platform to enable Business Innovation in Virtual Factories and Enterprises*". This 3-year project started in September 2011.

BIVEE addresses Virtual Enterprises and defines two spaces within their environment: The Innovation Space and the Production Space. The BIVEE Framework consists of three main parts:

- The Virtual Enterprise Modelling Framework (VEMF) that defines the setup phase of a Virtual Enterprise as well as the structure of the Innovation and Production Space. This structure contains a list of activities and processes that acts as frame for the other sub-frameworks.
- The Business Innovation Reference Framework (BIRF) contains templates for the input/output mapping of each activity, while differentiating between product, service, technology, and process innovation.

- The Measurement Framework (MF) to provide two sets of KPIs as metrics to manage the business within the Innovation and Production Space. Each KPI is aligned to one out of eight business objectives.

Derived requirements	• Relation to Virtual Enterprises have to be considered • Innovation and production processes have to be managed differently • Improvement and Innovation processes are to be distinguished
Derived additional conclusions	• A common strategy, policy, business plan and the choice of business objectives have to be defined during the setup phase of a Virtual Enterprise • Different areas of innovation (service, product, process, technology) show individual characteristics and process different information

6. Methods and Tools and services to support innovation

As described in the previous chapter MSEE ecosystem paradigm is focused on the inter-organizational innovation (i.e. collaborative, distributed innovation). In particular, methods, tools and services should support the effective collaboration among companies in order to get advantage from common creation of knowledge and ideas, and to promote an Open Innovation framework within the MSEE ecosystem.

Following sections include some State of the Art about methods, tools and services supporting open service innovation. The innovation ecosystem platform will include several tools to support this kind of innovation.

6.1. Methods to support innovation

Nowadays the traditional value chain [Porter 1985] is changing towards a service perspective; in fact new methods to support innovation give enterprises the possibility to rethink their business. Enterprises are adapting to these changes by creating new business models compliant with the "Enterprise 2.0" paradigm and by using new methods to support innovation.
In particular, the approach reported in [Ståhlbröst and Bergvall-Kåreborn 2011] supports the continuous outflow and inflow of innovations, i.e. **Living Lab**. The Living Lab approach allows enterprises to better understand what the customers want, in order to reduce the time-to-market of products, to improve the business and to adopt the innovation in real contexts. In other words, a Living Lab is a union of public and private partnerships where a large number of users co-creatively proposes, shares and tests innovations in real-life contexts.
The living lab approach has been studied in many EU countries and its methodologies have draw much attention, but there are very few contributions to definite and explain this approach. So the next paragraph will summarize the most common European Living Lab methodologies useful to support the process of innovation.
The Living Lab organizations are very interesting due to their features and because they act as intermediaries in an Open Innovation System [Almirall and Wareham 2009].

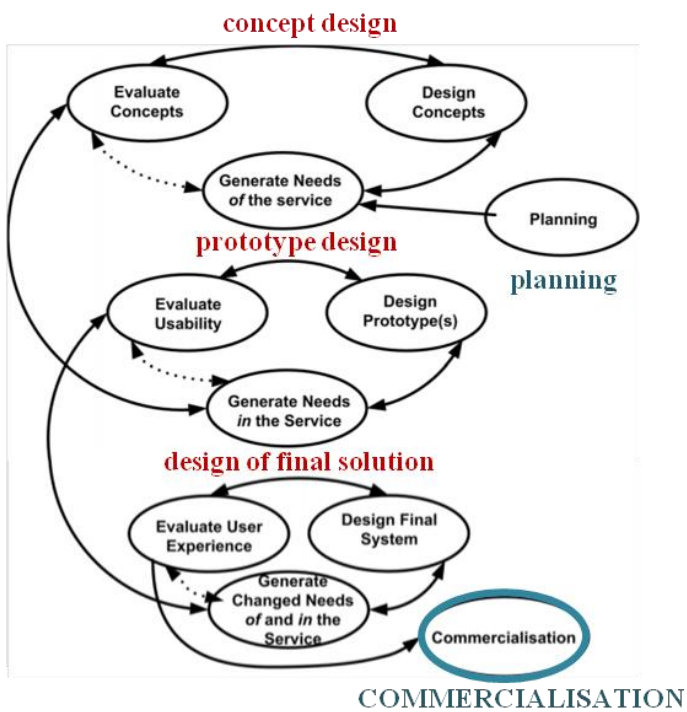
Following sections include several methods that enable the open service innovation among enterprises. These methods should provide input for the considerations regarding the MSEE innovation ecosystem.

6..1.1. FormIT methodology

The most used methodology in the oldest Swedish Living Lab (the Centre for Distance-Spanning Technology - CDT[1]), is "*FormIT"* [Ståhlbröst 2008]**.**
This methodology *refers to the opportunities of users to form future IT-solutions with an appreciative approach.*
The FormIT Methodology is based on three concepts [Bergvall-Kåreborn 2009]:

1. *Soft Systems Thinking* [Checkland and Scholes 1990]: This way of thinking is founded upon the notion that changes can occur only through changes in mental models. This concept is very important because it is necessary to well understand the worldview of all stakeholders.
2. *Appreciative Inquiry* [Holst and Ståhlbröst 2006]: this theory explains how to start the development process identifying all stakeholders' dreams and visions of how IT can support the lives of people. Appreciative Inquiry starts with the assumption that something in every situation is working; hence, it is an inquiry that searches for the best of what already exists in a system and as such searches for the life-giving forces of the system.
3. *NeedFinding* [Patnaik and Becker 1999]: this approach explains that needs are not influenced highly by trends; hence, they are more long lasting. Furthermore, it is better to focus on needs, instead of solutions because it keeps more alternatives.

The FormIT methodology supports openness and communication between user and all other stakeholders. This methodology is based on the gathering of knowledge through the exchange of interactions between the phases of the innovation process and people with different know-how and perspectives. In this way, knowledge increases through dialogue among participants. The idea enables the processes of taking knowledge useful to design IT systems that respond to user needs. The method is shown as a spiral in Figure 7.



[1] Centre for Distance-Spanning Technology (CDT) web site, http://www.cdt.ltu.se/

Figure 7: The FormIT Process

This process is composed of three phases: Appreciate Opportunities, Design, and Evaluate that are repeated in the three iterative cycles: the *concept design cycle*, *prototype design cycle* and the *final system design cycle*. There are also two additional phases included in the process: the planning and the commercialisation.
The first cycle of FormIT, *concept design* should elaborate a concept, which represents the generated needs from the first step in the cycle. At the beginning the phase starts by defining: a) the scope for the process; b) the target-user group and their important characteristics; c) where these users can be found and their role in the user involvement process.
The second cycle, *prototype design*, starts with the process of identifying stakeholders' needs *in* the service. In fact, within this cycle it is important to separate between needs *of* the service and needs *in* the service.
The third cycle, *final systems design*, starts by analyzing the results from the usability evaluation in order to generate changes in the needs *of* and *in* the service.
So in the FormIT methodology there are three basic phases, flow of the iterations: Appreciating Opportunities (AO), Design (D), and Evaluate (E) (Figure 8). These phases are interrelated to each other and they influence each-other as their paths are crossed. The kernel in the middle, illustrates the system that is going to be developed on the basis of this process.

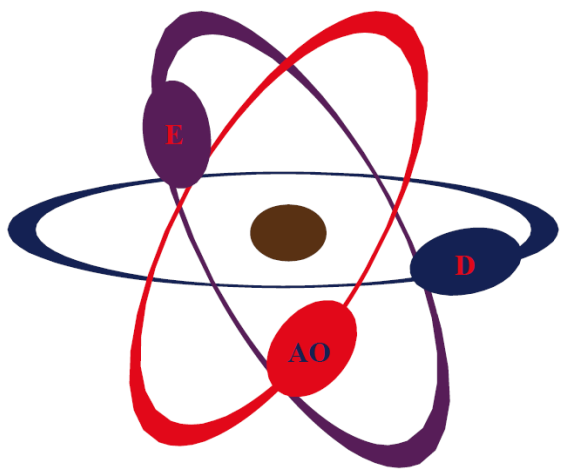


Figure 8: The Basic Shape of FormIT.

The phases shown in Figure 8 are iterated within the three cycles of FormIT methodology.
An important aspect of FormIT methodology is that users can learn from failures, as well as from successes, in fact every result from each evaluation needs to be analyzed in order to understand the evaluation results.
The FormIT is a particular method to support the innovation process, nevertheless nowadays there are many paradigms and models that support the open service innovation and facilitate the inter-organizational process of open innovation.

