D13.2
KPIs and SLAs for ecosystem governance
M15

Document Owner:	Christian Zanetti, Mohammadreza Heydari, Alessandra Carosi POLIMI
Contributors:	Yves Ducq UniBX1, Mike Freitag FhG-IAO, Ingo Westphal BIBA, Stefan Wiesner BIBA
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DELIVERABLE PEER REVIEW SUMMARY

ID	**Comments**	**Addressed (✔)** **Answered (A)**
1	Add the concept of SLO	✔ SLO explained and linked with SLA
2		
3		

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1. Executive Summary

The main aim of subproject 1 (SP1) is to study the world of frameworks, methodologies and toolsets to provide the methodological and scientific foundations for the application of the service paradigm to European Manufacturing Virtual Factories and Enterprises.

It can be stated that as defined in the DOW, the main point of WP13 is to lay the foundations for a governance framework, creating the condition to share resources between potentially unknown parties, providing methods to measure and defining performances measurements and service level agreement in order to create trust relationship and meet customer needs and priorities.

The main aim of D13.2 is to generate and select the PIs according to a Reference Governance framework which has been identified as a supporting decisional tool to govern MEs, VMEs and MSEs.
Several methods have been identified to create a MSEE governance framework for service: GRAI method (Graph with Results and Activities Interrelated), UGF (Unified Governance Framework) and MDSEA (Model Driven Service engineering Architecture).
GRAI Model and MDSEA Method have been chosen on the based on the decomposition by level of decision and decomposition by abstraction level. On the other side, UGF model, which tries to aid enterprises in implementing consistent governance with a certain focus on the use of ICT and ICT-based services, has been considered too.

In this document a MSEE Governance methodology has been proposed in order to support and define a clear governance framework to be used by End Users. Then, starting from this basis, we study a method to design, implement and classify specific KPIs related to the precise Use case objectives.
In the next updated version of this deliverable specific PIs and SLAs will be created and selected for precise Use cases following the MSEE governance for VME.

In D13.2 also a MSEE PIs method has been identified in order to design, implement and select specific performance indicator.

MSEE PIs method generation needs to be coherent with the previously mentioned MSEE Governance for VME. Therefore ECOGRAI method and VRM (Value Reference Model) have been selected for covering the mentioned requirements.

ECOGRAI has been investigated and discussed in details, thus showing that its decision-based approach properly supports the selection of effective PIs, while aiming at business control and improvement. PIs will be classified at BSM, TIM and TSM level, in order to associate adequate performance indicators at different level of decomposition and aggregation of an organization, while assuring consistency and effectiveness to support the decision making process.

VRM has been chosen as supporting tool for the selection of the main business processes end users have to take into consideration while structuring the governance. In fact VRM is a classical reference model that is providing a catalogue of building blocks for the definition of processes and KPIs. However, VRM has no explicit methodology for selecting a consistent set of KPI that is aligned to the required decisions. At the same time ECOGRAI model has been adopted as a method to cover the gap and the open issues left by VRM. Therefore VRM method and ECOGRAI approach will be integrated in order to provide a more coherent and useful set of PIs. The governance reference model is needed to support the definition of service/use case objectives so to govern the selection of processes from the blocks provided by VRM.

The methodology we have elaborated will be used as a useful method to help enterprise evaluating their service systems and design relevant PIs. Information will be collect and shared among MSE members in order to represents an important strategic tool for MSEE Project.

Data will be shared within the enterprises ICT systems in order to allow a fast and easy exchange of information among MSE members. This will be useful to provide the MSE members with effective solutions for governance.

In the next updated version of this deliverable the mentioned methodology will be tested through end users pilots in order to evaluate the results in real conditions and generate practical assets to be exploited within MSEE Project.

2. Introduction

In this deliverable we focus on the proposition of a new conceptual framework for service governance, on the definition of a MSEE Governance for VME and furthermore, a MSEE PIs method generation to clarify the methodology which will be used by End users in order to create and select PIs within MSEE Project.
D13.2 has to be considered as the second of two, containing the developments of T1.3.1 and T1.3.2 that are going to be released in separately. The former (D13.1) at M6 contains the initial definitions and the framework for the developments of KPIs and SLAs. In fact in D13.1 KPIs and SLAs have been defined and analysed in order to develop a coherent and comprehensive set of performance indicators, aiming at controlling service, servitization process, ecosystem governance and innovation within an ecosystem.
While D13.2, due at M15, is the continuation of the former document, including the developments of the topic and the basis for the implementation in the other tasks of the project.

This work aims at developing measurement systems (PIs and SLAs) in order to:

- To measure actors' performances and to create the conditions for disclosing and sharing resources within an enterprise network;
- To create trust among actors and players based on the value added exchanges into the different processes and enterprises;
- To define end-to-end SLAs with dynamic monitoring and control procedures;
- To manage enterprise's interactions, thus granting adequate distributed governance.

In *chapter three*, a MSEE Governance framework method has been discussed and analysed. Relevant connections between governance and service activities have been highlighted too and finally, a conceptual schema for MSEE Governance framework has been proposed.

In *chapter four*, performance indicators have been introduced and described. The use of PIs within the enterprise environment has been discussed together within the description of several methods which specify how to manage performance measurement in service systems.

In *chapter five*, SLA (Service Lifecycle Assessment) concept has been discussed and well as the role of SLAs within an enterprise environment have been highlighted.

Finally, in *chapter six*, a MSEE PIs generation method has been identified and explained. ECOGRAI method has been selected as the reference model together with VRM in order to design, implement and select PIs for industrial and service organizations.
The selected methods will be integrated together and will follow the objectives identified through the MSEE Governance framework in order to provide a more coherent and useful set of PIs to be exploited and used within the MSEE Project.

3. Definition of a MSEE governance framework method

3.1. Introduction on Servitization Process

An overview of the transition from product to product+service or service as a product, named as servitization process **(**K.D Thoben et al., 2001**)**, is derived from the DOW and is herewith discussed.

First of all, for the companies to survive under nowadays market pressure, it is necessary to provide extended products and an appropriate model to link products, product related services and the needs of the users.

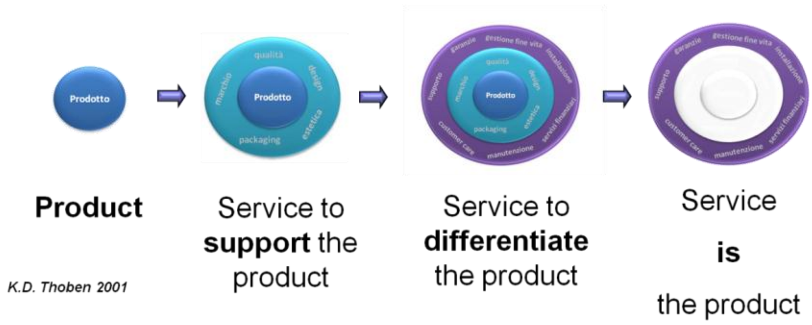

Figure 1 - Product shift to service

A smooth and steady shift is taking place from consumers buying products towards consumers buying solutions and benefits (see figure 1).

Customers and consumers have new and more complex requirements regarding products, therefore the role of additional services and product solutions need to be enhanced.

Both time-to-market and service-product offer leverage to gain sustained competitive advantage.

Finally, by the term *extended product* focus should be drawn on more functionalities than just the core or tangible product; therefore we aim at moving our attention from a tangible product to an intangible shell around the tangible product (i.e. Service as a Product).

The above mentioned transition represents one axe of the diagram only. MSEE has to consider also the transition from the management of a supply chain (planned, strictly controlled) to an ecosystem, where the added value is mainly due to the emergence of unexpected business possibilities (un-planned) and the openness to enterprise members within an appropriate environment.

Figure 2 depicts such transition phases from an OEM company, with its own supply chain, to a product+service configuration (i.e. servitization), to better tackle consumers. The company's ecosystem is still controlled and governed by the enterprise, which cannot take advantage of additional expertise and cross combination offered by other parties. By getting other SMEs involved in an adequate environment, additional services could be provided, thus leading to real service innovation within an open and unplanned ecosystem, where every player might take advantage of cross-functional business opportunities.

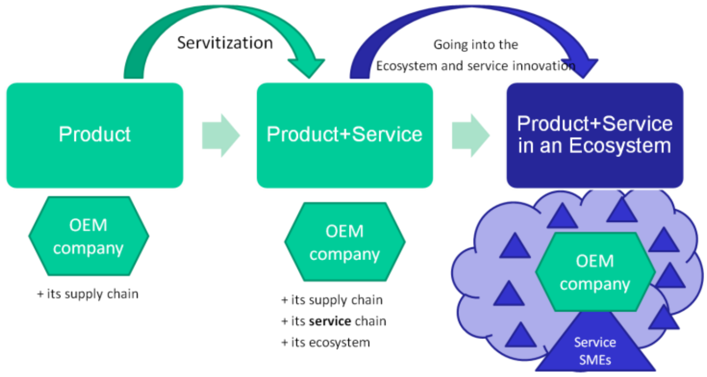

Figure 2 - From PLM to SLM synchronization

As far as SLM is to be reckoned, different service engineering components are to be defined, as described in WP 1.1 to WP 1.3, in order to properly manage the transition within the MSEE. In particular, figure 2 shows service lifecycle phases, ranging from service identification/concept to operation/implementation/decommissioning vs. service components, expressed in terms of modeling (WP1.1), methodology (WP 1.2) and KPIs/SLAs (WP 1.3).

Focus of the current document is to set the path for KPIs and SLAs, necessary to control both effectiveness of servitization and governance of the ecosystem partners.
In this chapter we focus on various issues and concepts concerning governance framework in service ecosystems.
Manufacturing Service Ecosystem (MSEE) needs to be able to measure and control the service system in order to ensure a maximized productivity. The conceptual governance framework will be used as a useful structure to help both Virtual Manufacturing Enterprise (VME) and Service Manufacturing Ecosystem (SME) to evaluate their service systems. Apart from analysing service system, the governance framework will provide, collect and share the results of the controlling activities among MSEE members; it represents an important strategic tool for MSEE Project.
Service governance framework allows regular observation and recording of activities, controlling and measuring actual performances and it presents visualization system which can guide the enterprise on taking corrective actions. The results of the conceptual framework can be then fundamental for decision making.

3.2. Governance: concept definition

Conceptually, governance can be defined as the rule of the rulers, typically within a given set of rules. One might conclude that governance is the *process* – by which authority is conferred on rulers, by which they make the rules, and by which those rules are enforced and modified. Thus, understanding governance requires an identification of the both rulers and the rules, as well as the various processes by which they are selected, defined, and linked together and with the society generally (Establishing a Service Governance Organization Posted by Jean-Jacques Dubray on Oct 12, 2007). The governance can be described as a circle which encompasses cultural, technological, structural, and motivational aspects.

Figure 3- Governance correlations

It is possible to find the major aspects of governance well captured by the following definition made by the OECD (Organization for Economic Cooperation and Development) about corporation governance:

"Corporate governance is the system by which business corporations are directed and controlled. The corporate governance structure specifies the distribution of rights and responsibilities among different participants in the corporation, such as, the board, managers, shareholders and other stakeholders, and spells out the rules and procedures for making decisions on corporate affairs. By doing this, it also provides the structure through which the company objectives are set, and the means of attaining those objectives and monitoring performance." (IBM's Unified Governance Framework (UGF) Initiative Birgit, Pfitzmann,CalvinPowers,MichaelWaidner, 10/12/2007)

Governance has become a huge topic in service enterprises. Key drivers are increasing regulatory pressure, there is a need for better service management, and the desire of enterprises to monitor and influence their service performance accelerates.
Service performance in current commercial competitions and fast-changing environments also requires new governance structures. Most existing enterprise governance structures are actually geared towards business performance. This concerns aspects like strategy-making, planning, measurement of execution, and reward systems. Classically, most of this governance is done manually and at significant time intervals. Meanwhile, in service performance governance there is a huge amount of information which needs to be purified and then classified regarding enterprise objectives and goals. Hence, developing an IT infrastructure is one of the major issues which are affecting the current service governance process and redesign.
Furthermore, it can be stated that one of the main aims of governance framework is to define clear boundaries among ecosystem members from a top-down and a bottom to up perspective in order to identify systematic correlations among members in monitoring service performances.

Service governance relationship to other governance activities

Service performance governance is a new type of governance as part of the broader IT governance activities lead by Enterprise Architecture groups. IT governance should remain in control of the SOA (Service Oriented Architecture) platform governance itself, while Service

Governance should focus its activities on designing, developing and implementing service functions for reuse at the Enterprise, Service Realization and Solution delivery levels (see the figure below). At the enterprise level, Service Governance should work closely with IT governance to support service management functions based on a top-down analysis and establish a roadmap for the deployment of these services. The service level is where most of the activities of Service governance take place. All of these activities are supported by a Registry and a Repository. At the solution level, the Service Governance organization should evaluate and direct the level of compliance with respect to Service infrastructure and service guidelines.

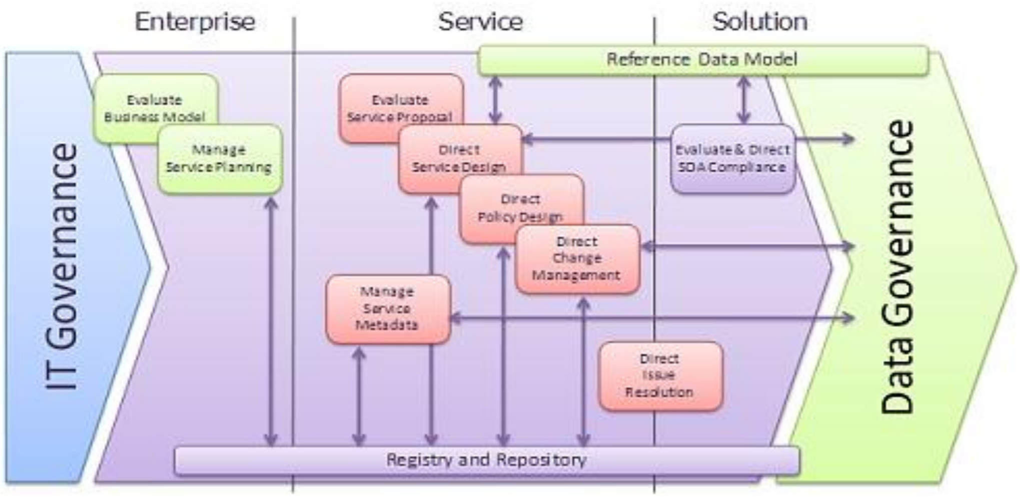

Figure 4 - Service Oriented Architecture governance and other governance activities

Service performance governance is an essential aspect of a successful Service Oriented Architecture. Its establishment has to be planned and tested out early in the initial phases of a SOA initiative. However, a full scale governance organization driven by a rigorous process should be launched only when the service pipeline is big enough to keep the team motivated and knowledgeable. If governance activities are too distant in time, the team might lose interest and the critical knowledge to execute its activities properly. The Registry & Repository is a key ingredient for successful governance as it manages the "service record". The ultimate goal of Service Governance is to enable the specification, realization and operation of reusable IT assets. Overtime it is expected that Service Governance will evolve towards being a lot more proactive in commissioning the implementation of mission critical services.

3.3. Unified Governance Framework

As already mentioned, governance has become a huge topic in the business world. A good starting point for elaborating a governance framework can be borrowed from Unified Governance Framework (UGF) **(**Birgit Pfitzmann, “IBMs Unified Governance Framework (UGF) initiative”, December 2007) and GRAI conceptual reference model explanation.

On one hand, UGF is intended to cover the entire space of enterprise governance, the core parts of UGF are a component model and a lifecycle and the major characteristic of this model is that the component model is structured in layers.

On the other hand, GRAI conceptual reference model is a recursive structure which allows representing with the same concepts, the global and the local models of a manufacturing system of an enterprise. The interest of a conceptual model is the possibility to relate the various concepts in order to show their coherence, to avoid redundancies and to have a complete modeling of the enterprise objectives.

Generally six functions are taken into account in GRAI model for typical enterprises: to manage commercial, to manage design, to manage development, to manage production, to manage assembling, and to manage delivery (G. Doumeingts, Y. Ducq, Enterprise modeling techniques to improve efficiency of enterprises, International Journal of Production Planing & Control, 2001, Vol. 12. N°2, 146-163).

In this chapter we try to explain both UGF & GRAI models and their related components by highlighting their advantages and synthesizing their main issues.

By synthesizing UGF model and GRAI model, in next paragraphs we will try to make a hierarchical decomposition to facilitate the integration between decisional levels and between functions.

UGF Component Model

IBMs Unified Governance Framework (UGF) is intended to cover the entire space of enterprise governance, with a focus on how IT-related services and components can support governance. The main governance types which are highlighted by IBM can be referred to:

- Corporate Governance;

- Enterprise Governance;

- IT Governance.

IBM Unified Governance Framework (UGF) goal is to aid enterprises in implementing consistent enterprise governance, with a certain focus on the use of IT and IT-based services to achieve enterprise governance. The main purpose and novelty of UGF is to serve as a framework also for the governance-enabling technology for the overall enterprise governance space.