6..1.2. iLabo

The Interdisciplinary Institute for Broadband Technology (IBBT[2]) is an independent Belgian research institute that provides a Living Lab and uses a step-wise methodology called iLabo[3]. In this methodology the main aspect is the context of application, in fact there is a focus on the technological and socioeconomic context. The phases can be summarized as follows:

- *Contextualization*: after analyzing the technological and socioeconomic contexts, in this phase the users are chosen and clustered in groups;
- *Concretization*: in this phase starting from a measurement, the concept is defined;

[2] IBBT Living lab web site, http://www.ibbt.be/en
[3] iLabo methodology web site, http://www.ibbt.be/en/develop-test/ilab-o

- *Implementation*: in this phase the defined concepts are implemented and tested in the real life context, using a combination of quantitative and qualitative methods;
- In the last phase, after further measurements, the project is improved and commercialized.

Each phase can be iteratively conducted. The iLabo Methodology is shown in Figure 9.

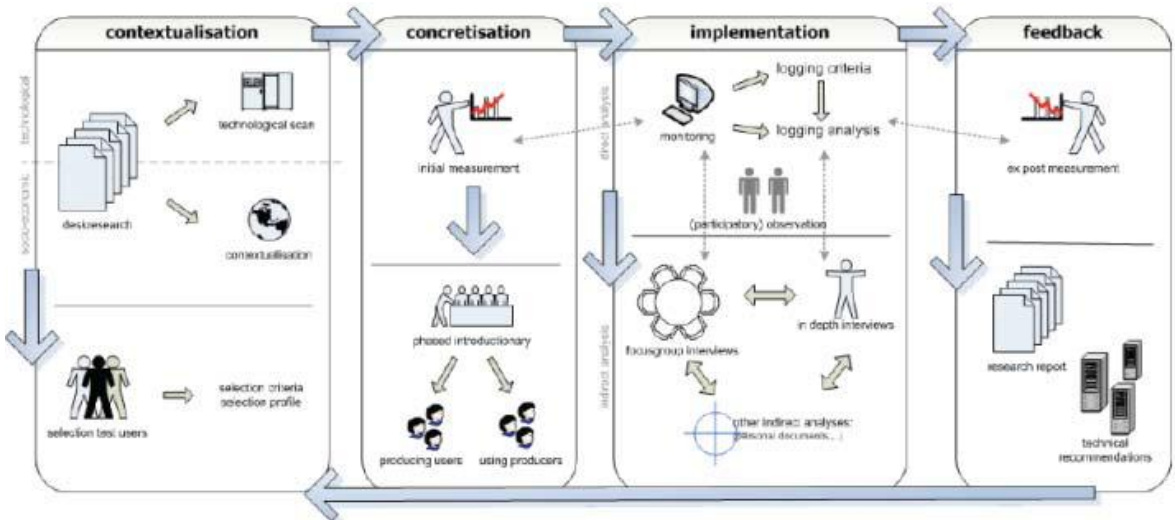


Figure 9 - iLabo methodology

6..1.3. The Catalan Living Lab

In the Catalan Living Lab there's not a formalized living lab methodology, but there are some studies and documents presented in the several conferences and workshops.
Like the previous methodologies, the methodology is divided in different phases and these create a spiral. The difference with the all previous studies is in the implementation in real life environments.
In the first phase a selection of users group is performed, each user has a equal value with respect to the rest of the team and they are very important for this model because they give their contribution to the innovation.
In the second phase they create an "innovation arena", where the project is developed in a free way, without a fixed structure. At the final phase they experiment their results in a real context, by trying to do a sustainable project. Figure 10 shows the Catalan living lab methodology

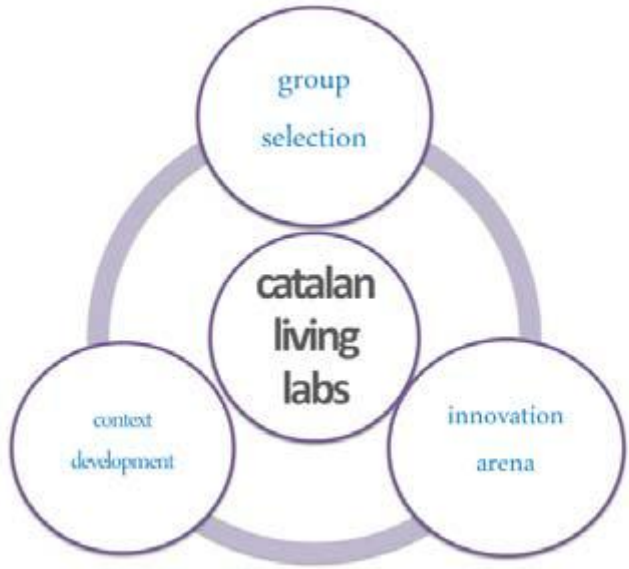


Figure 10 – The Catalan living lab methodology

6..1.4. Enterprise 2.0 paradigm and corresponding models

New technological evolutions (starting from Web 2.0 to Future Internet) allow the migration from vertical and hierarchical organizational forms (Enterprise 1.0) to horizontal ones process oriented, where the collaboration among stakeholders and knowledge sharing play a fundamental role.

The term "*Enterprise 2.0*" was introduced in 2006 by McAfee [McAfee 2006], as *the usage of social platforms inside enterprises or among them and with their partners and customers*.

By this vision, an enterprise becomes a virtual environment where different actors could exchange knowledge, share ideas, plan new business strategies and redesign organizational processes.

The definition provided by Enterprise 2.0 Observatory[4] is significant: Enterprise 2.0 term intends the set of *"technological and organizational approaches that enable new business model based on a wide stakeholder involvement, knowledge sharing and the increase in value of social networks internal and external to an enterprise*".

As stated at the beginning, the vertical and hierarchical structure of Enterprise 1.0 has to be overcome by a horizontal structure, more process oriented than product oriented, where collaboration and knowledge sharing become fundamental. Expertises have to be shared both inside and outside an enterprise, in the attempt to identify innovative solutions able to cover real business needs.

So, from an organizational point of view, by the Enterprise 2.0 vision, the classical boundaries of an enterprise change; an extended working space is created around people (e.g. new communication services, knowledge sharing), breaking company barriers. Standard procedures, linked to bureaucracy, are substituted by new organizational models more flexible and dynamic, that allow to answer to market changes in a more efficient and effective way.

Innovation itself is driven by user (no more by technology), enabling the definition of new solution able to meet user needs.

In this context, an important role is played by technology. Two main categories of enabling technologeis could be identified: Web2.0 technologies and Enterprise Information System (EIS) technologies.

Concerning Web 2.0 approach, McAfee has identified some tools and technologies that have a direct impact on business by the acronym SLATES:

[4] www.osservatori.net

- **S**earch – Discoverability of information drives reuse, leverage and ROI
- **L**inks – Using URIs to forge thousands of deep interconnections between enterprise content 24/7
- **A**uthorship – Ensuring every worker has easy access to Enterprise 2.0 platforms
- **T**ags – Allowing natural, organic, on-the-fly organization of data from every point of view
- **E**xtensions – Extend knowledge by mining patterns and user activity
- **S**ignals – Make information consumption efficient by pushing out challenges

Dion Hinchcliffe [2012] has extended McAfee work by the acronym FLATNESS, including organizational aspects besides technological ones (Figure 11).
The identify elements could be synthesized as:

- **F**reedom – no barriers against the Authorship
- **N**etwork-oriented – connection among different users inside and outside a company
- **S**ocial – strong emphasis on user relationships and sharing
- **E**mergence – spontaneous and bottom up dynamics

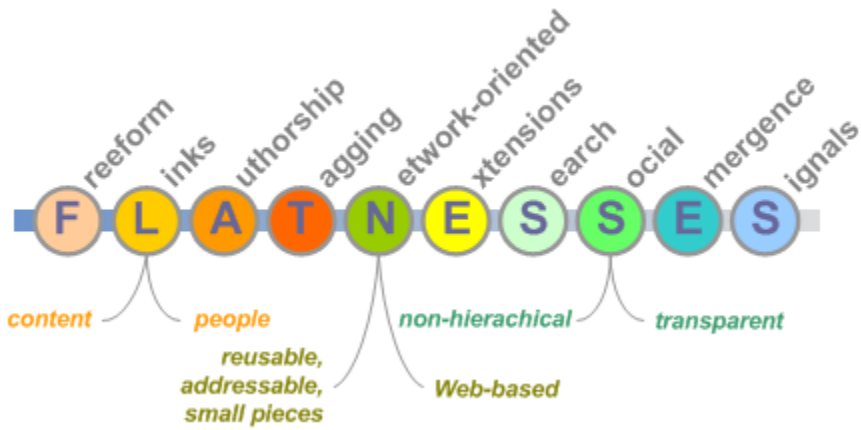


Figure 11: FLATNESS Hinchcliffe Acronym

Following this vision, Enterprise 2.0 should reconfigure their structure as well as their company values and culture.

Models of Enterprise 2.0 are trying to satisfy different needs through the integration of software systems of enterprises with several tools and features of the web 2.0. These needs can be grouped into six main areas, as shown in Figure 12.

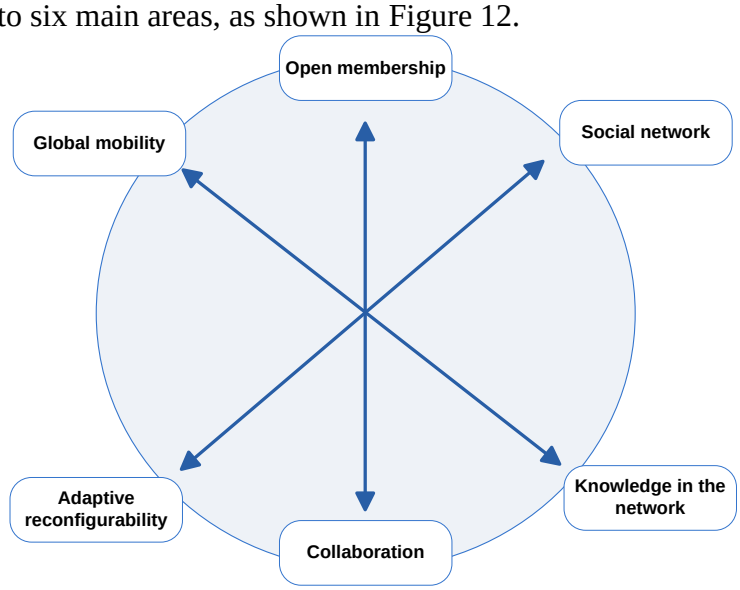


Figure 12 – Needs that can be satisfied by Enterprise 2.0

1. *Open membership*: people that affiliate to an enterprise are increasingly part of a wider dynamic network involving various stakeholders including suppliers, partners, customers of the network;
2. *Social network*: relations are a key asset for the dissemination of knowledge and value co-creation. So, tools that allow enterprises to communicate outside the organization are necessary;
3. *Knowledge in the network:* tools to quickly and easily access to information and knowledge are necessary;
4. *Collaboration*: the sharing of knowledge is an important challenge to deal with business problems of the organization. IT tools for creating collaborative environments enable faster interactions between the actors involved in the exchange of information, and enable to an efficient management of the knowledge and know how;
5. *Adaptive re-configurability*: enterprises need to be flexible in order to respond to changes of the market. This adaptation must be supported by tools that can quickly re-configure their processes and activities;
6. *Global mobility*: the globalization has created a breakdown in the boundaries of enterprises: companies are scattered in different markets and there is the need to connect to their network of tools, information without limits of space and time.

There are three different routes through which an enterprise can arrive at the model of Enterprise 2.0: Social Enterprise, Open Enterprise, and Adaptive Enterprise. The methods are described in the following sections.

6..1.5. Social Enterprise

The main objective of the Social Enterprise paradigm is the creation of new ways for collaboration, knowledge sharing and relationship management. The approach can be supported by the technology, although a cultural change within the enterprises is necessary. In Social Enterprise, the needs that require the evolution of organizations are: emerging collaboration, sharing and management of the knowledge within the network and the development of internal and external social networks.
The social enterprise paradigm can be adopted by using following technologies:

- *Social Network*: A social network is a social structure made up of individuals (or organizations) called “nodes”, which are tied (connected) by one or more specific types of interdependency, such as friendship, kinship, common interest, financial exchange, dislike, sexual relationships, or relationships of beliefs, knowledge or prestige.
- *Blogs:* The term “blog” is a contraction of the words "web" (network) and "log" (track) created by Jorn Barger in December 1997. The main purpose of the blog is the publication of contents on the web performed by a large number of users. Any contents can be commented by visitors of the web site.
- *Wiki*: it is a website whose users can add, modify, or delete the contents via a web browser by using a simplified mark-up language or a rich-text editor. Wikis are typically powered by wiki software and are often co-created by multiple users. Examples include community websites, corporate intranets and knowledge management systems.
- *RSS Feed*: (Really Simple Syndication) is a family of standardized web feed formats used to publish frequently updated works, such as blog entries, news headlines, audio and video files.
- *Tag*: it is an index term assigned to a piece of information.
- *Folksonomy*: it is a system of classification derived from the practice and method of collaboratively creating and managing tags to annotate and categorize contents; this practice is also known as *collaborative tagging*, *social classification*, *social indexing*, and *social tagging*.

- *Tags cloud*: It is a visual depiction of user-generated tags, typically used to describe the content of web sites and the more clicked arguments. Tags are usually single words and are normally listed alphabetically, and the importance of each tag is shown with font size or colour. Thus, it is possible to find a tag alphabetically and by popularity.
- *Social Bookmarking*: it's a method to organize, store, manage and search for bookmarks of resources online. Unlike the file sharing, the resources themselves are not shared, but bookmarks that reference them. Descriptions may be added to these bookmarks in the form of metadata, so users may understand the content of the resource without first needing to download it.

6..1.6. Open Enterprise

With Open Enterprise paradigm the reorganization of enterprise systems allow enterprises to go out their boundaries through a continuous exchange of contents and information, so an open enterprise creates new interactions with customers, suppliers, partners and consultants. In particular, the Open Enterprise models support the effective response to the phenomenon of mobility of people and activities.
The open enterprise paradigm can be adopted by using below technologies:

- *Enterprise Content Management (ECM)* [AIIM 2012]: It is the technology used to capture, manage, store, preserve, and deliver contents and documents related to organizational processes. ECM tools and strategies allow the organization to manage unstructured information, wherever that information exists.
- *Unified Communication & Collaboration (UC)* [Thews 2008]: They are communication and model systems, such as the Unified Messaging (UM), the collaboration, the systems interaction, the real time communication and transactional applications. In other words, UC is the strong version of UM and it includes voice mail, data communication (i.e. email and instant messaging), web conferencing and advanced features for data and voice related to PBX based solutions over Internet Protocol (IP).

These technologies are controllable as software services, or from the customer's existing business application software.

6..1.7. Adaptive Enterprise

In a market oriented towards a global economy, every company is required to adjust its internal processes in order to gain the flexibility and agility in order to respond efficiently market changes. From the IT point of view, the integration of heterogeneous subsystems and business units under a single information system is a strategic activity through which a company can gain a real competitive advantage. In this sense, Adaptive Enterprise focuses on flexibility and re-configurability of the process management of companies, and creates an environment that can change business processes quickly with low cost, in order to respond to changing business needs and customers requirements.
The adaptive enterprise paradigm can be adopted by using below technologies:

- *Business Process Management (BPM)* [Vom Brocke and Rosemann 2010]: Business process management (BPM) is a holistic management approach focused on aligning all aspects of an organization with the needs of clients. It promotes business effectiveness and efficiency while striving for innovation, flexibility, and integration with technology. It is argued that BPM enables organizations to be more efficient, more effective and more capable of changing in respect of a functionally focused, traditional hierarchical management approach.
- *Enterprise Information Portal (EIP)* [Firestone 2003]: It is a framework for integrating information, people and processes across organizational boundaries. EIP provides a secure unified access point, often in the form of a web-based user interface; it is designed to aggregate and personalize information through application-specific

portlets. One hallmark of enterprise portals is the de-centralized content contribution and content management, which keeps the information always updated.

- *SOA Architecture* [Perrey, R.; Lycett 2003]: it is a flexible set of design principles used during the phases of systems development and integration in computing. A system based on SOA will package functionalities as a suite of interoperable services that can be used within other separate systems from several business domains.

6..1.8. Comparison of identified methods and conclusions for MSEE

In Table 1 is analysed if the identified methods could effectively support the different phases of inter-organizational innovation processes.