In UGF, The inner three layers are those of an enterprise, while the outer (red) layers represent the Environment. A component model is a grouping of related functions and capabilities into components that communicate over relatively well-defined interfaces. A component can contain organizational structures, processes, people, and technology.

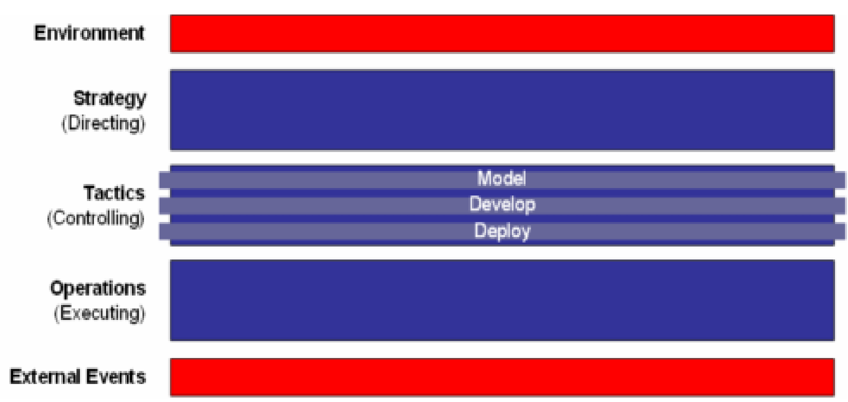

Figure 5 - UGF layers

The core parts of UGF are a component model and a lifecycle. The component model is structured in layers. A component can contain organizational, structures, processes, people, and technology. The specific purpose of UGF is to focus on enterprise governance, i.e. to distinguish and describe governance components in more depth than the rest of the enterprise.

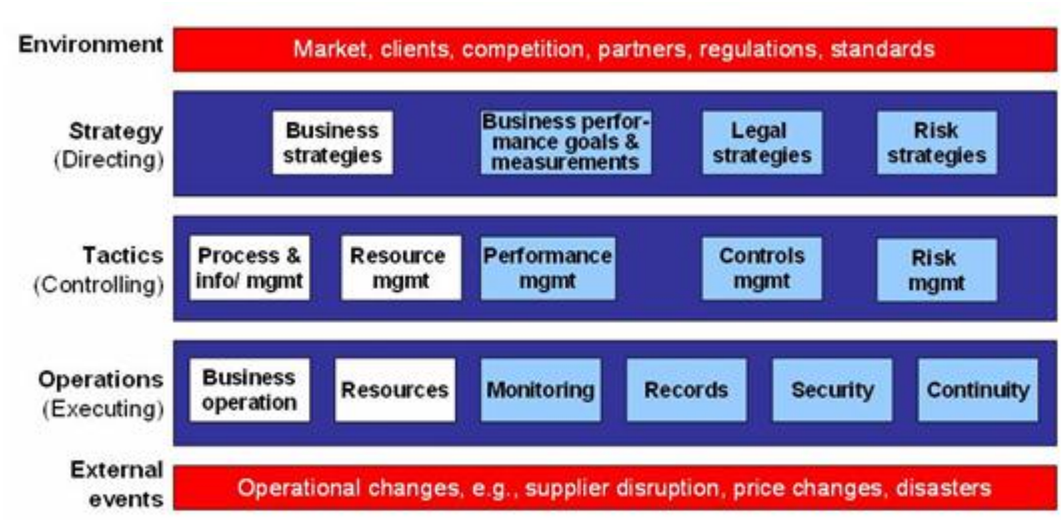

Figure 6- UGF component model

From the above figure it is possible to analyze the UGF component model: the light blue components (on the right) are specific to governance; the white components summarize the normal enterprise activities being governed.

Three specific layers are described on the UGF model: Strategy, Tactical and Operational layers, they may be referred to the business service management as well as to the organization as a whole.

It should be stated that the MDSEA method which is explained in previous pages has the same classification for decisions.

On the strategy layer, the normal enterprise capabilities are summarized. On the tactical layer, the normal enterprise capabilities are defined in terms of process and information management and resource management. On the operations layer, the normal enterprise capabilities are evaluated in a similar way and they are based on day-to-day tasks.
UGF sheds light on the domain of KPIs which are classified in three decomposition layers (Strategy, Tactical and Operational) by creating the link among main layer components. For instance, the business strategy component contains the standard elements of business strategies (see figure below). The first important elements are a stable company mission and the long-term culture and values of the enterprise; they are informal but cannot be changed very often.

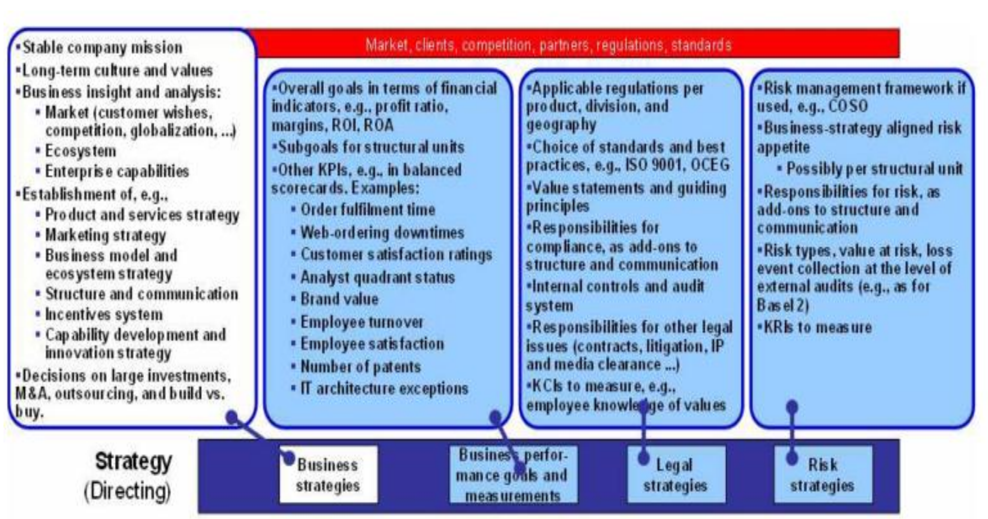

Figure 7 - Strategy layer components

Example of a Drill-Down Monitoring Infrastructure

In this section, we use the monitoring component as an example of how it is possible to drill down into the UGF model. Just IT-based monitoring will be considered now. The level of detail is such that one can start identifying actual service interfaces and options for technical synergies. In the figure below the monitoring component are represented on the right while the components of "business operation" and "resources" on the left. It is arranged vertically just for a clear layout reason.

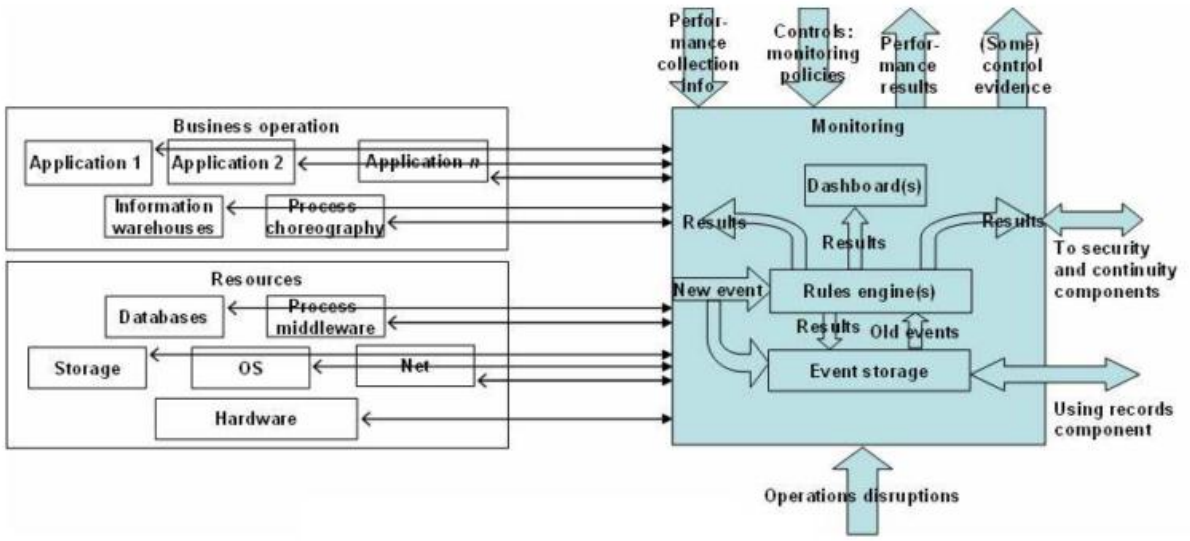

Figure 8 - Drill-Down Monitoring Infrastructure

The monitoring component may receive events from all the other components, here exemplified with typical subcomponents of the business operation and resources components. The normal components need adapters for this. Logically the adapters also belong to the monitoring infrastructure, in particular if they are configurable. Technically, the adapters are typically event interfaces or extensions of log interfaces; for networks they may also be separate sniffers or gateways. The events monitored at a component include the component's "own" events and events belonging to higher components. For instance, on the arrow from the subcomponent "Net", there are network management events as well as sent and received messages that logically belong to certain applications. Finally, there may be directly sensed events from the external environment on the arrow "operations disruptions", i.e., coming in via smoke sensors.

In the core monitoring infrastructure, the events are handled by rules engines, from very efficient simple filters to complex analytics engines. In addition, either all events may be stored or only those fulfilling certain rules. The event storage may use the records component, in particular if retention requirements exist for certain events. Stored events may be reused by rules engines.

Results of a rules engine can be shown on a dashboard in the monitoring component; most rules engines offer at least a simple dashboard. However, monitoring results are also used by many other components. In particular, they are the main contributions to the upward arrow "performance results"; the rules (policies, settings) for what results are reported come from the downward arrow "performance collection information". Monitoring results also contribute to the arrow "control evidence", based on controls that have been implemented as monitoring. Furthermore, the security and continuity components rely on monitoring; hence there are also rules that recognize security and continuity events. Finally, there may be feedback from monitoring to subcomponents of the components business operation and resources, although this is less usual at present.

The benefit of investigating monitoring as such a technology-neutral structure is that one can use this structure to classify individual products and components and to achieve synergies. One opportunity for synergies is that several rules engines share the same event adapters on the various applications, middleware components, etc. Common event stores are another opportunity. Furthermore, one can study whether analysing for different types of outputs, i.e. performance results, security events, and continuity events, needs separate rules engines or only different rules in the same engine.

3.4. Service Modeling by decomposition methods

In this section we are going to highlight two different models on the basis of decomposition: decomposition by level of decision and decomposition by abstraction level. First of all the hierarchical decomposition of the GRAI model within different levels of decision (Strategic, Tactical and operational) will be explained. Finally, MDSEA method which defines a framework for service modelling structured around three abstraction levels (BSM, TIM and TSM) will be taken into consideration.

GRAI (Graph with Results and Activities Interrelated) conceptual model

GRAI model objective is related to give a reference conceptual structure of the production system of any manufacturing or service firm or of any organization. Furthermore it defines the basic concepts that will be used during an application of the method, and their interrelationships.
The GRAI conceptual reference model is a recursive structure which allows representing with the same concepts, the global and the detailed models of a manufacturing system within an enterprise. In fact, the GRAI model defines the various concepts that will be represented in the GRAI graphical formalisms.

The GRAI Method is composed of three main building blocks. The first one is the reference model, called GRAI model, which is a consistent set of concepts that model any production system. Then it is generic and a priori, that means that it is independent of the case upon which the method is applied. The second one is concerned by graphical modelling languages that enable to instantiate the concepts of the GRAI model to build the specific model of the studied case. Finally, the third one is a structured and participative approach within which actors and steps are defined. The purpose of such an approach is to act as effective as possible and then to save time.

It should be emphasized at this point that, GRAI method has various domains of applications in which the following points can be observed:

- Production systems engineering;
- Choice and implementation of software packages for management: ERP (Enterprise Resources Planning), SCM (Supply Chain Management), CRM (Customer Relationship Management) or other computerized solutions (decisional, etc…);
- Choice and implementation of performance indicators systems;
- Development and implementation of industrial strategies;
- Support to quality approaches;
- Knowledge Management.

GRAI model is composed by three principles:

- The first principle is the control of the system (based on the information which is received by customers or materials);
- The second principle is the decomposition of the control system in two sub-systems: the decision and the information sub-system;
- The third principle is the decomposition of the decision sub-system according to two criteria, i.e. temporal and functional.

The control of the Physical system is the result of decisions taken according to various functions (to manage sales, to manage design, to manage engineering, to manage manufacturing, to manage delivery…). The decisions have various natures: strategic at long term (define the objectives), tactical at medium term (define plan the resources) and operational at short term (to perform the actions). This Grid is called the "Functional Grid". At the cross of a function and a level of decision a decision center is identified (shown in the Figure below).
The decomposition principles are based on the "Hierarchical System Theory" of Mesarovic which decentralizes the decision-making, keeping coordination in order to reach the objectives of the enterprise. This decomposition is called "Hierarchical decomposition" or "Temporal decomposition" because each level is determined by a time horizon of decision.

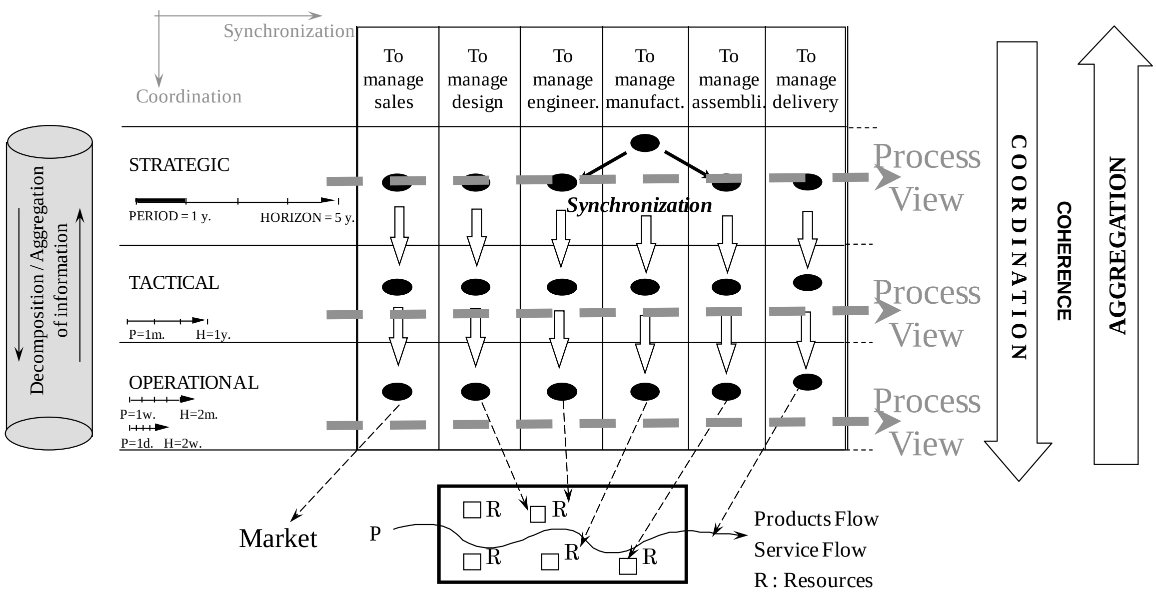

Figure 9 - The hierarchical or temporal decomposition of the Decision System

The principles of GRAI approach allow to represent and to study the system at the global level and at the detailed level (it is the case at the level of System of Systems and at the level of System). The fact to describe explicitly the control system (Decision plus Information) determines the elements which allow reaching the objectives.

There are several components in decision levels, they also enable to define what a decision is. We can say that to decide, it is necessary to know:

- What the expected performances of this decision are. These are called "objectives".
- What elements which one can play on are. These elements are called "decision variables" or "action variables".
- What the limits of the potentiality of the decision variables are. These limits are called " constraints".

- What the result of the previous decisions are, in term of performance. These levels of existing performance are called “performance indicators”.

Optionally, we can have also a support to choose among possible actions that are called “criteria”.

All the elements which have been right described in the decision components constitute the decision framework. This decision framework is fundamentally different from the main piece of information to be processed. This piece of information is qualified of order. The decision framework describes the context in which the decision must be made and leads to different decisions for different context. At this level, it is necessary to define what a decision framework and an order are.

GRAI method needs to decompose the functions in order to facilitate the integration among the actors. Decomposition of the functions split up into axis.

The first axis is related to the structure of the control system starting from a free division of the VME or MSE for decomposition:

- Traditional functions (commercial, design, industrialization, manufacturing, delivery...);
- The functions can change according to the Service Life Cycle phase or the VME creation, operation and decommission phases. The functions can change according to the Service Life Cycle phase and then the VME which is considered.

The second axis is related to a systemic decomposition. An activity, whatever its nature, may be characterized thanks to a typology coming from systems theory. Here, an activity is considered as a process transforming processed objects (that are inputs) into other processed objects (that are outputs). The process can run by the use of a processor as shown in figure below.