Phases / Open Innovation Methods	Idea Generation	Research and Development	Prototyping	Manufacturing	Marketing & Sales/ Launch
Living Lab approaches					
• FormIT	X	X	X	X	X
• iLabo	X	X	X	X	X
• Catalan living lab	X	X	X	X	X
Enterprise 2.0	X	X	X	X	X
Social Enterprise	X	X	X	X	
Adaptive Enterprise	X	X			
Open Enterprise	X	X			

Table 1 - Identified methods and how they support innovation processes

For the MSEE context some conclusions can be derived from descriptions and analysis of the different methods:

- An essential aspect is the interaction with partners from outside the enterprise and how this can be promoted and practically handled. The term that is generally used for this is "***open***". The MSEE approach is build on this openness in a Manufacturing Service Ecosystem (MSE), therefore there is a match/compatibility between the methods and MSEE.
- In different approaches for methods it is assumed that there could be a lot of dynamics and emergence in inter-organisational innovation processes. Therefore ***adaptability*** is needed. This applies in particular for MSE, since there is only limited formalisation in the ecosystem and there could be fluctuation of members.
- There is already a sound methodological basis for interactions between different organisations. Typically required interactions are sharing of knowledge and ideas or the exchange of developed content. However, there is no explicit link to servitization processes. Therefore it has to be checked, what adaptations are necessary.

- All methods support the early phases of the innovation process (Ideation and Research & Development). It can be assumed that these phases are in particular relevant for an open innovation approach like in a Manufacturing Service Ecosystem.

Summarised, the recent methods and tools are compatible with the MSEE approach and provides a sound methodological basis that can be adopted and specifically adapted.

6.2. Tools to support Innovation

In this section an approach to select some existing tools to support inter-organizational innovation is presented. The starting point of this study is represented by relevant research projects that were funded by the European Commission: LABORANOVA [www.laboranova.com], ECOLEAD [http://ecolead.vtt.fi], and COIN [www.coin-ip.eu].

The COIN project includes an open, self-adaptive, generic ICT integrated solution to support the Enterprise Interoperability and Enterprise Collaboration, which are essential condition for interactions like described in the chapter above.
The project is based on the concepts of Enterprise Collaboration (EC) and Enterprise Interoperability (EI), that are different but decidedly interdependent and simultaneously in every networks enterprise, in fact the motto of this project is "*Enterprise Interoperability and Enterprise Collaboration are the two sides of the same COIN*".
The technology vision of COIN is based on Saas (Software as a Service) paradigm and ISU (Interoperability Service Utility). The ISU is a generic concept that describes the delivery of IT functionalities as services that support several collaborative business forms, from supply chains to business ecosystems, and becoming like an utility, a commodity, value added services.
In particular in MSEE, open service innovation could be supported by "COIN Enterprise Collaboration" services. Main categories of those services are the following:

- ***Enterprise Collaboration Baseline Services***: support the long and short terms collaboration life cycle.
- ***Collaborative Product Development Services***: they focus on the collaborative new product/service development stage, where open innovation and user participation have an important role.
- ***Collaborative Production Planning Services***: they focus on the collaborative goods production planning stage.
- ***Collaborative Project Management Services:*** they focus on the collaborative project management, in particular on dynamic performance indicators and proactive events management.
- ***Collaborative Human Interaction Services:*** they cover the user interaction with a service platform that focuses on the human collaboration architectures, context-aware interaction and mobile-nomadic usage support.

Following COIN tools are part of above mentioned services:

Name of the tool	Description	State[5]

[5] Listed tools are part of a research project, therefore the openness information of some tools in *prototype state* could be not available (N/A)

Name of the tool	Description	State[5]
C3DDS Collaborative 3D Design Development	It is a web service-based application that allows enterprises the online visualization of 3D models in several formats (obj, dxf, stl, byu, jvd, xyz, etc...). The Collaborative 3D Design functionalities are designed to foster collaborative design process in the following areas, corresponding to different stakeholders of the product development process.	Prototype
C3P Collaborative Production Planning Platform	It is a platform that creates a collaborative production plan and supports collaboration among value-chain actors. Employees of the same company can easily work together on company data and solve internal problems.	Opensource
PPS Production Planning Service	It is a platform that creates a collaborative production plan for small enterprises. Web services can be invoked from everywhere, in order to give the best possibility to interact with every kind of input.	Opensource
cQMS (Collaborative Quality Management Service)	It is a mix of baseline functionalities (partner profiling, product structure) and an innovative algorithm for dependencies in partners competencies in respect of a special network constellation. It allows users to collaboratively perform the quality management	Opensource
COLL4PM (Collaboration for Project Management)	It is a tool to collaboratively perform the project management. It aims to solve the collaboration challenges on project management described in the third bullet of the previous chapter working as an upper layer relying on existing Gantt tools.	Opensource
CVT (Collaboration Visualization Tool)	It is a tool very useful to track and show relations networks and related trust values. It is used for the visualization of the human collaboration network, including COIN users and their discovered relations. Relations may rely on prior joint activities and interactions (communication, coordination, execution).	Prototype
TIS (Trusted Information Sharing)	It is s designed for flexible sharing of business-related information, contextual data, and personal profile based on emerged trust relations from previous collaborations. It allows users to perform knowledge sharing based on trust values	Prototype
TOHS (Trusted Online Help and Support)	It is a tool to perform competences discovery based on trust values. It allows users to dynamically find the right person based on situational awareness; e.g., discovery of and interaction with an expert who can assist to solve emerging problems	Prototype

Table 2 - Tools from COIN Project

LABORANOVA project provides us with several tools, which perform and increase the innovative output of companies and organisations. The table below lists the main tools:

Name of the tool	Description	State[6]
Distributed Feedback	This tool provides a set of widgets (small, lightweight desktop applications) which enable the user to have an overview of all the public ideas submitted and being traded by other users and of the different markets open in IdeM (the Idea Market tool). This tool support open innovation and co-creation	Prototype
Idearium	Idearium is a visual and interactive tool for asynchronous and distributed brainstorming.	Prototype
IDeM	IDeM is a collaborative innovation support environment that uses the market metaphor to provide idea generation mechanisms, feedback and rating, and an aggregation of idea selection.	Prototype
InnoJam	InnoJam is a discussion-based tool that asynchronously connect together thousands of users to set up the ideas.	Prototype
InnoTube	InnoTube is suitable for being deployed in whatever environment where communities are dealing with Innovation.	Prototype
Melodie	Melodie is a tool that allow the collaborative generation of ideas over the internet.	Prototype
ProfileSystem	This System is designed to improve users' ability to profile a user who would be useful to them in creating innovations.	Prototype
refQuest	refQuest is a multi-player online game supporting the idea generation trough the creation of virtual team.	Prototype
Rich Knowledge Meetings	This tool makes easy to have rich meetings even if you are geographical apart.	Prototype
Social and Collaborative Web Search	SCWS allows us to perform collaborative web search.	Prototype
Xpertum	Xpertum is an interactive web-based tool for visualizing social networks, in terms of know-how and people.	Prototype

Table 3 - Tools from LABORANOVA Project

ECOLEAD is an "Integrated Project" co-funded by the European Commission (FP6-IST).

[6] Listed tools are part of a research project, therefore the openness information of some tools in *prototype state* could be not available (N/A)

The main object of ECOLEAD is to establish a solid mechanism to create an advanced collaborative and network-based industry society in Europe.

Tool	Description	State[7]
Dynamic VO creation assistance	It supports the rapid creation of virtual organizations;	Prototype
VO collaboration and performance measurement	It records the collaboration performances of all organization members, so everyone can select always the right organization needed in new VO;	Prototype
Contract negotiation wizard	It allows to quickly define the rights of the new members when they decide to join together in a new VO;	Prototype
VO management e-service	It manages an operating VO in ASP modality with low impact to the single organization ICT structure;	Prototype
Collaborative problem solving support e-services	It improves the profitability and the quality of VBE's members with problem solving processes;	Prototype
Advanced collaboration platform for PVCs	It assists the cooperation and the sharing of know-how of single professional humans and supports the creation of the business arena.	Prototype

Table 4 - Tools from COIN Project

Nevertheless, other tools to support open innovation processes are available [Leitzelman and Trousse 2011]. The following are the more consolidated commercial idea management tools:

- **Accept360™ Idea Management** from Accept Software [www.accept360.com]: this tool helps all stakeholders (enterprise, customers, employees, etc…) to collaborate; in particular it manages customers, employees and partners ideas incl. prioritizing. This product is divided in three main areas: Product scope, People and Constant change.
- **CREAX Innovation Suite 3.1.** from CREAX [www.creaxinnovationsuite.com]**:** it is a tool that drives the enterprise through the innovation process. There are several types of CREAX tools on the market that satisfy specific innovation and problem-solving needs. The most complete suite is Innovation Suite Deluxe, this gives enterprises the access to all innovation tools by combining the full software and other tools and it offers the following forms:
  - Evolutionary Potential
  - Module for Industries
  - Module for Business & Management
  - Perception Mapping
  - Matrix 2003
  - Evaluate
- **CRITflow** from soft4Crit [http://critflow.com]**:** this system allows enterprises to perform collaborative innovation among various groups inside or outside the organization. It is suitable to different workflows. This tool allows enterprises to select the best ideas and keep the best decisions, it is customizable for large companies as well as SME. This tool includes the following functions:
  - Idea generation, voting, improvement, and selection.