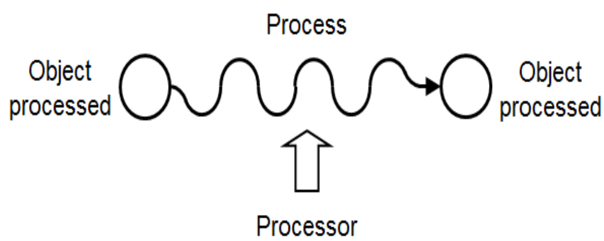

Figure 10 - Activity control

The controlled system (that may be called physical or operating system) transforms inputs into outputs. Applied to a manufacturing system, inputs are raw materials and outputs are finished products. The control system aims at getting an expected behaviour of the controlled system. In order to do so, the control system requests actions from the controlled system. Within this framework, it must match the overall objectives of the organization and response to external information (orders for example).

Furthermore, it must get follow up information from the controlled system. This is the feedback in automatic control. Because the behaviour of the controlled system is generally ill-modelled, this feed-back is very important.

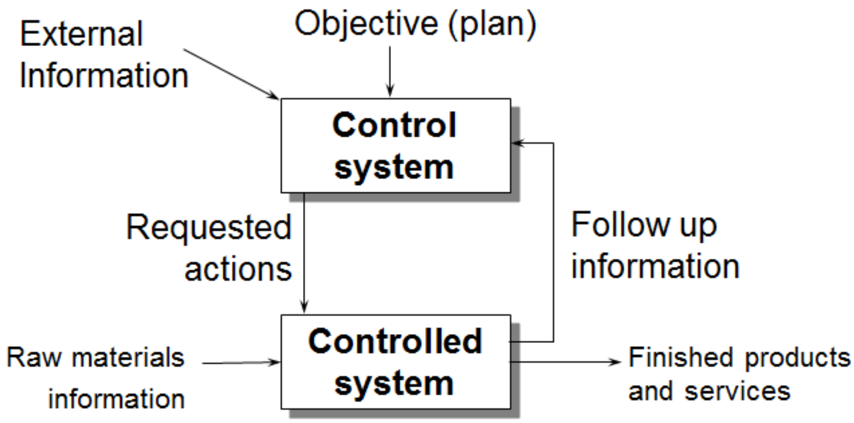

Figure 11 - Physical system or operating system

On the basis of this typology, we can define the elementary concepts of a production activity. That may be considered as the minimal model of a production activity. Processed products are here called products; the process is called activity and the processor resource. It must be noticed that product and resource have an existence by them. Conversely, an activity has no physical existence and then can be considered as the convergence of product and resource. That is why the product notion is simplified into “P”, resource into “R” and activity as a Cartesian product “PxR”.

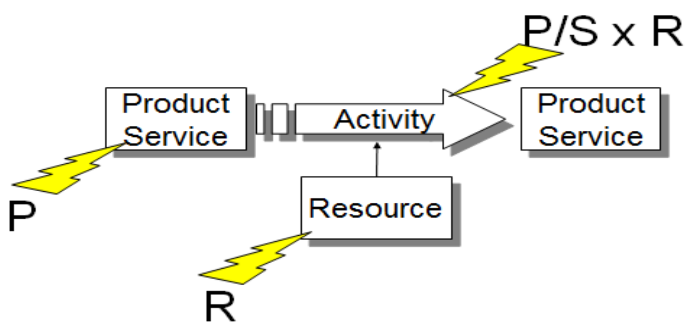

Figure 12 - Production activity

In the production activity the control schema, which is shown in figure below, some basic concepts are used and need to be explained. These basic concepts are defined as follow:

- Products are managed by an activity called “Product Management”;
- Resources are managed by an activity called “Resource Management”;
- Activities are managed by an activity called “Activity Management”. However, because activities have no physical existence, Activity Management does not act directly but through Product Management and Resource Management.

Furthermore, management must be understood along time. Then, Product Management is simplified into PxR, Resource Management into RxT and Activity Management into PxRxT. Finally, Activity Management generally corresponds to planning in companies (figure below).

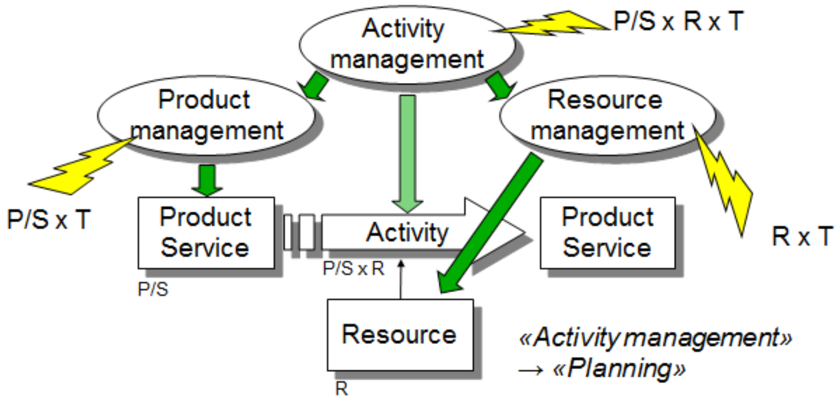

Figure 13 - Production control

3.5. GRAI (Graph with Results and Activities Interrelated) conceptual model

In this chapter we try to provide a short description of the GRAI tools (the grid and the nets) used in the GRAI method.

The GRAI grid takes up the hierarchical and functional approach. It allows identifying the set of decision centres of the studied system, as well as their links. Whereas the purpose of the GRAI model is to be generic, the GRAI grid aims at the modeling of a real case. The concepts presented by the GRAI model are implemented by the GRAI grid in order to get a specific model.

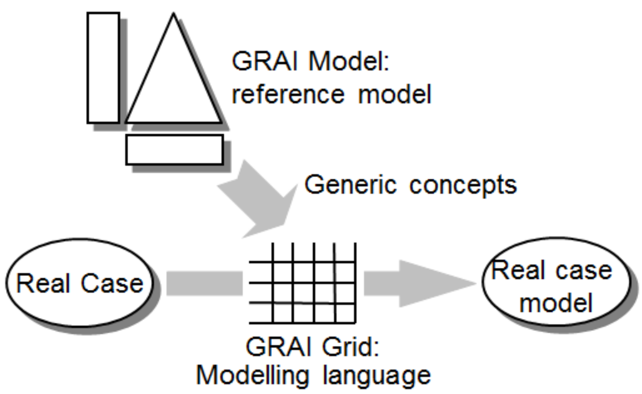

Figure 14 - GRAI GRID modeling language

The GRAI grid is presented in the form of a matrix with:

- The managerial axis or control axis which represents the various levels of decision which can be found in the organisation. Traditionally, this axis is decomposed hierarchically in several levels, according to the nature of the decisions: strategic, tactical, and operational levels.
- The functional axis which describes the various activities required to the product life cycle. However, in MSEE this axis can be adapted to service life cycle without any problem. It is decomposed into several functions which group a set of activities having

a same identified finality (Engineering, Manufacturing, Quality, Maintenance, and Delivery, Recycling...).

Each function of this axis is decomposed into: manage the products/service (internal or external, it means supplying and purchasing), to manage the resources (human or technical) and to plan (to synchronize at each level product and resource management).

Two columns are added to the functions, one on each extremity of the grid. They concern: the external information (exchanges with the environment of the production system, primarily commercial information), and next one is the internal information (exchanges with the physical system, primarily information of follow up).

A decision centre is defined crossing a function with a decision level. The GRAI nets are aiming at describing in details all the activities identified inside each decision centres of the GRAI grid. It should be emphasized at this point that they are two types of relationships between decision centers in a GRAI grid:

- Decision frameworks, symbolized by a double arrow;
- Information flow, represented by a simple arrow.
-

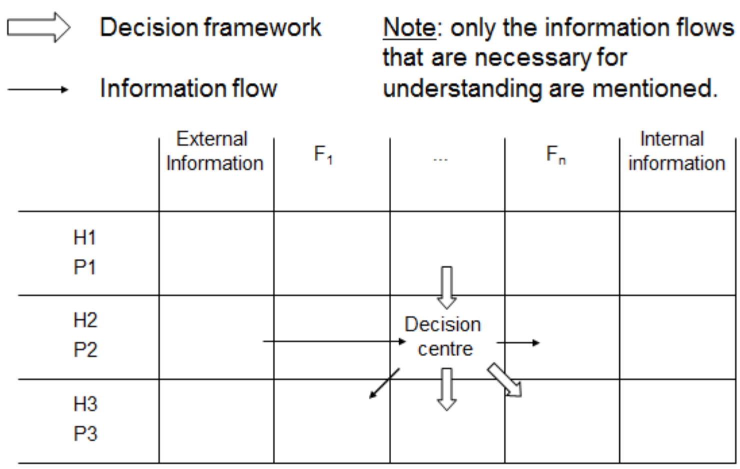

Figure 15 - Decision framework and information flow

3.6. The Model Driven Service Engineering Architecture (MDSEA) and its decomposition levels

Inspired by MDA/MDI (Model Driven Architecture/Model Driven Interoperability), the proposed MDSEA, which has been developed within MSEE Project, defines a framework for service system modelled around three levels of abstraction (see also Deliverable D11.1).

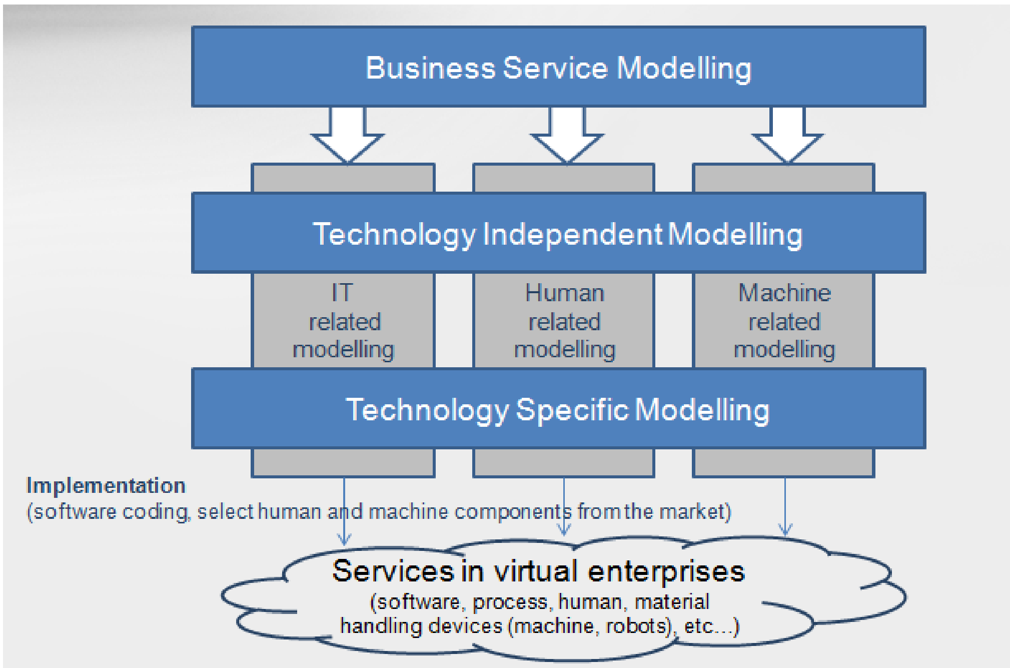

Figure 16 - MDSE Architecture

The three abstraction levels are explained here below:

- Business Service Modelling (BSM). This specifies the models at the global level describing the running of the enterprise or set of enterprises as well as the links between these enterprises. BSM level focuses on the representation of the service (and its functionalities) and the service system in virtual enterprise, capturing information on its related product, customer and service KPIs and values. The models at the BSM level must be independent from the future technologies that will be used for the various resources. In this sense, it's useful, not only as an aid to understand a problem, but also it plays an important role in bridging the gap between domain experts and the development experts that will build the service system. In fact the BSM level has been divided into two sub-levels: the Top BSM and the Bottom BSM. The Top BSM sub level models the enterprise and its environment at a global level in order to analyse the possibilities to develop the System Service; while the Bottom BSM will allow to model in detail each issue that is directly affected by the development of the Services System. Based on this first analysis, the service system will be decomposed in the various components (IT, Organisation/Human and Physical Means). For example at Bottom BSM level we will describe in details the model of the IT domain, or the model of the Organisation/Human component, or the model of the Physical means.
- Technology Independent Modelling (TIM). This corresponds to the models lying at a second level of abstraction, independent from the technology used to implement the system. It gives detailed specifications of the structure and functionality of the service system that do not propose technological details. More concretely, it focuses on the operation details while hiding specific details of any particular technology in order to

be suitable for use with several different technologies. At TIM level, the detailed specification will be elaborated with respect to IT, organization / Human and Physical Means for service system.

- Technology Specific Modelling (TSM). This combines the specification in the TIM model with details that specify how the system uses a particular type of technology (such as for example IT platform, Machine technology Organisation structure or Human profile). At TSM level, modeling and specifications must provide sufficient details to allow developing or buying software/hardware components, implementing specific Organization, recruiting human operators / managers or establishing internal training plans, buying and realizing machine devices, for supporting and delivering services in interaction with customers. For instance for IT component, a TSM adds to the TIM, technological details and implementation constructs that are available in a specific implementation platform, including middleware, operating systems and programming languages (e.g. Java, C++, EJB, CORBA, XML, Web Services, etc).

3.7. Conceptual schema for MSEE Governance framework (proposition)

As mentioned in DOW the purpose of WP13 is to lay down the foundation of governance framework, by using the world of frameworks, methodologies and tool boxes which can support various levels of performance indicators in service ecosystem. So, referring to deliverable 13.1 contexts there are three relevant models for enterprise activity classification.
In this paragraph we present a proposition of a conceptual schema of MSEE reference governance framework in which GRAI and MDSEA models have been synthetized with UGF model in order to create a conceptual reference framework for governance within MSEE Project.
The classification is based on decomposition: decomposition by level of abstraction, i.e. Model Driven Service Engineering Architecture (MDSEA) and decomposition by level of decision, i.e. GRAI. GRAI model is generated by university of Boudreaux 1 to enable a complete model of the enterprise from a structural and a running point of view.
Another useful model we can use for service system governance is Unified Governance Framework (UGF) which is generated by IBM. This model focus on how IT-related components can support service governance and it is composed by three decision levels: Strategic, Tactical and Operational.
Finally, refer to the UGF model's core components and regarding GRAI decomposition model by level of decisions, it should be emphasized that by synthesizing both mentioned models a new service governance framework has been generated in this deliverable.
MSEE reference Governance framework will be developed to support service ecosystem in order to comply the following items:

- Assess the service performances;
- Manage the efficiency in the use of resources;
- Identifying problems and finding solutions;
- Improve revenues due to a better service offer;
- To develop services by standardizing service development processes and preventing the repetitions of past mistakes;
- To support the service performance assessment to monitor performances, prevent error causing and redundancy or duplication of work among the main actors of service ecosystem;
- Facilitate the Integration between decisional levels & between functions.

The mentioned framework can have a strong strategic role inside the MSEE Project because it represents a clear and open structure to share knowledge and resources among the partners inside the ecosystem and the configuration of the VMEs. Therefore the framework needs to integrate within the MSE platform so to support service management, exchange and evaluation within the manufacturing networks. The framework will be used as a supporting toolset to generate specific KPIs related to end users or VME core activities.

By using the relevant KPIs and PIs the following points can be observed:

- Adequate measures for effectiveness, efficiency, productivity and flexibility can be assessed in order to offer a satisfactory service system;
- The framework can improve the efficiency of the service system by measuring the ability of firm to reach the main goals within the MSE/VME perspectives;

Service management needs to be able to control all the issues involved within the service system in order to ensure a maximized productivity.
Relevant methods, which are useful to generate and control service governance, have been studied in this chapter. We generated a MSEE reference governance framework to facilitate the control of the whole service system.

All the requirements need to be specified into the three level of decomposition (strategic, tactical and operational) on the basis of the MDSE Architecture in order to classify quantity and quality PIs inside one unique model.
Relevant PIs and KPIs can be then generated on the basis of the requirements identified inside the MSEE reference governance framework.
They can be presented in three levels, as following the decomposition of BSM level (i.e. Strategic, Tactical and Operational). The remain KPIs which are collected in TIM and TSM levels specify the parameters which can be used as a supporting mean referring to technology implementation.
The MDSE Architecture has been used, therefore, as a filter for KPIs, in order to define in detail which parameter is affecting which functions inside the SLM of a service system and at which level within the enterprise environment.

Referring to the reference framework structure, it is important to highlight the importance of the recursive structure. In fact the conceptual framework needs to make integration and to be coherent between different decisional levels and functional levels.