[7] Listed tools are part of a research project, therefore the openness information of some tools in *prototype state* could be not available (N/A)

  - Initiative launch and tracking with integration to project portfolio management tools.
  - Campaign and reward management.
- **DataStation** from DataStation [www.datastation.com] : it's a cloud platform that manages the enterprise innovation from new ideas to the launch. This tool allows people:
  - To share ideas within a community;
  - To rank ideas.
  - To classify ideas with tags;
  - Submit the ideas;
  - Select the best ideas;
  - View dashboards and reports;
- **e-Tipi** from myLittleTools [http://beta.e-tipi.com/tipi]: it is a web-based collaborative system, built to offer companies an enterprise-class idea management solution. This tool managed the following processes:
  - Community of Practice (CoP) management.
  - Idea management;.
  - Brainstorming;
  - Innovation management.

  This tool allows enterprises to collect, store and manage the ideas to develop and improve the enterprise ideas.
- **Hype Innovation** from HYPE [www.hypeinnovation.com]**:** This tool starts the innovation process by monitoring and measuring innovations through an adoption or selection pipeline. Selected ideas are subject to detailed review, this process may include several steps of review and stages where stakeholders can build up business cases and compare the concept. The toll offers also an intelligent search tool for defined content.
- **IBM Idea Factory** from IBM [www.ibm.com/smarterplanet/us/en/communication_technology/nextsteps/solution/T077864J57367R46.html]**:** this tool integrates several idea management features, such as wikis, blogs, forums, surveys and communities. This solution enables the creation of a collaborative, interconnected community that allows enterprises to define new ideas for services innovation. The idea can come from internal and external sources, such as partners, customers and other potential collaborators.
- **IDEALYST** from Applied Marketing Science [www.ams-inc.com/npd/idealyst.asp]**:** It is an online brainstorming tool useful to generate new ideas about products and services. They offer also tools for Voice of the Customer Analysis and for Quality Function Defployment.
- **INPAQT Idea Management** from INPAQT [http://www.inpaqt.nl/page/72/inpaqt-idea-management.html]**:** it is a web based tool to capture, structure and control new ideas. This system has a great number of features to help the innovation process. The main features are the following:
  - *Customization*: the possibility to customize the ideas based on levels of difficulty;
  - *Blogs & voting*: the possibility to share and vote for issues and ideas;
  - *E-mail alerts*: Automatic alert sending by using e-mail;
  - *Search engine & tags*: Advanced search features;
  - *Special campaigns*: the possibility to setup campaigns through Idea Management Systems about specific themes;
  - *Authorization*: rights management features about ideas;
  - *Interoperability*: the possibility to interact with well know platforms like Microsoft SharePoint;

- **ID8systems Error! Reference source not found. from** ID8 Systems [www.id8systems.com]**:** It is an idea management system that helps an organization to submit the new ideas. These ideas are organized in a "Virtual Idea Market";
- **Ideas Management Platform 2.0** from ATOS **[**http://pgi2-en.atosorigin.es/node/236]: It is a web platform for idea collection, management and evaluation, supporting the innovation process in companies and organizations. It is built on top of the open innovation paradigm and it uses web 2.0 and social networks technologies in order to improve collaboration among the different stakeholders;
- **Innovation Suite** from Brightidea [http://www.brightidea.com/products-suite.bix]**:** it's a suite end-to-end system-of-record for any kind of innovation initiative. This system is made up of three products:
  - **WebStorm**: it is a community where employee and customers can share their ideas and collaborate to launch innovative ideas, there is also the option to connect related ideas;
  - **Switchboard**: it is a tool that facilitates the managing and the merging of ideas as well as processes for further development;
  - **Pipeline:** it is a social project management tool.
- **Qmarkets Innovation Management solution Error! Reference source not found.** from Qmarkets [www.qmarkets.net]: The solution offers many products to improve the innovation process of enterprises by using the collective intelligence of employees. Qmarkets is designed for medium and large enterprises that want to discover the best ideas. In particular there're two products to manage the ideas: "Enterprise Idea Management", to manage the flow of the creation of new ideas, and "Idea Market" to evaluate a set of new ideas or concepts and choose the ideas with the best potential for the business of enterprises;
- **Sales Force Idea** from Salesforce [http://www.salesforce.com/crm/customer-service-support/ideation]**:** it is a cloud-based innovative tool that enables enterprises and customers to collaborate. Furthermore, social networks analysis features are adopted in order to get new ideas;
- **SimNet 8** from Total Quality Systems Software – TQS [http://www.tqs-sim.com/documents/tqsgen3.pdf]**:** it is an idea management software tool where people can create ideas, collaborate and easily solve problems. This tool includes all types of innovation, i.e. related to manufacturing, new product development, etc.; it is able to generate reports that summarize the key information;
- **Target Idea Management for mySAP** from SAP [http://www.target-soft.com/en/Home/Home.php]**:** this tool is a lightweight idea management software useful to capture ideas in a structured way. It is an add-on of SAP application. So, customers can use their entire existing SAP-infrastructure, without interface issues or data redundancy;
- **Uservoice** from UserVoice [www.uservoice.com]**:** this tool is able to manage feedbacks and questions of customers. This software is composed of three modules:
  - *UserVoice Feedback*: by using this module one can collect and manage user feedbacks;
  - *UserVoice Helpdesk*: by using this module one can collect user issues and requests for support;
  - *UserVoice Full Service*: by using this module one can combine and integrate feedbacks and helpdesk modules.

6..2.1. Comparison of identified tools and conclusions for MSEE

In Table 5 the list of identified tools with respect to the different phases of the Collaborative Interactions in inter-organizational innovation processes (cf. paragraph 3.1.2) is shown.

In the following table the innovation tools are associated with different phases of the inter-organisational innovation processes in order to track, for each tool, its contribution to support inter-organizational innovation processes:

Phases / **Open Innovation Tools**	**Idea Generation**	**Research and Development**	**Prototyping**	**Manufacturing**	**Marketing & Sales/ Launch**
Tools from COIN project					
C3DDS (Collaborative 3D Design Development)	X	X			
C3P (Collaborative Production Planning Platform)	X	X	X		
PPS (Production Planning Service)	X	X			
cQMS (Collaborative Quality Management Service)		X			
COLL4PM (Collaboration for Project Management)		X			
CVT (Collaboration Visualization Tool)		X			
TIS (Trusted Information Sharing)	X	X			
TOHS (Trusted Online Help and Support)		X			
Tools from LABORANOVA project					
Distributed Feedback	X	X			
Idearium	X	X			
IDeM	X	X			
InnoJam	X				
InnoTube	X				
Melodie	X				
ProfileSystem	X				
refQuest	X				
Rich Knowledge Meetings	X				
Social and Collaborative Web Search	X				

Phases / Open Innovation Tools	Idea Generation	Research and Development	Prototyping	Manufacturing	Marketing & Sales/ Launch
Xpertum		X			
Tools from ECOLEAD project					
Dynamic VO creation assistance					X
VO collaboration and performance measurement					X
Contract negotiation wizard					X
VO management e-service					X
Collaborative problem solving support e-services		X	X		
Advanced collaboration platform for PVCs			X	X	
Other commercial tools					
Accept360™ Idea Management	X	X	X		
CREAX Innovation Suite 3.1.	X	X	X		
CRITflow®	X	X	X	X	
DataStation	X	X			
e-Tipi	X	X			
Hype Innovation	X	X			
IBM Idea Factory	X	X	X	X	X
IDEALYST®	X				
Idea Management – INPAQT	X	X			
ID8systems	X	X			
Ideas Management Platform 2.0	X	X	X	X	X
Innovation Suite by Brightidea	X				
Qmarkets	X				
SalesForce Ideas	X				

Phases / Open Innovation Tools	Idea Generation	Research and Development	Prototyping	Manufacturing	Marketing & Sales/ Launch
SimNet 8	X	X			
Target Idea Management for mySAP	X				
Uservoice	X				

Table 5 - Benchmarking of identified tools

From this analysis some conclusions can be drawn for the requirements upon an MSEE Innovation Reference Framework:

- The relations to the members/inhabitants of the ecosystem have to be managed, e.g. identification potential partners and rewarding.
- It is obvious, that there are already many tools available that support collaborative innovation processes. So MSEE can refer to this tools and services and does not have to develop these tools a second time. For the Manufacturing enterprise it could be helpful to get overview over available services and tools.
- Managing collaboration, mainly in the sense of project management (covered by the tools from ECOLEAD and COIN) is an important aspect. The framework should support the innovation- related aspects of this management.
    - Managing agreements and contracts.
    - Inter-organisational Workflows
    - A special task is the identification of potential partners with certain competences.
- Some tools cover the aspect of rewarding. This is a critical aspect in MSE since there are many informal relationships and there is a lot of uncertainty in the early phases of innovation process. Therefore the framework should offer concepts for rewarding under the conditions of MSEs.
- Another important element is decision making. The framework should consider voting and collaborative decisions on ideas and other issues.
- It is obvious, that the main emphasis is put on the early phase of the innovation process, e.g. supporting the generation of ideas and the sharing of ideas. This could also help to determine priorities in the MSEE Framework.
- The ecosystem and corresponding ICT provides very suitable conditions for gathering the Voice of the Customer (VOC).
- The search for content and the exchange of content, in particular ideas, are important challenges in an inter-organisational innovation scenario.