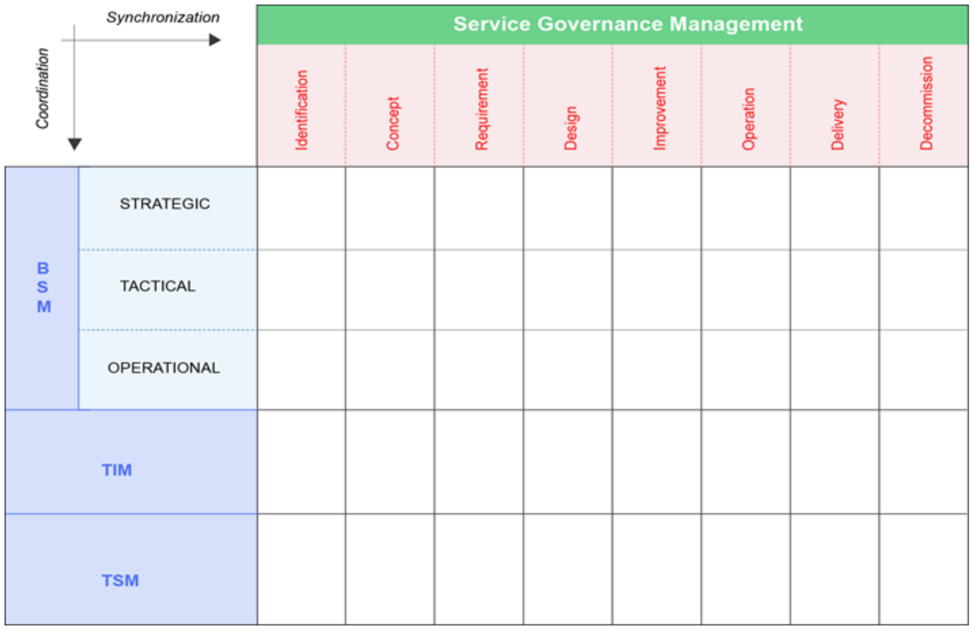

Figure 17 - Conceptual schema for MSEE Governance framework (proposition)

As it is possible to notice from our proposition of the Conceptual schema for MSEE Governance framework, several phases have been identified inside the Service governance management axis. These phases have to be considered like the "functions" which have been identified and used in the GRAI method.

These functions have been identified following the service life cycle phases studied in D11.1, (see the figure below).

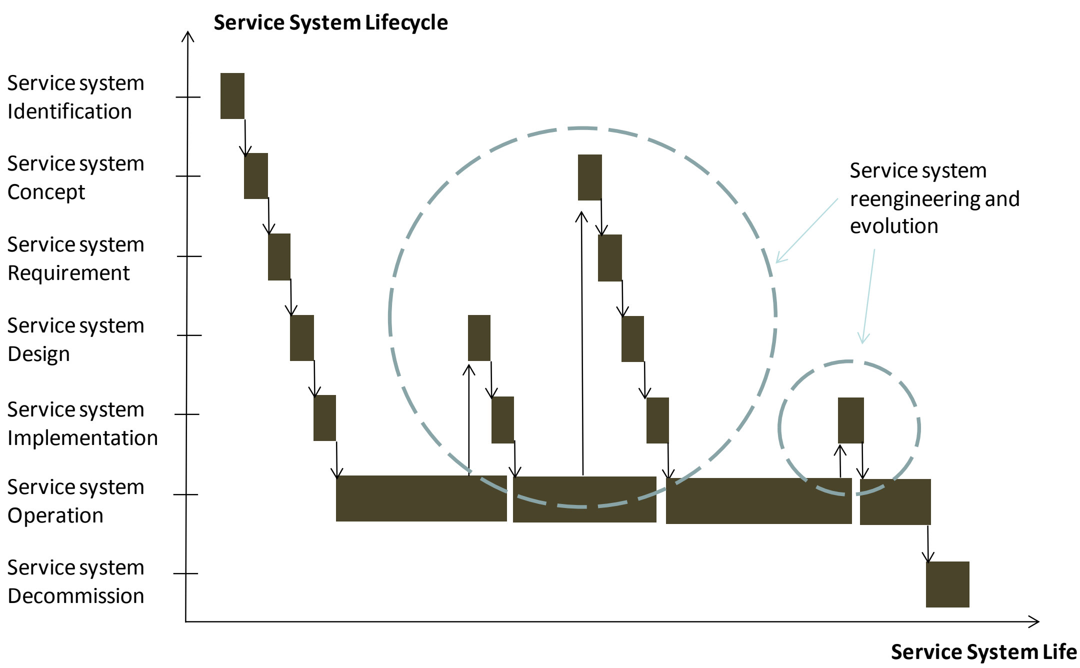

Figure 18 - Service System lifecycle phases vs. Service System life - adapted from Bernus (1995)

Service Engineering components can cover the whole service lifecycle phases from early stages, where both intrinsic and extrinsic parameters and requirements should be defined and measured, to the final decommissioning steps, which could give rise to further business opportunities (recycling, refurbishing, different use, etc).

	BSM	**TIM**	**TSM**
Identification			
Concept			
Requirement	X		
Design	X	X	X
Implementation			X
Operation			
Decommission			

Figure 19 - System Lifecycle and Modeling Levels

These phases have been implemented in the SLM Toolbox developed in SP1.
As it has been discussed during the MSEE Milano Meeting (23/25 January 2013), the functions can be simplified in order to set the assessment just during particular phases. As far as the SLM is concerned, we can consider upper phases related to MSE (identification, concept, requirement) and lower phases to VME and ME (design, implementation, operation, decommission).

The conceptual schema for MSEE Reference Governance framework tries to synthesize MDSE Architecture with the modeling of a service system along the SLM lifecycle. BSM (Business Service Model) aims at elaborating high abstraction level model from business user point of view. TIM (Technology Independent Model) gives service system specifications independently of technology for implementation. TSM (Technology Specific Model) adds necessary technology specific information related to implementation options.
The aim of this framework is to help end users represent and describe the intended service and its system from various points of view, give structure to the whole knowledge in order to help the decision making and the controlling activities.

3.8. SLM ToolBox to support GRAI method

To create or modify a service within an organization (either a single enterprise or a virtual manufacturing enterprise), the stakeholders need to specify, evaluate, communicate and design the system supporting the service and its lifecycle in a structured and "easy to read" and reusable format. Hence, SLMToolBox is available to create new service by providing several graphical editors to model manufacturing services and service systems from a "business perspective" (BSM) and a "functional perspective" (TIM) for service engineering activities. Some of the activities which will be supported by graphical modeling editors of SLM ToolBox's can be observed by the following items:

- To capture and formalize the business requirements regarding a new service (or a modification) within a single enterprise or a virtual manufacturing enterprise,

- To identify and design "what" to implement or modify within an organisation for implementing a new service (or a modification on the service),
- To evaluate several scenarios for implementing a new service (impact on IT / Organization / Manufacturing) and select the most appropriate,
- To prepare the implementation of an IT system so that its specification is coherent with the business requirements of the service,
- To communicate a graphical representation of a "servitization project" between the stake holders

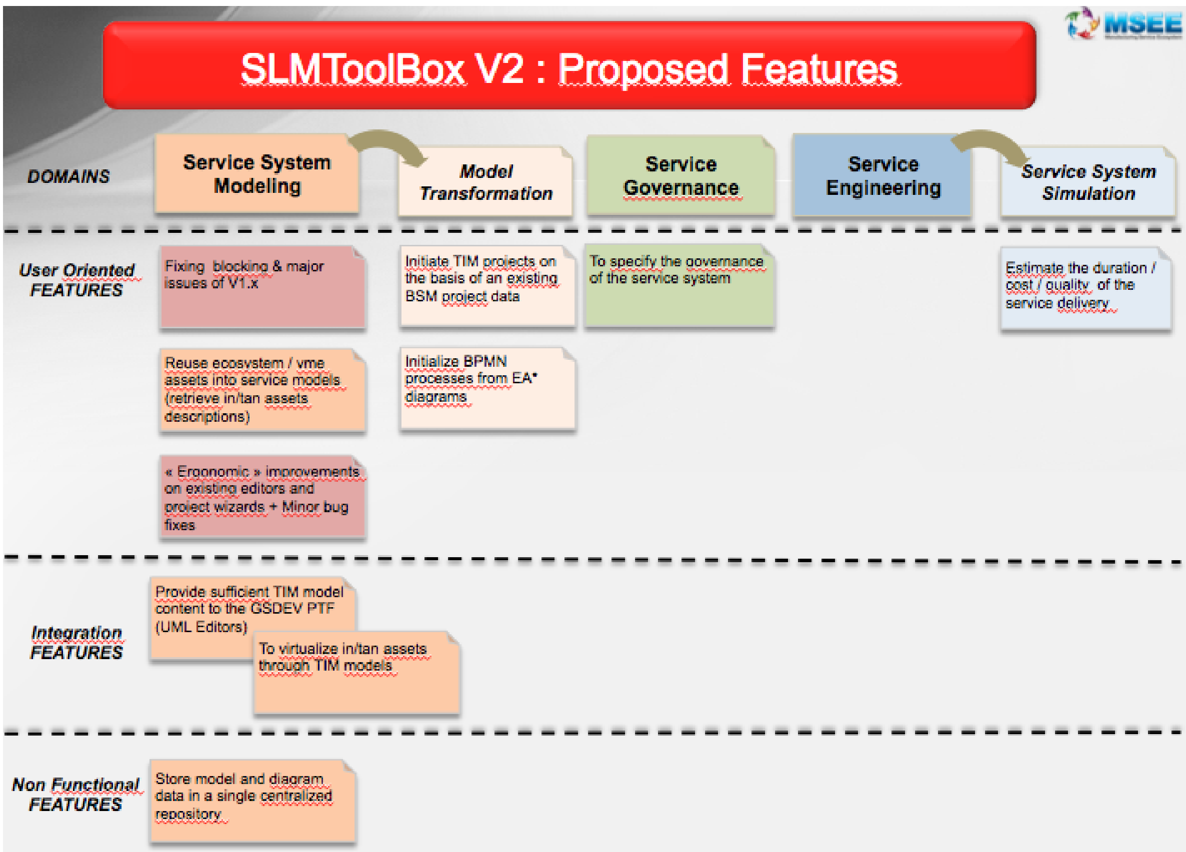

Figure 20 - SLM Toolbox proposed features

As it is highlighted from the figure above, the SLM Toolbox is inserted in the domain of service system modeling, service governance and service engineering. Therefore it consists in a useful supporting tool when defining the governance of a service system.
SLM ToolBox can be used to maximize the productivity of the development and the quality of the IT part of a service system. For instance, to prepare online shirt configurator the development teams need to: concentrate on technical activities (e.g.: technical design, implementation …) then provide a solution which is directly connected to the initial requirements (e.g.: integrates with the business processes of the company). In the figure below the service structure for execution is shown.

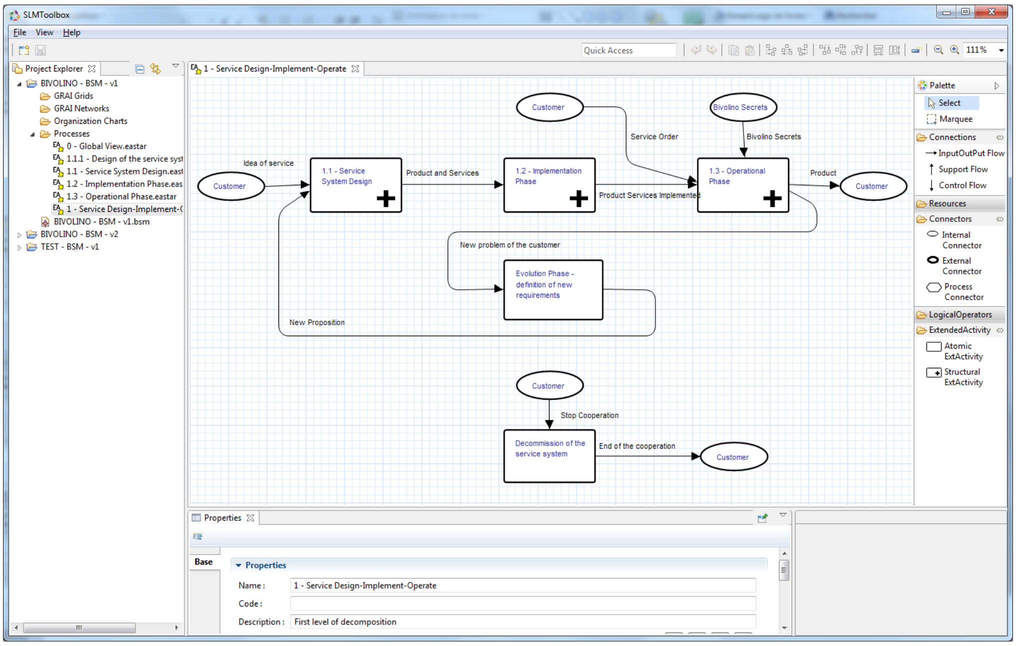

Figure 21 - SLMToolBox demo

Refer to the mentioned software user guide two level of modeling are mentioned:

- Business Service Models: to concentrate on the "business aspects" and the requirements related to the service system and the service lifecycle (processes: Extented Actigram Star ; decision: Grai Grids)
- Technology Independent Modeling: focused on the specification of the IT part of a service system (interaction view: BPMN; architectural & structural view: UML)

The "Technology Independent Models" will be shared with the Service Development Platform, to leverage the development of software code, in coherence with the service models elaborated with the SLM ToolBox. These models will be exportable in standard and interoperable modeling format (UML; BPMN2.0) so that the models can be reused, modified and enriched within third party modeling tools.

3.9. Example of MSEE Governance

During the MSEE Milano Meeting (23/25 January 2013), a MSEE Governance for VME has been presented as a reference. The GRAI model framework has been applied to Bivolino Use case.

	Informations Externes IE	Customer decisions F	To manage service product ideation DE	To manage service product design Log	To manage service product development F	Informations Internes II
H= 5 years P= 6 months Strategic	Evolution of the market	Business plan for the service proposition to final customer	Business Plan for the company services	Partners selection and Technologies for the future services	Choice of the service product technology	Current strategy of the company and related results
H= 1 year P= 2 months Tactical	Existing services at the competitors	Annual activity and production Planning of services	survey planning of existing services	Global planning for the design of new product service	Planning of the technology implementation for the service product	Difficulties to implement previous product services
H= 2 months P= 1 week Operational	expectations from the final customer	Modifications for new services	brainstorming meeting planning to generate periodic ideas	weekly meeting to manage the advancement of product service design	Service product implementation planning	Advancement of product service design
	IE	F	DE	Log	F	II

Figure 22 - Control of the service product life cycle

In the above figure the control of the service product life cycle has been structured following the GRAI grid. While in the following figure the exploitation of the service system is presented. As it possible to notice, functions have been identified; objectives and tasks have been specified too according to the level of decision (strategic, tactical and operational).

	Informations Externes IE	Final customer P1	To manage service system design F	To manage Service commercial Log	To manage Service realisation and delivery DE	Informations Internes II
H= 5 years P= 6 months Strategic	Customer and final customer requirements survey	contracts for service demand	To select the technologies for the service system	Sell planning	Service Master planning	KPI's
H= 1 year P= 2 months Tactical		Long term orders	to plan service system design and implementation activities	Order book planning	Annual service planning	Results of service production of year n-1
H= 2 months P= 1 week Operationnal		service order	to manage short term activities of design	Validation of service order	Short term service scheduling	Status iof service system (performance indicators)
	IE	P1	F	Log	DE	II

Figure 23 - Exploitation of the service system

GRAI method has been defined to represent activities and decision tasks, which give rise to objectives (see Actigram).
GRAI grid takes into account functions and classifies them into different levels of decision (BSM, strategic, tactic and operational) taking into account how each decision centre is affected. Specific PIs will be generated at this level.
Then when entering the IT system, the whole information needs to be translated into the TIM level.
Different PI (definition, formula, computation, etc) will be determined at TIM level, at this level the indicator will be of an IT system, i.e. an IT level information system.
Based on TIM level then, the information needs to be translated into the TSM level where the ICT formula is defined, where all the technology details are described.
The SLM Toolbox will be used to support the GRAI method referring to service life management phases. In fact, as, previously mentioned, referring to SLM phases, upper phases will be related to MSE definition (identification, concept, requirement) and lower phases to VME and ME assessment (design, implementation, operation, decommission).
Such a method has been defined to be the MSEE Governance for VME and MSE to be used as reference, and will be integrated by UGF on occurrence for VME and MSE.

4. PIs: characteristics and description

4.1. Principles of performance measurement in production system

The evaluation of the production system performances becomes more and more important in the current economic context. Until the 80's, the concept of industrial performance was only linked to the minimization of production costs. Then, the production system performances evaluation consisted in controlling the costs using essentially analytic accounting. The "Stiglitz Report" (Stiglitz, Sen, & Fitoussi, 2009), commissioned by the French former President Sarkozy, is a clear signal of the global concerns about the shortcoming of present tools of economic and social performance measurement, mismatch between market prices and things (or qualities) that society (i.e. people) value, and the nature of societal goals. As the report puts it: "what we measure shapes what we collectively strive to pursue - and what we pursue determines what we measure". The evolution of industrial environment (intensification of the international economic competitiveness, product diversification...) leads the industrial performances to become today a real multi-criteria performance combining the cost objectives with quality, lead time, flexibility and environment.

This evolution has created new requirements for the performances evaluation of a production system in order to improve the effectiveness the coherence and the accuracy; Therefore, System controlling is a discipline which studies how to reach the mentioned results.