7. Requirements upon MSEE support for Innovation Processes

To determine the requirements upon the Innovation Reference Frame there has to be a defined understanding of innovation in the context of MSEE first. Therefore next sub-chapter describes the basic understanding of innovation that should be used as a foundation for the further considerations. This model is mainly based on elements that were identified during the analysis of the state of the art. Based on the basic innovation model the main requirements upon the Innovation Reference Framework that can be derived from the state of the art analysis will be summarised.

In MSEE it is assume that there is a general demand for an Innovation Reference Framework. (Demand "for something", a demand is not specified in more detail.) The requirements upon the Framework should specify this demand.

7.1. Basic innovation model that is used for MSEE

For MSEE the innovation process is strongly related to servitization. It is assumed that the innovation in a Manufacturing Service Ecosystem (MSE) is based on servitization, that means a combination of manufactured product and product related services. Innovations that are not related to services or innovation processes that do not involve members of the MSE are not considered in MSEE.

There are generally two ways to support innovation in MSEs:

1. Support the provision of conditions for innovations.
   The objective of this approach is to build up, improve and sustain capabilities and a corresponding infrastructure for producing innovation in a MSE. These capabilities are the basis for the innovation performance. Special attention has to be paid to capabilities regarding the interaction with MSE members when it comes to the identification of opportunities for innovation and the generation of corresponding ideas.
2. Support the activities during the phases of an innovation process.
   The objective is to facilitate and support all activities that are specific for innovation processes, in particular activities that are based on interactions between MSE members. (Activities that are also part of the usual daily business are not regarded as innovation specific activities.)

To ensure an effective description of requirements it has to be determined what kind of innovation should be supported in MSEE. As described above, innovations are characterized by the attributes *new, improved* and *beneficial*. Applying this to the MSEE context could provide a more detailed characterization of MSE-specific Service Innovations:

- New:
  - A new combination of an existing product with an existing service.
    Example: Smart TV that combines internet services and TV-sets. Another example is "My Muesli" that applies the concept of ordering individual configured product on the internet to muesli/cereal [www.mymuesli.com].
  - A new service for an existing product.
    The combination could be completely new or there could be an already existing comparable service.
    Example: Würth is a leading supplier for connecting materials. It has provided

customers free of charge with a special barcode scanner (ORSYscan) that supports highly automated reordering service for their materials.

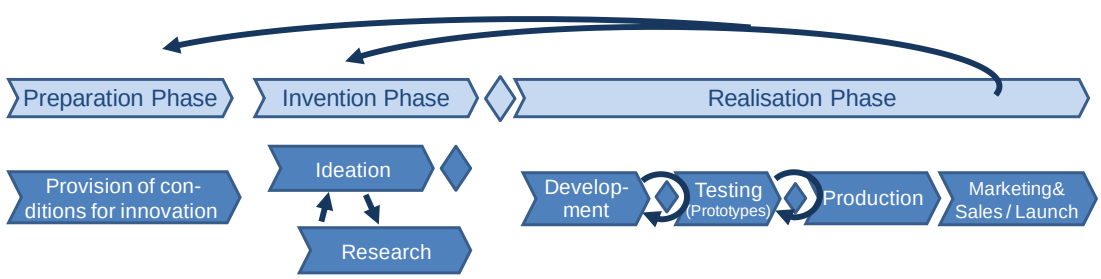
- A new product for an existing service.
  Example: Navigation Systems for cars that were developed based on the available Service of the Gobal Positioning System. Other examples are the communication devices that were developed specifically for the Voice-over-IP-service Skype, like a Skype TV adapter that can be connected to a TV to enable Skype video calls without an extra computer.
- A combination of a new product with a new service.
  Example: Aples iPod and the corresponding iTunes platform to download songs to the IPod. The SAVI solution that provides container tracking services together with the corresponding hardware [www.savi.com].

- Improved:
  - Improved in comparison to the usage of the product without the service.
  - Improved in comparison to the "stand-alone" service without the product.
  - Improved in comparison to an existing product-service-combination.
- Beneficial:
  There are no specific aspects of "beneficial" for innovations based on servitization. However, since the innovation is based on collaboration in the MSE it has to be regarded that it is generally somehow beneficial for all involved members of the Ecosystem.

Since the objectives mentioned are aiming at the conditions for innovations and the activities during the phases of an innovation process it is necessary to describe the underlying process model for these considerations.

For many of approaches that were described above the innovation process ends with the realization of the benefits of an innovation. Usually this means measured success on the market: "From idea to cash" [PWC 2011]. If an invention does not produce such benefits it is not regarded as an innovation.

Based on common elements of the process models analysed above the main phases of innovation processes can be summarised as follows:



This process is not purely sequential but there will be loops according to the obtained results and the experiences that were made (the sequential view in the figure above is just used to provide a better overview). This process will have certain point where decisions have to be taken, like at the gates of the stage gate approach.

These main phases can be applied to MSEE too. However, on the level below these main phases there will be a need to add certain elements that regard the involvement of Manufacturing Service Ecosystems (MSE) and Virtual Manufacturing Enterprises (VME),

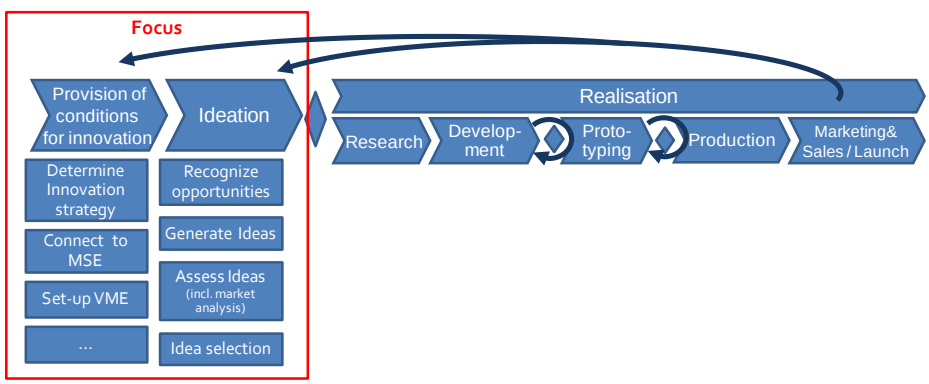
e.g. activities to identify and involve partners or to agree on common objectives and rules for the collaboration.

Although an innovation process comprises all phases from preparation to realisation and marketing & sales WP 21 will focus on the preparation and ideation processes. The reasons for this are:

- Innovations are essentially characterised by the attributes “new” and “improved”. The novelty and the approach for improvement are essentially determined in the ideation phase.
- For innovations based on servitization the core of the innovation is a new combination of physical product and service. This combination is basically defined in the ideation phase. The following phase will work on the development of the physical product and the service but generally not on the combination as such.
- Research and development as well as the subsequent phases are also done for “standard developments” that do not necessarily lead to innovations. They are covered by general reference frameworks like the VRM model. A repetition of these parts of already existing reference frameworks would not provide added value.

This is consistent with the conclusion drawn from the analysis of existing tool to also put special emphasis on the early phases.

The following graphic shows the first draft of the innovation process model that will be used as basis for WP 21.



Important issues for WP 21 are the question when and how the ecosystem is involved and when a Virtual Manufacturing Enterprise set up. The following figure should give a first idea of different options. The figure is just schematic and there will be several other options.

Example 1: „Trigger for ideas“					
Company level		X	X		
MSE-Level	X				
VME-Level				X	X
Example 2: „Elaboration Partner“					
Company level	X			X	X
MSE-Level		X			
VME-Level			X		

For instance, there are generally two options for the idea generation (they work for both technology push or market pull):

1. The Idea was generated in one enterprise and this enterprise involves members of the ecosystem during the further process.
2. The idea was generated through interaction in the ecosystem,
    a) Actively , e.g. in a common meeting brainstorming
    b) During the regular interaction one partner has done something (without the purpose to do so) that has triggered ideas at another partner. For example during the planning of a common marketing campaign a member has mentioned a current development activity that can be servitized by another member.