A System Control is a device, or set of devices to manage, command, direct or regulate the behaviour of other devices or system. (http://www.answers.com/topic/control-system#ixzz1tWDOfRK2)
The role of a Performance Indicator System is to allow the decision makers to know the status of the production system. They must use the performances indicators as a control tool, i.e. to measure the efficiency of their actions and to react in the appropriate response time, in coherence with the global objectives of the production system (Figure 24).

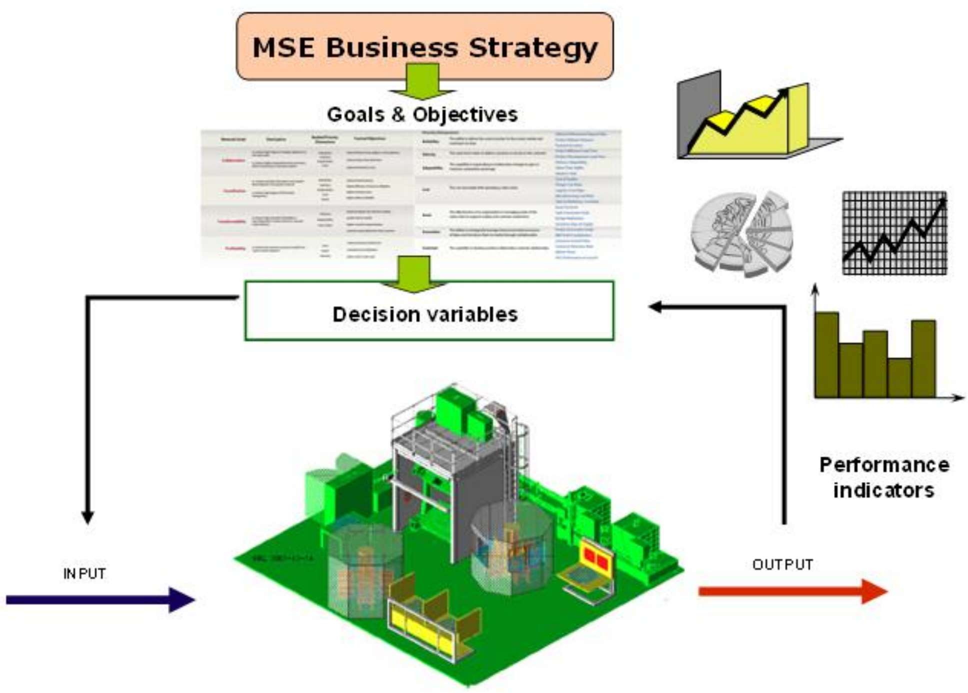

Figure 24- Principles of Performance Indicators in a production system

The figure above shows the importance of performance measurement within MSEE Project: the business ecosystem needs to transform inputs (information, raw material, requirements…) in outputs: product and related services.

The business strategy is transformed in goals at the strategic, tactical and operational levels. For each objective, decision variables are defined. These are the action means on the controlled production system to reach the objectives. Brief definition of each set of decisions are mentioned here below:

- At the strategic level, the project goals must be defined, as well as the policy of involvement of human and technical resources, the image of the project and partners, the strategy of cooperation with partners.

- At the tactical level, the project aims to decide on the harmonization of methods and means of collaboration between partners (i.e. collaborative platform...) on the dissemination of information inside the project in order to maintain a coherent level of knowledge among the partner, on the technical survey.

- At the operational level, the decisions aim to manage the project added value with taking into account the customer requirement changes, to master cost, lead time and results quality, to synchronize the partners work, to measure intermediate customer satisfaction to manage the sub-contracting and finally to take into account the return of experience.

Then, the performance indicators are implemented in the controlled ecosystem to evaluate its performance.

4.2. The use of PIs within an enterprise environment

A performance indicator is a quantified data which measure the efficiency of decision variables in the achievement of objectives defined at a considered decision level and in coherence with the defined business strategy (Ducq.Y, V. B.2005). “Definition and aggregation of a performance measurement system in three Aeronautical work shop using the ECOGRAI Method”).

Several kinds of PIs can be defined. The first kind is the PIs for results. These are measuring directly the achievement of objectives. Let's consider for instance total amount of turn over raised by service against over all organization revenue. The second kind is the progress PIs. These are measuring a progress in the achievement of the objective. For example: total number of service occurrences per month and average service value vs. organization monthly objectives.

So, these two kinds of PI’s are complementary.

The second typology concerns the decision level (Strategic) and relevant PI’s. Indeed, in order to control the system, it is necessary to measure strategic PI’s which are measuring the performance of the whole controlled system. Then, tactical PI’s are required to measure middle term PI’s. Finally operational PIs are required to measure the performance of a part of the system at the daily routine work tasks and usually referred to short term.

Key Performance Indicators (KPI’s) are those which are the most important to measure in order to know the achievement of the strategy. These are strategic PIs.

Key Performance Indicators (KPIs) can be defined as measures that provide managers with the most important performance information to enable them or their stakeholders to understand the performance level of the organization.

KPIs should clearly link to the strategic objectives of the organization and therefore help monitor the execution of the business strategy.

KPIs serve to reduce the complex nature of organizational performance to a small number of key indicators in order to make performance more understandable and digestible.

Here below some best practices dealing with KPIs are presented:

- Clearly understand what indicators are required for learning and improvement and focus on those;
- Separate out the external reporting indicators if they are not relevant internally to avoid confusion and data overload;
- Create the right culture to drive high-performance.

4.3. The problem with PIs

In practice, the term Performances Indicators is too loosely defined and very much overused. For many it describes any form of measurement data and performance metrics used to measure business performance. Instead of clearly identifying the information needs and then carefully designing the most appropriate indicators to assess performance, we often observe what we have termed the 'ICE' approach (see also attached picture):

- Identify everything that is easy to measure and count
- Collect and report the data on everything that is easy to measure and count
- End up scratching your head thinking "What the heck are we going to do with all this performance data stuff?

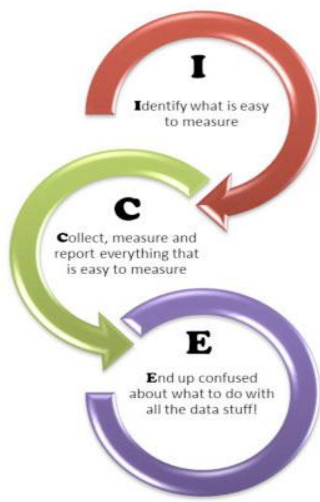

Figure 25 - ICE approaches

If we analyse the current situation in industry concerning Performances Indicators (PI), we will notice the following:

i. First, there is a difficulty to determine which indicators to use, where to implement them and to update them. There are a lot of Performance Indicators if we consider the literature but it is not easy to choose an efficient and representative set. Usually, the number of Performance Indicators is high and then it is difficult to maintain their updating. With this huge number of PI, we do not cover the totality of the Production domain we consider in terms of functions and levels of decisions.

ii. Often, these Performances Indicators are not efficient because they are not directly connected with the various actions (drivers) on which the decision makers can act in order to reach the objectives. Certainly, this last situation explains why the production people do not use with profitability the information given by the Performances Indicators: there is a lack of approbation because it is difficult to understand the meaning of the indicators.

iii. Finally, a very important point concerns the coherence of the PI system. They must cover all the decision levels (strategic, tactical and operational) but also the various functions of the domain. Often, there is no coherence between them. We think this situation is the result to the fact it does not exist an explicit link between the objectives, the variables (or drivers) on which people can act to reach their objectives and the evaluation of the situations.

4.4. PIs Design and implement methods

Numerous tools (recommendations, models, methods, systems, frameworks) proposed by various researchers and business managers have been proposed until today with the aim of helping organisations to measure and manage their performance. The 80s were especially marked by the recommendations concerning the choice of performance indicators (PIs) further to the ineffectiveness of exclusively financial indicators used in the years previously. Especially from the 90s appeared other characteristics based on the concepts: well-balanced (several dimensions), integrated (centred on external and other dimensions), determinants and results concept (causes and effects relationship), and still other recommendations relating to their elaboration (definition, implementation, revision) to obtain an efficient Performance Measurement System (PMS) or an effective PIs. Many positive and/or negative criticisms were expressed by various authors on these tools on various points such as: the nature of PIs used, dimensions retained, well-balanced and/or integrated character, procedure for the PIs selection and their connections etc. Even the Balanced Score Cards (BSC), the most known and used is deeply criticized with regard to the reduced stakeholders, the absence of procedure for the choice of PIs etc. **(**Neely and al., 1995, Ghalayini and al., 1996 and others**)**. In spite of these criticisms, it turns out that these tools present a lot of similarities and differences, advantages and inconveniences.

Among all these methods, more or less used and well known, one can cite the most famous ones or the more used or disseminated around the world as Balanced Score Card **(**Kaplan, 1996**)**. The Performance Prism **(**Neely, 2002**)**, ECOGRAI **(**Ducq, 2005**)**, IPMS **(**Bititci, 1997**)** and DPMS **(**Ghalayini, 1997**)**.

Several studies have been done to compare methods for PMS from several points of views. For instance, classifies these methods in three categories: financial, goal centred and behavioural, concluding that each one has its own advantage to obtain consistent PIs.

In Franco, (2007**)** 17 definitions of what a Business Process Measurement System (BPMS) is, are analysed through methods available or theoretical articles. This analysis was made on the main features of a BPMS, on its role in an organisation and on the process of use. The main conclusion are that a BPMS must be multi-dimensional (financial and non-financial), must include strategic objectives, performance targets and supporting infrastructure **(**Franco, 2003**).** Uses systematic review to analyse few methods in order to detect why some of them are more useful to manage organisations through measure, i.e. to obtain an efficient BPMS. The most important aspect is that a method for BPMS must help to the definition of detailed action plans extracted from measures, to measure progress, to have a vision (a perspective as a strategic map) and to have cause and effect relationships (links between indicators).

The table below shows a collection of existing methods without classification.

Dupont PYramid [Dupont, 1900]	Wisner & Faw [Wisner,1991]	TOPP [Sintef,1992]	SCOR [Scc, 1996]
PMMatrix [Keegan et al, 1989]	PBSCW [Kaplan et N., 1993]	IDPMS [Ghalayni et al.,1997]	IPMS [Bititci et Carrie, 2002]
Sink & Tuttle [Sink,1989]	CPMS [Flapper, et al. 1996]	QMPMS [Bititci, S., C.,1997]	ENAPS [Esprit, 1999]
PMSSI [Fitzgerald et al, 1991]	PPMS [Kueng, 1999]	Tableau de Bord [1930]	
PPS [Cross et Lynch, 1992]	GIMSI [Fernandez, 1999]	ABC /ABM [J. et Kaplan, 1987]	
BSC [Kaplan et Norton, 1992]	IPMF [Medori et S., 2000]	TdC [Goldratt, 1990]	
Scandia Navig [E. et Malonne,1994]	MSDP [Rentez, 2002]	PRISM [Neely et al.,2001]	
Strategy Map [Kaplan et N.1992]	SMM [Bititci, 1995]	MBNQA [19878]	
PCS [Globerson, 1985]	PMQ [Dixon et al.,1990]	AMBITE [Bradley, 1998]	
ECOGRAI [Ducq, 2005]	PROMES [Pritchard., 1990]	EFQM [EFQM, 2000]	

Table 1 - The existing methods to define and/or implement Performance Indicator systems

Several methods developed around the world by academic or practitioners for PIs definition & implementation that we described some of the most know methods here below:

Balanced Scorecard (BSC) method was originated by Robert Kaplan and David Norton as a performance measurement framework that added strategic financial performance measures to traditional financial metric to give managers and executives a more "balances" viewed of organizational performance **(**Kaplan, 1996**)**.

EFQM (formerly known as the **European Foundation for Quality Management**) is a non-profit membership foundation based in Brussels. EFQM is the custodian of the EFQM Excellence Model, a non-prescriptive management framework that is widely used in public & private sector organizations throughout Europe and beyond.EFQM is method for simulating and assists management teams in adopting and applying the principles of organizational excellence, improving the competitiveness of European companies and close the competitiveness among European and USA and Japan (http://www.efqm.org/en/tabid/108/default.aspx)

Interior point methods (**IPMs**) are among the most efficient methods for solving linear and wide classes of convex optimization problems. Any convex optimization problem can be transformed into minimizing (or maximizing) a linear function over a convex set (Robert M.Freund, M.I.T & Shinji mizuno "Interior Point Methods").

In the next chapters, we will focus on ECOGRAI Method that has been selected to support the generation of KPI's inside the MSEE Project as stated in the introduction. In this way KPIs will be clearly linked to the strategy. Once the strategic objectives have been agreed, defined and mapped, it is possible to design KPIs to track progress and gain relevant insights to help manage and improve performance. KPIs will then provide the answers to the decision models questions.

5. SLAs and SLOs: characteristics and definition

5.1. SLA definition

A service level agreement (SLA) is a technical contract between two types of businesses, producers and consumers. A SLA captures the agreed-upon terms between organizations with respect to quality of service (QoS) and other related concerns. In simple cases, one consumer forms a SLA with a producer. In more complex cases, a consumer may form a SLA that defines a set of producer businesses (*By Edward Wustenhoff –Sun Professional Services Sun BluePrints™ OnLine - April 2002*).

An SLA promises what is possible to deliver and deliver what is promised. The Service Management lemniscates shows the role and the importance of SLA as means for bridging a gap between User & Service Provider. A SLA supports a communication about services and forms a basis for implementation of the Service process.

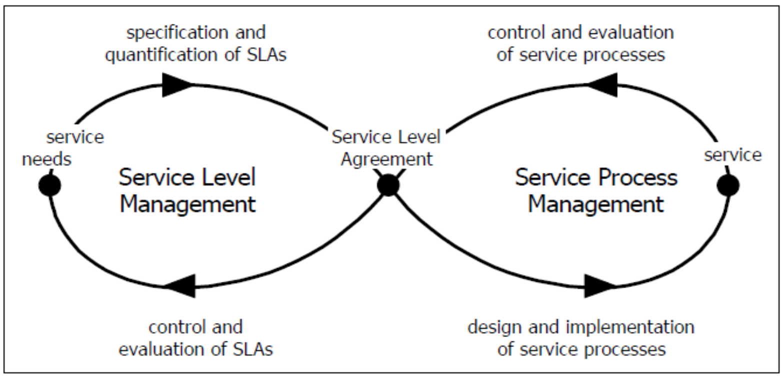

Figure 26 - SLA role in Service structure

A Good SLA addresses five key aspects:

- What the provider is promising.
- How the provider will deliver on those promises.
- Who will measure delivery, and How
- What happens if the provider fails to deliver as promised?
- How the SLA will change over time.

The SLA defines a clear relationship between the customer and the provider by setting boundaries, conditions, penalties and expectations.

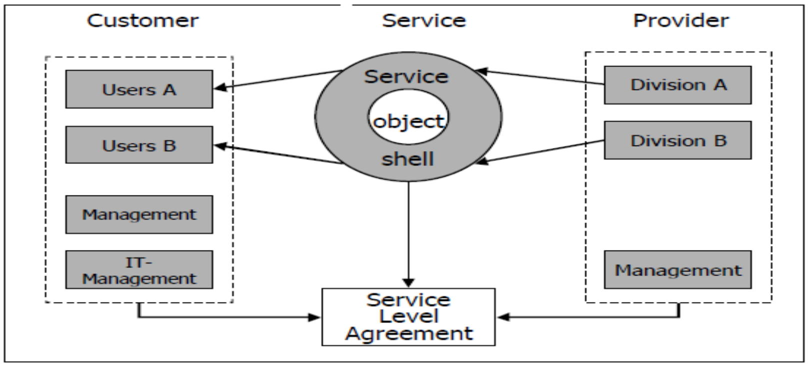

Figure 27 - SLA relationship among Customer and the Provider

SLAs promote trust between service consumers and service providers and encourage service reuse by facilitating the formal creation of service-level objectives and other contractual terms and conditions. These objectives capture the expectations that service consumers can have from their respective providers.
The benefits of a good SLA are many, but the most important ones are:

- Sets Clear customer relationships;
- Sets Goals for internal organizations;
- Sets a framework for continuous quality improvement;
- Drives the SLM system architecture.

The SLA drives the definition of key performance Indicators (KPIs) at the service, application, system and network level. Defining these KPIs facilitates the proper tools selection, process definition and skills (people, process and technology) for an organization.

As previously stated, Service Level Agreement (SLA) is a generic document which drives the definition of Key Performance Indicators (KPIs) at the service, application, system and network level. Defining these KPIs facilitates the proper tools selection, process definitions and skills (people, process and technology) for an organization (Edward Wustenhoff, "Service Level Agreement in the data center" April 2012).

Used in the 90's by telecommunication companies, and then by software companies, the SLA is now used by most of the big service companies in the domain of water supply, environment…SLA can be related the performance level but also to the modality of execution of services, responsibilities, warranties, after sales service etc.

So, SLA must define performance level that will have to be measured using PI's and KPI's.

The main problem of SLA is to define a set of coherent performances. This coherence must be ensured first at the objectives level. The various objectives must be linked and the level of these objectives must be coherent between the various parts of the services.

This coherence might be identified through the service system modeling and the decision modeling.

The figure below shows that some global PIs (KPI's) can be used to SLA definition and measurement (external visible PIs) but other KPI's would only be used as internal PI's for the control of the system (internal PIs).

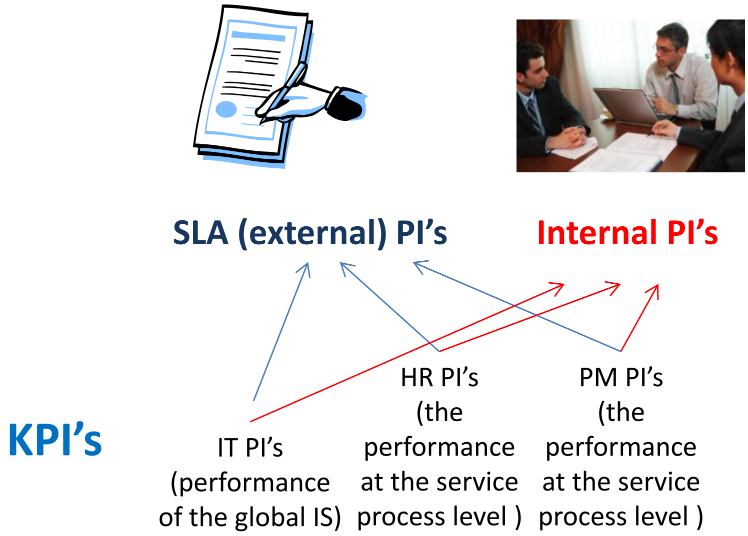

Figure 28 - Links between SLA and KPI's

This is important to mention that a lot of PI's will be only available for internal managers based on their own decisions and the KPI's are in the SLA contract are only those dedicated to the customer decision.

While a KPI is a measure of performance, the Service Level Agreement or SLA is the ideal state of those measurements. For instance our body temperature is a KPI for our health, while 98.3 degrees Fahrenheit is the SLA i.e. the ideal state of affairs.

Hence, if we were to control our health, we would create a mechanism in which our temperature is being automatically measured. When the KPI deviates from the desired SLA i.e. temperature deviates from 98.3 degrees Fahrenheit, it must send some sort of a message to the management that management interference is required.

The importance of KPI's and SLA's is that they can provide required solutions in required time. By using them, management can take preventive action instead of having to cure the problems.

5.2. The use of SLAs within an enterprise environment

As services and technologies change, the SLA may change to reflect the improvement or changes. This SLA will be reviewed in fixed period and updated as necessary. In this chapter we try to describe how SLA availability is measured in strategic, tactical and operational levels. A good SLA is important because it sets boundaries and expectations for the following aspects of service ecosystem:

- Customer commitments: Clearly defined promises reduce the chance of disappointing a customer. These promises also help to stay focused on customer requirements and assure that the internal processes follow the right direction.
- Key performance indicators for the customer service: By having key performance indicators in service, it is easy to understand how they can be integrated in a quality improvement process (like six sigma). By doing so, improved customer satisfaction stays a clear objective.

- Key performance indicators for the internal organizations: an SLA drives internal processes by setting a clear, measurable standard of performance. Consequently, internal objectives become clearer and easier to measure.
- Key performance indicators for claims: if the SLA has penalties (something that some organization prefer to avoid but should not) non-conformance can be costly. However, by having penalties defined, the customer understand that the organization truly believe in its ability to achieve the set performance levels. It makes the relationship clear and positive.

The capability to segment service offering with different options (price, SLA, etc) for different service levels benefits both the vendor and the customer. The vendor widens its target market by being able to customize its service and the customer only pays for what it needs.
Having the ability to measure against key performance indicators facilitates the continuous quality improvement process. Being able to raise the performance bar at a steady pace help the service ecosystem to remain competitive. By trying the problem resolution process to an SLA, a service performance problem becomes an opportunity to structurally improve overall service quality and customer satisfaction, as opposed to just resolving the symptoms of the real issue.
Knowing what to measure eliminates redundant data collection, which reduce the total overhead of the SLM system on the service infrastructure.

5.3. Link between SLA and SLO

Service Level Agreements (SLAs) have been a common product in support of services offered by service providers for many years. SLAs also are now being considered for non-communications (network) services and are being adopted both internally and externally to define the agreed performance and quality of the service or product and as an important part of a customer relationship management (CRM) program (SLA Management Handbook Volume 4 Enterprise Perspective October 2004). To achieve quality and performance targets for the products or services may require the enterprise to establish and manage the number of technical goals that ensure the SLAs will be met. To reach the targets, while the SLAs are set in generalities and business goals, the measurable performance indicators are set as specific technical objectives.

Hence, Service Level Objectives (SLO) is measurable performance indicators that are often included as a part of a service level agreement. A service level objective is a key element of a service level agreement between a service provider and a customer. SLOs are agreed as a means of measuring the performance of the Service Provider and are outlined as a way of avoiding disputes between the two parties based on misunderstanding. The SLO may be composed of one or more quality-of-service measurements that are combined to produce the SLO achievement value. As an example, an availability of SLO may depend on multiple components, each of which may have a QOS availability measurement. The combination of Quality of Service (QOS) measures into a SLO achievement value will depend on the nature and architecture of the service. Refer to the Rick Sturm and Wayne Morris argues in **"***Foundations of Service Level Management* (2000)" they emphasized that SLOs must be:

- Attainable;
- Repeatable;
- Measurable;

- Understandable;
- Meaningful;
- Controllable;
- Affordable;
- Mutually acceptable.

In order to accomplish above objectives, SLOs should generally be specified in terms of an achievement value or service level, a target measurement, a measurement period, and where and how measured.

Nevertheless, there is often confusion in the use of SLA and SLO. The SLA is the entire agreement that specifies what service is to be provided, how it is supported, times, locations, costs, performance, and responsibilities of the parties involved. SLOs are specific measurable characteristics of the SLA such as availability, throughput, frequency, response time, or quality.

5.4. SLA-SLO in customer contact centers: a practical example

In the customer contact centers SLO's used as measurable performance indicators that are often included inside of a service level agreement. These agreements are usually made between two businesses that enter into some sort of partnership with each other. Meanwhile, agreements usually seen in the call center outsourcing industry and customer contact center, where one business operates as the other's customer care department.
Since many of these call centers are responsible for delivering service and support to the clients' customers, the service level agreement establishes acceptable performance targets that are otherwise referred to as service level objectives. In the case of a call center, one of those objectives may be that a certain percentage of incoming calls is answered within a certain period of time. For example, one of the service level objectives may state that 70 percent of calls need to be answered within 20 seconds.
This type of service level objective refers to how long customers must wait on hold before they reach a live customer service agent. In an inbound call center, calls will line up in a queue. Agents are typically notified when queues begin to back up beyond acceptable service level standards. This may prompt them to become more efficient in resolving the calls. In order to keep customers from becoming irate, the wait time for the majority of inbound calls needs to be kept at a minimum.

In a call center scenario, the objectives help both the vendor and the client determine how many agents are needed at different periods of the workday. It helps guide decisions about the number of people to hire, how many types of agents are needed, and when breaks and lunches can be scheduled. Call volume spikes are monitored and observed in order to determine if staffing levels need to be adjusted.
It should be emphasized at this point that not all service level objectives are quantitative or numbers based. For example, the quality of customer service that is provided during customer contact may be an additional stipulation that is outlined in the service level agreement. First call resolution, taking ownership of the call, adhering to established policies and procedures within reason, and documenting essential pieces of the conversation may be additional objectives.
Most often, vendors or outsource companies are rated on their ability to perform according to service level objectives. Whether the client continues to allow the vendor to handle its business following the end of a contract period may be dependent upon the vendor's performance. If the vendor fails to meet the objectives that are spelled out in the service level agreement, the vendor may lose the client's account.

Meanwhile, a good SLO also specifies the metric to be used to measure the objective. For example, an SLO on response time for customer service requisition might specify what reports or utilities are to be used to measure response time. SLOs must be actionable. That is, there has to be something the administrator (or the software) can do to correct the situation if the SLOs parameters are not met.

Finally, the both SLA and SLO should be an integral part of the business planning and execution process, without it the business objectives are unlikely to be achieved, ongoing performance cannot be determined, corrective action taken, or future plans made.

5.5. Service level management

Service-level management is the primary mechanism for managing the IT function as a services business. As shown in the figure below, a good deal of effort goes into ensuring that the services IT provides meet business needs, are delivered in a way that creates and maintains customers' satisfaction, and ultimately help the corporation create value and drive profit.

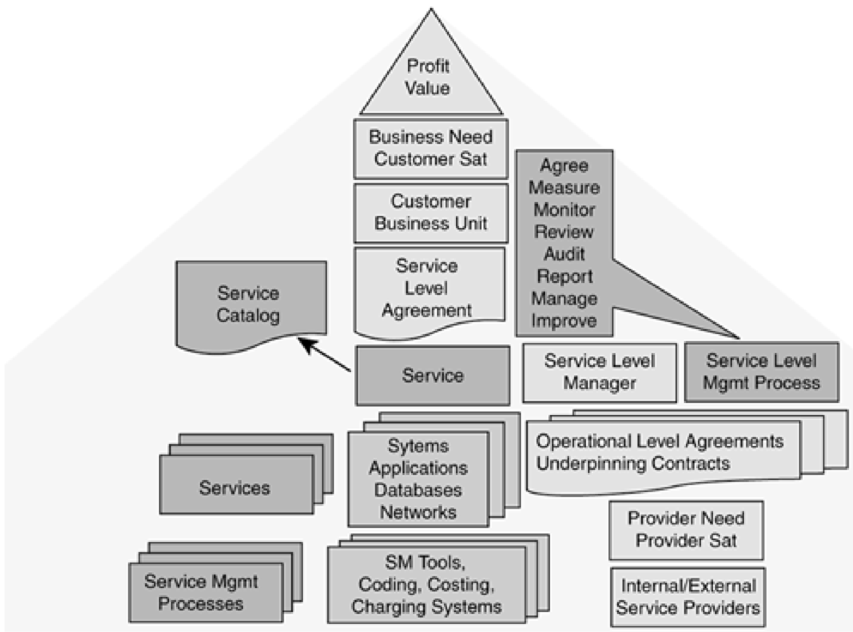

Figure 29 - Service level management pyramid
Source: Pultorak, David, "Exploring the Intersection of Service Level Man- agement and Corporate Governance", BetterManagement.com Web Seminar, Thursday, December 4, 2003.

Service-level management provides an ideal basis for the interface between IT and corporate governance because it and corporate governance have much in common. In fact it can be stated that both service-level management and corporate governance:

- Are governance mechanisms;
- Have the aspect of agency/representation; that is, a small group of individuals represents the interests of a larger group;
- Have a "down and in" management aspect and an "up and out" leadership aspect (it means both SLM and corporate governance require managing infrastructure and internal people and process as well as managing clients and external stakeholders);
- Focus on performance, conformance, and relating responsibly to stakeholders;
- Focus on maximizing value and minimizing risk;
- Have stakeholders in common.

6.1. KPIs and SLAs definition at specific MDSEA levels

Based on the previous decomposition structure, performance evaluation will be ensured at each level of decomposition, in order to verify the achievement of specific objectives and the use of action means and interoperable solutions.

The reference framework for performance indicators, as proposed in the figure below, will follow the three level of decomposition, i.e. BSM, TIM and TSM levels.

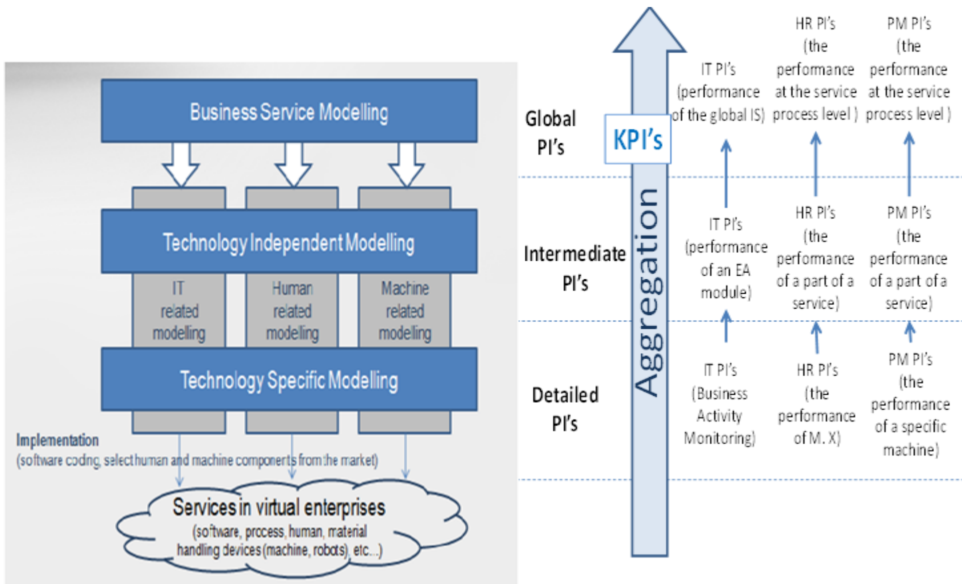

Figure 30 - Performance indicators in the frame of MDSEA

PIs must be defined related to the three kinds of components: IT, Organization/Human resources and Physical means resources. Several PIs maybe applied for an organization but just a few are meaningful in terms of process control, improvement, efficiency, effectiveness and business performances, in general sense. There are some companies with several KPIs at different levels but all the information which are collected to the regular basis may be overwhelming and not supporting the management in the decision making process. Therefore it is recommended to sort out the KPIs only which can effectively contribute to define necessary information for every level of business model. Lets us assume that KPIs have been defined at BSM level only (e.g. turnover, EBIT, WIP, etc...): in this case we organization should define an appropriate deployment policy to share these KPIs within all levels of the organization. In other terms BSM KPIs should be translated into TIM KPIs which are strongly bounded to the previous ones and the results of each will contribute in the same direction to meeting the organization objectives: if you want to increase the EBIT at TIM level we must increase total output of the production and reduce operational costs. To do that KPIs at TSM level should be defined which are consistent with TIM KPIs. Therefore the operator at CNC machines should be aware that his PIs are the number of pieces manufacture per day and total number of scrap/ rework downgrading

The criteria of these performance indicators will then be related to traditional performances as cost, quality, lead time or other kinds of performances as interoperability, flexibility, environment…

However, when we are at the top level (BSM level), the models are global and then the PIs must be global (PI's), at the level of a complete service process. When we are at the TIM lev-

el, the resources are detailed and we are at the level of a part of the service process. So, the PI's will be detailed but we will keep the same performance criteria. The PI's will be at the level of a set of resources, or at the level of Enterprise Software Application (ESA) modules.
At the TSM level, the principles will be the same. The PIs will have the same criteria of performance but will be more detailed than at the TIM level. For instance, the PI's will be at the level of a machine, at the level of a process activity and at the level of specific organisation or specific human resources. Business Activity monitoring will be used in order to measure the performance of a web service in the IT system.

6.2. ECOGRAI Method

The main reason to adopt ECOGRAI as a standard method is that this is the only one based on decision modelling, thus focusing everyone's attention on why we need PIs (to make decisions and which decisions), instead of sorting out the best indicators directly. In addition, in the past twenty years a significant experience have been gained by University of Bordeaux 1 (see also D11.1) with good results and such a method has been applied to service too.

ECOGRAI is a method to design and to implement Performances Indicators Systems for industrial and service organizations. This method is applied with the implication of the decision makers of the organisation. There are two main steps in this method: design and implementation. The results of the design step are a coherent set of specification sheets describing each Performances Indicator (indicators, concerned actors, required information and processing...) and coherence panels describing the coherence in the control of the system. The implementation and the operating of the PIS are supported by an EIS (Executive Information System) tool or Business Intelligence tool.

The main characteristics of the ECOGRAI method are:

- a logical process of analysis / design using a top-down approach, based on enterprise models (process and decision) and allowing to decompose the objectives of the strategic levels into objectives for operational levels,
- a concrete process of participative implementation, creating a dialogue between the various levels of the hierarchy, and favouring the identification of indicators by the future users involved in the study : it is a bottom-up implementation,
- the use of a number of tools and graphic supports : GRAI grids, GRAI nets, actigrams (IDEF0), splitting up diagrams, coherence panels, specification sheets,
- a coherent distribution of Performances Indicators covering the various functions and the various decision levels (strategic / tactical / operational),
- The search of a limited number of Performances Indicators by an original approach (figure 31). In a first step, we identify the objectives assigned to the decision makers (target situations which have to be reached inside the functions, depending on the decision level which is considered); in a second step, we identify the variables (called "Drivers") on which the decision makers can act to reach their objectives; and in a third step, we identify the Performances Indicators (quantified data which measure the efficiency of an activity or a set of activities of a function in the process to reach the objectives). In fact, the originality of the ECOGRAI method is not in the definition of Performances Indicators, but the search of Drivers on which decision makers can act to reach their objectives. The Performances Indicator is a consequence of the preliminary choice.