From these considerations it becomes obvious, that the different types of service innovation and the different types of involving the MSE and the VME are particular challenges that have to be regarding in the Innovation Reference Framework.

7.2. Requirements derived from the state of the art analysis

The previous analysis of existing models, methods, projects and tools were done to derive requirements upon the Reference Framework for Innovation Ecosystems. In this section the conclusions regarding the requirements should be summarised.

General requirements

- Recent research projects and conceptual publications as well as tools on the market have shown the importance of interaction with partners from outside the enterprise. This is described by the term “open”. The MSEE approach is fundamentally aligned to this openness that is represented by the collaboration. The framework has to pay special attention to ***openness***. Therefore the elements of the framework have to regard the aspect of ***collaboration and interaction***. E.g. process description must consider interactions.
- In different approaches for methods it is assumed that there could be a lot of dynamics and emergence in inter-organisational innovation processes. Therefore ***adaptability*** is needed. This applies in particular for MSE, since there is only limited formalisation in the ecosystem and there could be fluctuation of members.
- From the analysis of other innovation related projects it became clear that the framework has to cover different sizes of MSE and VME, different intensities of collaboration, and also different durations. The requirement is ***scalability***.
- Another aspect is, that collaborations on innovation in a MSE are very likely not static but will change over time. Therefore the framework has to be applicable for ***dynamic*** scenarios.
- The framework should generally ensure that all relevant aspects are considered when it comes to planning and controlling of innovative servitization in a MSE. This includes also strategic issues. Furthermore it should help manufacturing enterprises and their partners, in particular members of the MSE, to achieve a common understanding of their innovative servitization activities that represent application cases for the Reference Framework.
- The Reference Framework should make suggestions but leave enough open space for the manufacturing enterprises and their partners to find their own way of doing things.

Ecosystem related requirements

- Although an ecosystem is acting with a low level of formalisation and hierarchy and although this fosters innovation, there is need for managing some innovation-related aspects of the ecosystem. Potential aspects are agreements and contracts, handling of intellectual property, inter-organisational workflows, identification of partners with certain competences.
- The framework should regard the common and complementary objectives of the members of the ecosystem.
- The ecosystem usually does not only consist of the manufacturing enterprise and its suppliers. At least it is necessary involve suppliers of services. Some of them may not have worked with manufacturing companies before. An addition there is the option to involve customers. The roles have to be defined so that the MSE partners can assess their own role and the potential roles of the partners.
- Manufacturing Service Ecosystem provides special conditions to gather information regarding the Voice of the Customer. Therefore the Reference framework should consider this aspect to make sure that this potential is used, e.g. by applying the living lab approach.

Servitization related requirements

- As it was described above there several options to combine physical products and related services to achieve servitization-based innovation. So the concepts of pure physical product innovation and pure service innovation are not sufficient. This MSE-specific aspect has to be covered by the framework.
- Since the ecosystem provides generally good conditions for systemic innovations, this aspect should be regarded in the framework.

Process related requirements

- Almost all analysed methods and many of the tools support the early phases of the innovation process (in particular Ideation). It can be assumed that these phases are in particular relevant for an open innovation approach like in a Manufacturing Service Ecosystem.
- The MSE can be regarded as a condition for innovation. Therefore the provision of these conditions has to be regarded as a specific process and the effectiveness of this process has to be controlled by corresponding indicators.
- The Framework should provide performance indicators that can be used to assess the general capability for servitization-based innovation in a MSE as well as the actual innovation performance in an innovation project.
- Since there is a broad variety for the distribution of activities between the manufacturing enterprise, the MSE and the VME the framework has to regard these different organisational levels. It has to be considered when and in which intensity the ecosystem is involved.

Method and tool related requirements

- One result of analysing different approaches for reference frameworks was that they should help to obtain a better common understanding of an application case, which is mainly achieved by providing concepts for the characterisation and classification of

application cases. This is also relevant for MSEE, in particular when manufacturing enterprises have little or no experiences regarding the concepts of MSE.

- There are already many tools available that support collaborative innovation processes. So MSEE can refer to this tools and services and does not have to develop these tools a second time. For the Manufacturing enterprise it could be helpful to get overview over available services and tools. Important aspects are the generation of ideas and the sharing of ideas. Several existing tools are devoted to this aspect.
- The big number of tools for exchange results of the innovation process (from ideas to design and product data) shows the need for this exchange. To enable this exchange there is a need to have a common basis, in particular standards for communication and exchange of this data.
- Since the ecosystem requires ICT-based interactions due to the distribution of the members of the ecosystem, virtualisation should be considered as a relevant aspect for the elements of the framework.
- For an ecosystem its advantageous to have a platform that brings together members of the ecosystem to collaborate on innovation.
- A particular challenge is the general need for searching content in the MSE.
- A relevant aspect is voting and collaborative decisions on ideas. This has to be covered by concepts for methods.
- Some tools cover the aspect of rewarding. This is a critical aspect in MSE since there are many informal relationships and there is a lot of uncertainty in the early phases of innovation process. Therefore the framework should offer concepts for rewarding under the conditions of MSEs.
- Generally the framework should refer to best and good practices to give support and guidance to the manufacturing enterprise and its partners from the ecosystem.

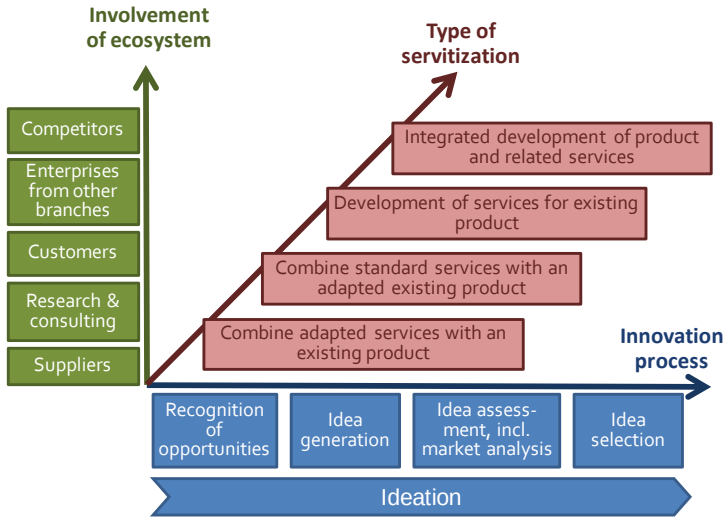
8. Conclusions and next steps

Research has provided a broad state of the art regarding innovation, service innovation and collaboration. Therefore MSEE can make use of a lot of existing concept and tools and things do not have to “re-invented” again. However, innovations based on servitization and innovations in Manufacturing Service Ecosystems have not been investigated extensively yet. The analysis and consideration have shown that there are many specific aspect and requirements in the MSE context and that therefore the gap should be filled. If the framework can contribute to identify and to fill the gaps then this could be a significant support for manufacturing enterprises on their way of servitization.

A major conclusion is that three dimension have an essential impact on innovation and corresponding activities in a MSE. These dimensions are:

- The current phase or step in the innovation process. In this case it has to be regarded that there is no fixed standard sequence but that activities could take place in different sequences and also in parallel.
- The type of servitization based innovation that considers what is new and advantageous on the combination of physical product and service.
- The involvement of different members from the ecosystem.

These dimensions that are depicted in the figure below define the general space for the framework. The subdivision of the axis is provisional and will be verified according to the further consideration on the elements and the structure of the framework.



The next step would be the identification of potential elements of the framework. The requirements from this deliverable will be used to evaluate, which elements should be integrated in the framework.

9. References

Almirall, Esteve; Wareham, Jonathan (2009): Innovation: A question of Fit – The Living Labs approach. ESADE Business School. [5]

Bergvall-Kåreborn, Birgitta; Holst, Marita; Ståhlbröst, Anna (2009): "*Concept Design with a Living Lab Approach*", Proceedings of the 42nd Hawaii International Conference on System Sciences. [8]

Checkland, P.; Scholes, J. (1990): Soft Systems, Methodology in Action. Chichester: John Wiley & Sons. [9]

Chesbrough, H. W.; Teece, D. J. (1996): When is virtual virtuous? Organizing for innovation. Harvard Business Review, 74/1, pp. 65 – 73.

Chesbrough, H. W. (2003): *The Era of Open Innovation*. MIT Sloan Management Review, vol. 44, pp. 35-42,. [1]

Chesbrough, H (2011): "Open Service Innovation - Rethinking your business to grow and compete in a new era". San Fransisco: Jossey-Bass. [2]

Chesbrough, H. (2011): *Bringing Open Innovation to services*. MIT Sloan Management Review, vol 52, 2011. [3]

Goldbrunner, Thomas; Hauser, Richard; List, Georg (2005): The Four Dimensions of Intelligent Innovation – Winning the Race for Profitable Growth. Booz Allen Hamilton, www.boozallen.com.

Haritz, A. (2000): Heterarchische Innovationsnetzwerke: Eine heuristische Konstruktion auf Basis des Systemansatzes. Dissertation. 1st Edition. Wiesbaden, Dt.- Univ.-Verlag, Gabler Verlag.

Hinchcliffe, Dion (2007): The State of Enterprise 2.0. Retrieved from http://www.zdnet.com/blog/hinchcliffe/the-state-of-enterprise-20/143 in March 2012. [12]

Holst, M.; Ståhlbröst, A. (2006): *Enriching the Process of Appreciating Needs with Storytelling*. International, Journal of Technology, Knowledge and Society. [10]

Koehler, Peter T. (2006): ITIL - Das IT-Servicemanagement Framework. Springer, Berlin, Heidelberg.

Kuepper, Claudia (2001): Service Innovation – A review of the state of the art. LMU, University of Muenchen, Institute for Innovation and Technology Management.

Leitzelman, M.; Trousse, B. (2011): *Supporting the Selection of Open Innovation Software Tools*". Proceeding of the17th International Conference on Concurrent Enterprising (ICE). [23]

McAfee, A.P. (2006): *Enterprise 2.0: The Dawn of Emergent Collaboration*. MIT Sloan Management Review Vol. 47, No. 3, pp. 21-28. [11]

McAfee, A.P.(2009): Enterprise2.0 – how a connected workforce innovates. Harvard Business Review, Vol. 87, 12, S. 80

Meyer, Jenny (2009): Does social software support service innovation? ZEW Discussion Papers, No. 09-046, http://hdl.handle.net/10419/28108.

Patnaik, D.; Becker, R. (1999): Needfinding: The Why and How of Uncovering People's Needs. Design Management Journal. [13]

Perrey, R.; Lycett, M. (2003): Service Oriented Architecture. Applications and the Internet Workshops. [19]

Porter, M. (1985): Competitive Advantage: creating and sustaining superior Performance. Free Press, New York. [4]

Scheidweiler, Ingo; Musmacher, Matias (2011): Innovationen im Service - Wie Sie Trends erkennen und im Unternehmen wirtschaftlich umsetzen. Gabler Verlag, Wiesbaden.

Ståhlbröst, Anna (2008): Forming Future IT, The Living Lab Way of User Involvement. Department of Business Administration and Social Sciences, Division of Informatics. [7]

Ståhlbröst, Anna; Bergvall-Kåreborn, Birgitta (2011): Living Labs – Real-World Experiments to Support Open Service Innovation. IIMC International Information Management Corporation. [6]

Toivonen, Marja; Tuominen, Tiina (2009): Emergence of innovations in services. The Service Industries Journal, 29:7, pp. 887-902.

Vom Brocke, J.; Rosemann, M. (2010): Handbook on Business Process Management: Strategic Alignment, Governance, People and Culture. International Handbooks on Information Systems. Berlin-Springer. [18]

Weber, D. (2005): Strategische Planung im Unternehmensnetzwerkam Beispiel industrieller Dienstleistungen im Industrieanlagenbau Elektronikfertigung. Dissertation, Technische Universität. Braunschweig, Shaker Verlag.

Weber, F. (2007): Formale Interaktionsanalyse—Ein Beitrag zur systematischen Gestaltung von Informations—und Kommunikationsstrukturen im Concurrent Enterprise durch die Berücksichtigung von Informationseigenschaften. Universität Bremen.

Examples for Innovation related Indicators

Category 1: Typical indicators for the generally provided input for Innovation Processes.

These PIs can be used to assess if a partner meets the requirements regarding his general attitude towards innovation. Examples are:

- R&D Budget.
- Research Cost Ratio. (% of cost of research in relation to total operating cost. This includes all employees involved in research.)
- Budget for new concepts breakthrough. (Budget allocated the front end innovation to develop new to the world concepts / products.)
- % of senior management time invested in growth innovation.
- % of dedicated resources for radical innovation. (One option it to measure this bases on personal resources calculated as full-time equivalents.)
- % of investment in non-core innovation projects.

Category 2: Typical indicators for the achieved overall output of Innovation Processes.

The indicators in this section can be used to assess how successful a company is regarding innovation. This can also consider relation between provided input, the performance of the innovation processes and the achieved output. Examples are:

- Number of patents.
- Number of products below a certain age (e.g. products or services introduced in the past 3 years).
- Share of new products in the overall profit.
- Innovation revenue per employee (revenues from products or services introduced in the past e.g. 3 years).
- Number of new markets entered in a defined period of time.

Category 3: Typical indicators for the general performance of Innovation Processes.

The processing of the provided input and the activities that produce the desired output are regarded by the indicators in this section. They assess the work of the employees and partners that were and are involved in innovation processes. The considered process starts with the early idea generation (sometimes before a specific innovation project has even started) and result in product launch, marketing and sales. Therefore these PIs can be regarded as an option to assess the “innovation capability” of an organisation. The performance of the innovation process has to be monitored and controlled to ensure that the activities make best use of the provided input and that the objectives regarding the output are achieved. To enable general conclusions the indicators have to regard the sum of on-going and finished projects. Examples are:

- Number of ideas submitted by employees in a defined period of time. Or number of ideas/builds collected.
- Number of ongoing experiments and ventures.

- Number of employees / "Authors" who submitted ideas. Alternatively: Ratio of these employees in relation to the overall number of employees.
- Number of ideas reviewed and concluded.
- Number of Ideas passed through to concept development
- Number of Event Visitors / Contributors
- Average time required from idea conceptualization to go-forward decision.

Category 4: Typical indicators for the input provided for a specific Innovation Processes.

The set of indicators in this category can be mainly derived from category 1, "generally provided input". In contrast to category 1 the indicators in this category are assessed for a particular innovation project. The objective of these indicators is to assess if sufficient or appropriate input is provided to the project and to assess later if the achieved output could justify the provided input.

- Project Budget for a particular R&D project (this can be assessed in relation to the average budget for comparable projects).
- Relation between expected revenues and project budget.
- % of time (in relation to their overall working hours) the members of the innovation team can use for the innovation project.
- Time senior management invests in a particular R&D project.

Category 5: Typical indicators for the performance of specific Innovation Processes.

These indicators provide the basis to assess, monitor and control the actual innovation performance in a particular innovation process. Again, the indicators in this category are linked to the general innovation process performance describe above. Examples are:

- Number of examined customer groups.
- Number of ideas collected.
- Number of employees / partners / "Authors" who submitted ideas.
- % of suppliers engaged in the collaborative design.
- % of ideas from outside.
- Number of Voice of Customer specifications.

Category 6: Typical indicators for the achieved output of specific Innovation Processes.

The analysis of the output of an innovation project is usually done at the end of the project to evaluate if the defined objectives were achieved, what are the reasons for deviations and which "lessons learned" can be identified. These information come usually too late for corrective actions in the corresponding project, however they provide input for the next specific project. Examples are:

- Product Innovation Index (the number of new, innovative, or upgraded product features distinguishable from the previous product).
- Number of patents (or qualitative: has the innovation process produced patents – yes/no).
- Number of Engineering Changes approved for a certain design in a defined period of time. This is an indicator for the quality of the upfront design.

- % of customer requirements addressed as determined during the voice of the customer research at the time of product launch.

Category 7: Typical indicators regarding the provided conditions for Innovation Processes.

The "conditions for innovation processes" can be regarded as a different type of input for innovation processes. These conditions do not necessarily have to be "innovation-specific" rather they should provide a "fertile ground" for innovation processes. They are related to terms like leadership, motivation and momentum. Several of these conditions can only be assessed in a qualitative way. Examples are:

- % of employees that are involved in innovation projects
- % of employees that trained in concepts, methods and tools that can support innovation processes.
- % of employees with target agreements/agreement on objectives that cover the aspect of innovation.
- % of working time the employees could spend for no-core/creative activities.
- Provision of a knowledge management systems (yes/no)?
- Is there cooperation with universities, research institutes etc. (yes/no)?
- % of employees that use/apply the knowledge management tools.
- Is the corporate culture excessively risk averse (yes/no)?