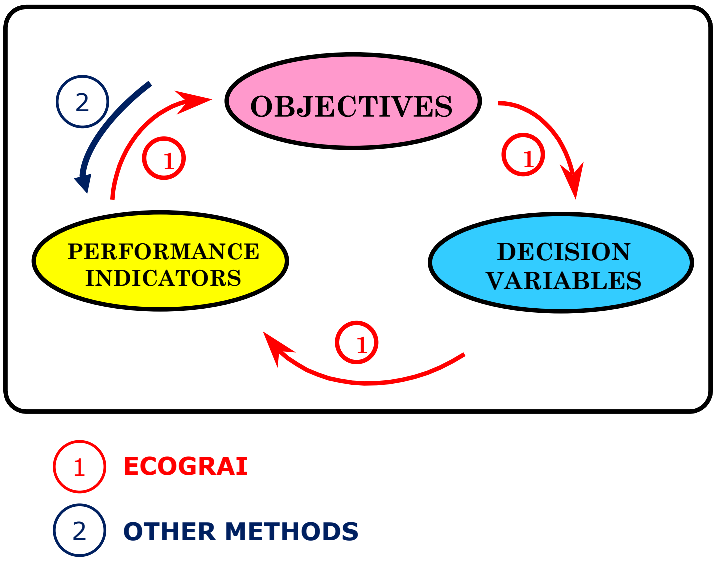

Figure 31 - The ECOGRAI original approach

6.2.1 The six phases of ECOGRAI method

The logical structured approach of the method is decomposed into six phases (Figure 32). The first phase (phase 0) consists in modelling the control structure of the organisation (the MSEE in our project but also each part of the MSEE) and its business processes on which the performance will be measured. The two following phases (phase 1 and 2) aim at identifying the basic elements which are required: the objectives and the drivers. The fourth phase (phase 3) consists in identifying the Performances Indicators, the fifth (phase 4) in designing the information system to build the Performances Indicators, and the sixth (phase 5) in implementing it inside the Production Management Information System.

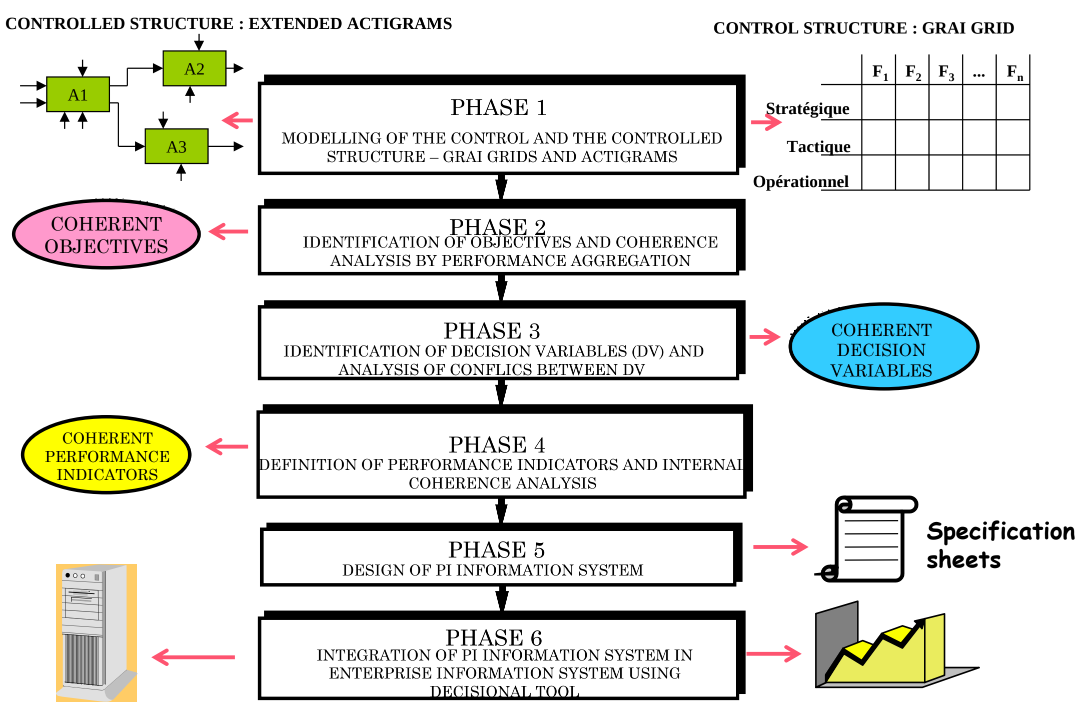

Figure 32 - The six phases of the structured approach

Phase 0: Modelling of the organisation Business Processes and Control Structure and Identification of the Decision Centres (DC).

The objective of this phase is to determine the Decision Centres of the organisation to which the Performances Indicators will be connected.

Phase 0.1- Modelling of the organisation Business Processes.

This phase aims at describing the controlled part of the organisation which has in charge to add the value to the product or the service. For this modelling, we traditionally use IDEF0 (actigrams) or extended actigrams. This phase is very important in order to understand clearly the processes on which the performance will be measured.

Phase 0.2- Modelling of the organisation Control Structure.

As written above, ECOGRAI uses the GRAI tools (grids and nets) to model the organisation control structure in order to identify the set of the decision centres, their activities, their links (decisional and informational) and the basic elements which are taken into account to design a Performances Indicator: the objectives and the drivers.

This deliverable does not aim at describing the GRAI method. Therefore, to understand better ECOGRAI, a short description of the GRAI tools used (the grid and the nets) is presented below.

The GRAI grid takes up the hierarchical and functional approach. It allows identifying the set of decision centres of the studied system, as well as their links.

The GRAI grid is presented in the form of a matrix with:

- The managerial axis or control axis which represents the various levels of decision which can be found in the organisation. Traditionally, this axis is decomposed hierarchically in several levels, according to the nature of the decisions: strategic, tactical, and operational levels.
- The functional axis which describes the various activities required to the product life cycle. However, in MSEE this axis can be adapted to service life cycle without any problem. It is decomposed into several functions which group a set of activities having a same identified finality (Engineering, Manufacturing, Quality, Maintenance, and Delivery, Recycling...).

Each function of this axis is decomposed in: to manage the products/service (internal or external, it means supplying and purchasing), to manage the resources (human or technical) and to plan (to synchronize at each level product and resource management).

A decision centre is defined at a cross of a function and decision level.

The GRAI nets are aiming at describing in details all the activities identified inside each decision centre of the GRAI grid.

Phase 1 / Identification of the Decision Canter objectives and coherence analysis

This phase is aiming at identifying the objectives of each Decision Centre identified in the GRAI Grid. We follow a top-down approach: it means that the first step consists in identifying the organisation global objectives, the second in identifying the global objectives of each function belonging to the functional axis, and the third in defining the objectives of each Decision Centre inside the functions. These identifications are based on the notion of contribution. Actually, each objective must contribute to the achievement of the objectives identified at the upper level. Each step is supported by graphic tools (splitting up diagrams) allowing to verify if a sub-objective contributes to an objective at the upper level.

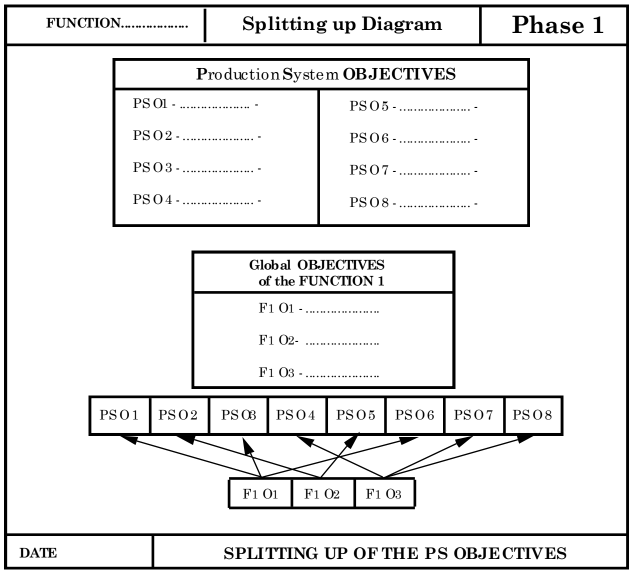

Figure 33 - Splitting up diagram

Then, the inter-function coherence between the global objectives is analysed. The links which exist between the global objectives of the various functions are identified in order to check there are no perverse effects (the objectives assigned to a function do not prevent another function to achieve its objectives).

Phase 2: Identification of the DC Drivers and analysis of the conflicts

As already mentioned, if it is necessary to know the objectives in order to build relevant performances indicators, it is not sufficient. Actually, the drivers, corresponding to each objective of Decision Centres must be identified (Figure 33). This identification must be interpreted as one of the steps leading to the building of the triplets (Objectives / Drivers / Performances Indicators). This notion of triplet is another valuable characteristic of the method, and it expresses the controllability principle.

During this phase, it is necessary to highlight the intra-function and inter-function influences of the Drivers. The aim here is to evaluate the relationships which appear inside a function and between the functions. Indeed, the proposed objectives (and by consequence the Performances Indicators) for a given Decision Centre are sometimes related to drivers that belong to another Decision Centre. In this case, we must evaluate the degree and the origin of the influence. The notions of "driver with direct effect and indirect effect" refer to this phenomenon. A direct effect is assigned to the driver which has a dominating influence on the considered objective.

Phase 3: Identification of the DC Performances Indicators and internal coherence analysis. Identification of the Performances Indicators for the Decision Centres.

The previous phases allow, for each Decision Centre, to identify one or several objectives (coherent with the global objectives of the function, themselves coherent with the global organisation objectives) and the associated drivers. The determination of the Performances indicators is performed during this phase 3. The approach uses the knowledge of all the people involved in the study and this identification is validated by an internal coherence analysis inside each Decision Centre.

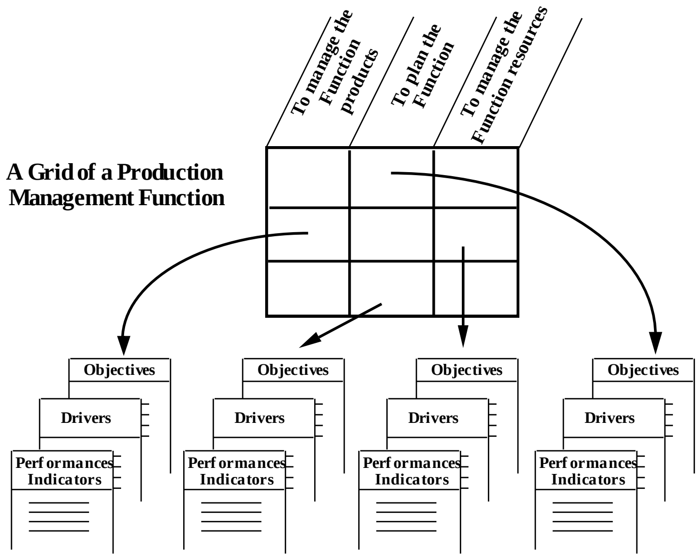

Figure 34 - Identification of the DC Performance Indicators

Internal coherence analysis in the DC

This study consists in verifying the internal coherence inside the Decision Centre in terms of triplet {Objectives / Drivers / Performances Indicators}. A triplet is coherent if:

- It is composed of one objective, one or several drivers and one or several performances indicators,
- The performance indicators allow measuring the efficiency of an activity or a set of activities of the considered function in the process to reach the objective, and are influenced by actions on the drivers (Figure 34).

Figure 35 - Internal coherence studied in each Decision Centre

In order to verify this coherence, coherence panels are built. They allow identifying the various links between the elements of the DC as well as their weight.

Then, "coherence panels" are filled in (Figure 35). The links between the DC elements are classified according to the connection (strong link / weak link / no link).

Figure 36 - Coherence panel

Phase 4: Design of Performances Indicators information system

An indicator is basically a measure which will become more and more sophisticated: "measure -> raw information -> process -> review -> statistical process" can be an example of a possible chain. ECOGRAI is completely oriented towards the phase of specification, which is preliminary to any possible automation of the performances evaluation system. Two aspects are considered: the data aspect (which information are necessary?) and the processing aspect (the processing which are necessary to build the indicators, starting from basic information). Whatever the case of study, it is always necessary to define clearly each indicator with fundamental parameters. The tool which guides these definitions is the specification sheet for each indicator which contains:

- The identification of the indicator (name, decision centre, horizon, period);
- The objectives and the drivers related to the indicator;
- The perverse effects which have been identified,
- The identification of the data required for the implementation of the indicator;
- The definition of the associated processing;
- Finally, the way of representing the indicator, determined by the future users (using graphics for most of the time).

Phase 5: Integration of the Performances Indicators information system inside the enterprise or the MSEE IT system

The phase five consists in integrating the performances indicators system inside the organisation IT system. This integration phase is developed using an EIS tool or a business intelligence tool. It is used to converse with the existing data bases. Data on MSEE IT system are located and the extraction frequencies, the processing and the visualisation choices to exploit the Performances Indicators are then specified into the EIS tool. This work is performed from the specification sheet.

The implementation of ECOGRAI method

One cannot define a method to design and to implement PIs without defining also the way to implement it. So the ECOGRAI structured approach is based on the GRAI structured approach. In particular, the notions of involvement (creation of various working groups), and top-down / bottom-up approach have been kept.

Three kinds of groups are defined (Figure 37):

- The synthesis group is composed of the people in charge of the considered business unit. They define objectives and orientations, and they check the results presented by the analysis group during the synthesis meetings. They also structure the information and locate them in their context;
- The functional group, is composed of the main actors of the considered function of the organisation (managers, supervisors, and if necessary, operators). During the functional meetings with the analysis group, this group is involved in the organisation analysis of the function they are in charge of the definition of the indicators;
- The analysis group, composed of one analyst (eventually two or three depending on the size of the study) has in charge to help the two other groups to collect information, to organize meetings, to formalize the results and to propose solutions to the problems which may appear during the study.

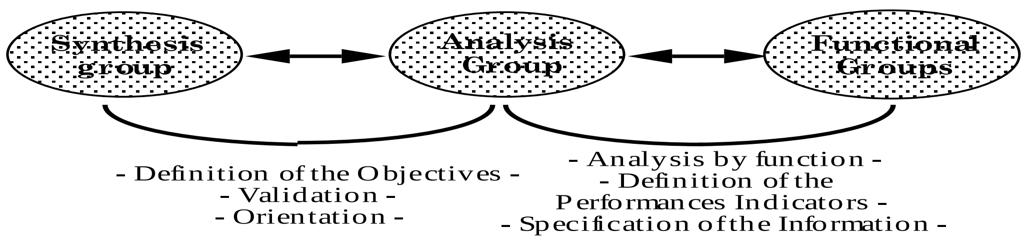

Figure 37 - The various groups involved in the structured approach

The information technology department involved in the design, with the help of an EIS specialist, ensures the physical implementation of the performances indicators.

Thus, after having constituted the various groups, the structured approach follows the six phases of the method. The main remark that can be made is the continuous iteration between the functional groups and the synthesis group all along the study.

6.3. Value Reference Model

In this section the Value Reference Model is going to be presented and explained. The Value reference Model (VRM, VCG 2012) has been chosen for the selection and measurement of metrics for MSEE End Users, which provides pre-defined measurable indicators for Value Chain goals in several dimensions.
VRM and ECOGRAI method have been selected within MSEE Project to be the supporting tools on defining and assessing the efficiency of Performance indicators.
The ECOGRAI model, which has been chosen to design and to implement performance indicators, as presented in the previous paragraphs, has been adopted as a method to cover the gap and the open issues left by VRM.

In D51.2 a Methodology for Requirements Engineering & Evaluation in Manufacturing Service Ecosystems is discussed; in particular, an assessment of the MSEE Impact on Process Performance is performed by adopting VRM.

Following this model, it is possible to select appropriate processes and dimensions, featuring the preferential goals and objectives for each end user. This allows selecting the appropriate Key Performance Indicators to evaluate the process improvements of implementing the MSEE results.

This is the reason why VRM is applicable in MEs, VMEs and MSEs environment.
The Value Reference Model Framework (VRM) provides descriptions of standard processes, their inputs and outputs, metrics and best practices. Input and output templates and guidelines for tactical level processes are also provided. The VRM does not only focus only on managing the processes of a supply chain for a given product, but also incorporates the preceding and successive activities of product development and customer relations in the sense of a value chain.

By the application of the VRM, value chain goals of horizontal and vertical collaboration are supported by a standardised language of syntax and semantics. Processes, activities and their dependencies are described and relational connected throughout the value chain. The comprehensiveness of the Value Reference Model provides a suitable approach for visualization of the performance(s) of the total Value Chain, or parts thereof by providing standard metrics (Key Performance Indicators) throughout the Value Chain (VCG 2012).

6.4. VRM Processes

The VRM model is structured to support the integration of the three domains product development, the supply chain and customer relation in a reference model for an integrated value chain.

The Top Level of the model encompasses all the high level processes in Value Chains which are represented through the Process Categories *Plan – Govern – Execute* (see38). The Plan process is used to align strategic objectives with tactical and execution abilities. Govern supports the strategic objectives by rules, policies and procedures for the Value Chain. Execute encompasses all execution processes in a strategic context within the management criteria from Govern and the parameters defined by Plan.

The Level is defined to be the Strategic Level of the Model, meaning that this is where high level decisions are made regarding how to gain a competitive advantage for the Value Chain in scope. An example of such a competitive advantage could be Increased Market Share through a Cost Optimized, Adaptive Value Chain and extensive Collaboration with Customers and/ or network partners (VCG 2012).

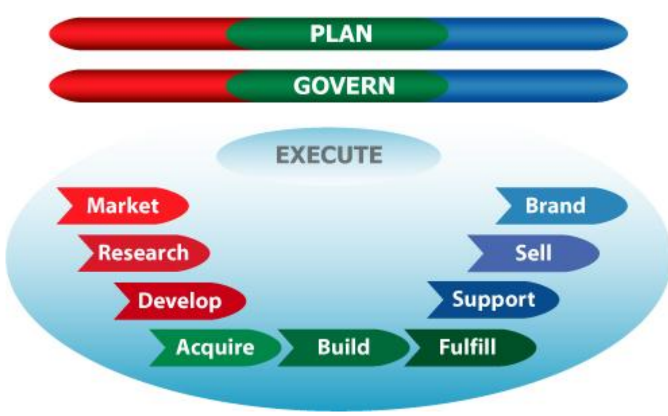

Figure 38 - VRM Strategic and Tactical Level Processes (VCG 2012)

The Second level of the model contains "abstract" processes decomposed from the Strategic Level. The Value Reference Model processes decompose from Strategic to the Tactical Level with Plan and Govern keeping their respective naming. Execute decomposes to *Market-Research-Develop-Acquire-Build-Sell-Fulfill-Support* (VCG 2012).

The third level of the model represents specific processes in the value chain related to actual activities being executed. On this level, focus is usually vertical business process improvements or business process re-engineering (see Figure39). In a value chain perspective this is the level where fine-tuning occurs (VCG 2012). The performance measurement on this level is the key to evaluate the improvements and assessing the benefits.

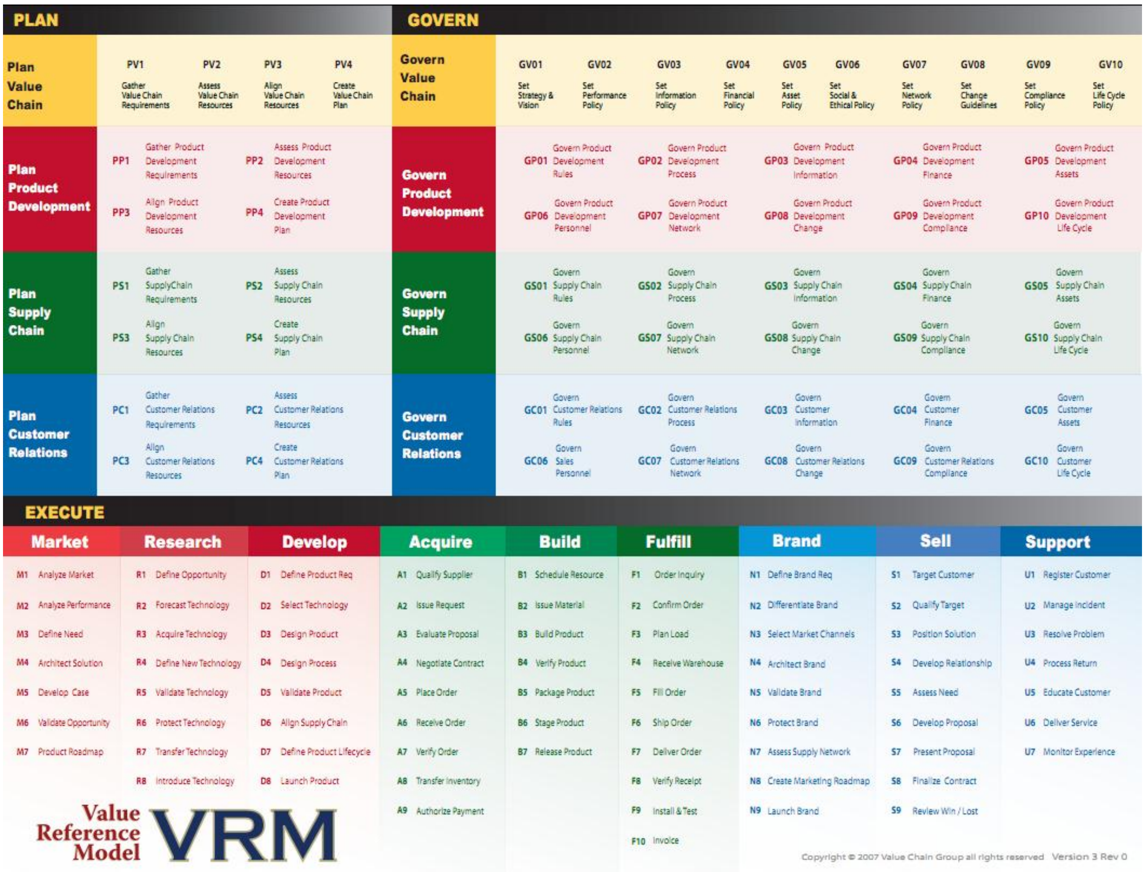

Figure 39 - VRM Operational Level Processes (VCG 2012)

The metrics provided by VRM are not only mapped to the processes of the framework, but also grouped into seven distinct dimensions, each representing a different area for optimization (see the Table below).

Priority Dimension	Description	Examples for KPI's
Reliability	The ability to deliver the correct product to the correct market and customers on time.	*Delivery Performance, Request Date Product Release Variance Forecast Accuracy*

Velocity	The cycle time it takes to deliver a product or service to the customer.	*Order Fulfillment Lead Time* *Product Development Lead Time*
Adaptability	The capability in responding to market place changes to gain or maintain competitive advantage.	*Delivery Adaptability* *Value Chain Agility* *Ideation Yield*
Cost	The cost associated with operating a value chain.	*Cost of Quality* *Design Cost Ratio* *Logistics Cost Ratio* *Manufacturing Cost Ratio* *Sales & Marketing Cost Ratio*
Asset	The effectiveness of an organization in managing assets of the value chain to support market and customer satisfaction.	*Asset Turnover* *Cash Conversion Cycle* *Design Realization* *Inventory Days of Supply*
Innovation	The ability to strategically leverage internal and external sources of ideas and introduce them to market through multiple paths.	*Product Innovation Index* *R&D Profit Contribution*
Customer	The capability to develop positive collaborative customer relationships.	*Customer Growth Rate*

Table 2 - VRM Priority Dimensions (VCG 2012)

After processes and priority dimensions have been identified, the VRM gives information about possible metrics to measure business process improvements. The Table below shows the information delivered for each metric by the VRM.

Information	Content
Metric Name	Brief descriptive name less than 50 characters.
Metric Definition	Detailed definition usually one sentence to two paragraphs in length.
Priority Dimensions	Strategic Classifications used in Value Chain Alignment.
Metric Class & Sub Class	Classification for navigation and search index.
Formula	Algorithm for calculating metric value. Some metrics are considered a „Base Metric“ in which calculations are not required.
Input Requirements	Suggested application data fields and sources to acquire information necessary for performing the calculation.
Dimensions	Sources of input from different areas of involvement.
Calculation Rules	General notes and guidelines for use of the metric.

Table 3 - VRM Metric Information

6.5. MSEE PI method

During the MSEE Milano Meeting (22-25 January 2013), an MSEE PI method to create and select PIs has been agreed among partners. PIs will be generated and selected according to a Reference Governance framework which has been identified as a supporting decisional tool to govern MEs, VMEs and MSEs.

As explained in the previous chapters, two methods have been identified to create a reference framework for service governance: GRAI method and Unified Governance Framework (UGF). Both mentioned method will be synthesized together to represent and describe the service governance framework and its interaction with the external and the internal information. It should be emphasized that the GRAI method has been selected in order to synthesize coherently various governance concepts (at a detailed and global level) in one generic model and facilitating the integration between decisional levels and functions. Meanwhile, UGF has been selected because it has a certain focus on the use of IT and IT-based services to achieve enterprise governance.

The result of GRAI method and UGF combination will give to shape a new conceptual framework for service governance. This new framework needs to be structured, as previously explained, within the MDSE Architecture in order to classify PIs into different level of decompositions; it means decomposition by level of abstraction (BSM, TIM and TSM) and decomposition by level of decision (Strategic, Tactical and Operational). Therefore the PIs generation method needs to be coherent with this scientific background.

ECOGRAI and the Value Reference Model (VRM) are the methods which will be used to design, select and implement specific PIs according to the precise objectives identified by the Reference Governance Framework. This method can be applied to a single ME, within VMEs but also referring to MSE Ecosystem.

As mentioned in the previous paragraphs, in order to design and implement the PIs, ECOGRAI method will support the enterprise and service organizations by generating decision requirements. ECOGRAI offers no predefined processes or PIs list but consists in a methodological approach based on GRAI method governance approach. Therefore ECOGRAI will help identifying appropriate indicators according to the defined methodology.

On the other hand VRM will be used as a framework that provides pre-defined business processes to be identified and then used as input for the GRAI method. In this way VRM will offer support to the end user on selecting which are the main processes to take into consideration while structuring their service system governance. In fact VRM is a classical reference model that is providing a catalogue of building blocks for the definition of processes and KPIs. As such, VRM provides pre-defined KPIs, which are used by ECOGRAI to create a consistent set of KPI that is aligned to the required decisions.

Therefore VRM framework and ECOGRAI approach will be integrated in order to provide a more coherent and useful set of PIs. The governance reference model is needed to support the definition of service/use case objectives so to govern the selection of processes from the blocks provided by VRM.

In the following, a list of actions is presented in order to specify and clarify the MSEE method to generate and select PIs:

1. The Governance model has to be defined (through GRAI grid) and will be then used as a reference to govern the process selection through VRM according to the precise service/use case's objectives;
2. The VRM framework will be used to identify the affected business processes for each use case (plan-govern-execute), which are used to define the processes and functions in GRAI grids;
3. ECOGRAI will be used to define the decisions inside decision centers based on a discussion with pilots and to define the objectives and decision variables of each decision
4. At this point, priority dimension are identified for each process and pre-defined PIs will be selected (through VRM). Both methods will be used, and it will be possible to pass from one to the other in order to reach the maximum efficiency on PIs design and implementation.

Specific PIs will be generated following ECOGRAI which is based on GRAI method and therefore relays on the service/use case definition of main objectives and goals through GRAI grids. VRM will be then used again to integrate relevant elements to add like priority dimensions and related PIs, domains, metrics, etc… In fact in VRM the definition of the goals for each process is described using the VRM Priority Dimensions.
In particular ECOGRAI will be used to define the decisions inside the decision centers based on Use case's objectives and also to help identifying the objectives and decision variables of each decision. On the other hand VRM will suggest specific KPIs referring to the business processes and priority dimensions previously selected to fill the GRAI grid.
Use cases will select matching indicators from the list of KPIs suggested by VRM Framework for the process steps/activities. Therefore ECOGRAI method will be used to integrate missing elements, and cover the gaps and open issues derived from VRM.

Finally, as a further step we propose to validate this MSEE PIs methodology through the Use cases. A definition of objectives and functions needs to be provided by the Use cases in order to help us defining their governance rules with which we can select the processes and the PIs from VRM. Following the same governance rules we can generate specific PIs using ECOGRAI method. After this phase Use cases will be involved again in order to test all the defined PIs so to maximize their efficiency.

6.6. Results of the Workshop on MSEE PI method

During the MSEE Milano Meeting (22-25 January 2013), a workshop on MSEE PI method has been done to clarify the methodology to create and select PIs within MSEE Project.
The workshop has been based on the integration between different methods, i.e on how to combine GRAI, ECOGRAI and VRM approaches.
A VME creation has been taken into account as an example of integration between VRM and ECOGRAI.
MSEE governance method for VME has been applied to a generic VME creation concept. Therefore GRAI method has been used in order to analyse which functions should have been identified inside the GRAI grid. The main objectives have been identified in order to set the definition of governance rules.
Then, according to them, VRM framework has been examinated in order to select the more coherent processes. According to the Process definition (see Plan-Govern-Execute by VRM), the following functions have been identified:

- Management of process;
- Management of products;
- Management of information;
- Management of finance;
- Management of assets;
- Management of personnel;
- Management of network.

Levels	**Functions**						
Func-tions/level	**External info**	**Process mgmt**	**Product mgmt**	**Finance mgmt**	**Infor-mation mgmt**	**HR mgmt**	**Internal info**
Strategic		Definition of main processes in charge of VME	Definition of main service product to perform	Budget, invest-ment def-inition	Communi-cation poli-ty and con-fidentiality	Recruit-ment plan	
Tactical (means)		Definition of tools to support the process	Master service production service				
Opera-tional		Short term planning					

Table 4 - VME creation GRAI grid

(VRM governance model to control VME creation, GRAI essentials in bold-italic).

In the above table it is possible to see a first practical example of how a VME creation governance can be structured following the GRAI grid. As it has been already explained in the previous lives, the VRM framework has been adopted to define the functions on which give structure to the GRAI grid.

Then PIs have to be identified through the integration of VRM and ECOGRAI methods.
In the final version of the deliverable, as a further step, we propose to:

- Develop further this structure in other to specify it in detail;
- Start generating PIs according ECOGRAI approach;
- Start selecting PIs following VMR method.

The same methodology has to be applied to specific Use cases in order to generate practical results and use this selection of PIs as exploitable assets from the end users.

6.7. Roadmap based on Final agreement

After the final agreement on MSEE PI method has been achieved, a roadmap on next scientific research activities, updates and validation needs to be defined.
Here below the main activities the MSEE PI method will follow are highlighted just to remind:

- The Use Case Governance model has to be defined (through GRAI grid) and will be then used as a reference to govern the process selection through VRM according to the precise service/use case's objectives;
- The VRM framework will be used to identify the affected business processes for each use case (plan-govern-execute), which are used to define the processes and functions in GRAI grids;
- ECOGRAI will be used to define the decisions inside decision centres based on a discussion with pilots and to define the objectives and decision variables of each decision;
- At this point, priority dimension are identified for each process and pre-defined PIs will be selected (through VRM). Both methods will be used, and it will be possible to pass from one to the other in order to reach the maximum efficiency on PIs design and implementation.

The MSEE PI method implies a strong collaboration between scientific research and Use cases. Pilots and researchers need to work together accordingly. Therefore the roadmap will take into account the interdependence of these activities; in parenthesis the responsibilities of the partners have been provided. The roadmap based on final agreement can be described through the following steps:

1. Investigate Use case servitization process (responsibility of the Use case in collaboration with POLIMI);
2. Define the Use Case Service Governance framework (Use case in collaboration with POLIMI);
3. Adopt the MSEE PI method in order to generate specific PIs (POLIMI);
4. Match Use Case Requirements (Use case in collaboration with POLIMI);
5. Validate the results with the Use Cases in order to improve their efficiency (Use case);
6. Optimization of the PIs (POLIMI).

6.8. Indesit Use Case: first feedback

According to the Roadmap on final agreement, a first approach on Indesit pilot processes has been studied and developed.

In the below table governance and servitization activities have been investigated according to Indesit main objectives.

As it is possible to notice, first of all a set of functions has been defined and classified inside the two frameworks of servitization and governance. Service, Service ideation, Design and engineering, commercial, delivery and disposal have been detected as the main functions.

Secondly the main objectives have been identified inside each function, specifying the internal objectives at strategic, tactical and operational level in order to detail the decomposition of level of decision.

Finally a KPIs proposition has been suggested accordingly. Indesit provided a list of KPIs they are already using for their internal report and monitoring activities. These indicators have been purified and classified according to the following first attempt of servitization /governance modelling process.

It is important to highlight this is a first feedback on the path of precise PIs definition; therefore further research is needed in order to support the Use case with final and exploitable results.

Indesit FUNCTIONS	**Governance OBJECTIVES**	**Strategic - Tactical - Operational**	**KPIs proposition**
SERVICE	Technical support Consumer loyalty Increase of service sales	S: business plan for service proposition to final consumers T: planning of the actions to provide services supporting the customer needs O: implementation of planning actions, service delivery	Customer satisfaction
DESIGN & ENGINEERING	Efficiency Sustainability of the manufacturing process Energy saving Usability (human-machine interaction)	S: technological innovation, selection of design-for-X methodologies T: product and process technological choices O: implementation of the selected technologies, application of design-for-X methods and tools	Number of New Ideas Production Costs, Direct Production Costs, Indirect Effectiveness in designing (iterations) Efficiency in designing (time)
COMMERCIAL	Increase in product sales Consumer loyalty	S: product sell planning T: order planning O: validation of product orders	Identification of consumer needs Customer growth rate
DELIVERY	Efficiency in use Sustainability of transport	S: planning of the transports, planning of the marketing actions T: managing of the resources O: transport-resources combination to have the optimal solution; high Efficiency performance	Time to market for new product-services Number of new registrations
DISPOSAL	Sustainability	S: selection of consortia T: planning of disposal policies O: implementation of the best disposal policy	
Indesit FUNCTIONS	**Servitization OBJECTIVES**	**Strategic - Tactical - Operational**	**KPIs proposition**
SERVICE IDEATION	Service customization User habits analysis Increase of service sales	S: business plan for the company services T: service activities reorganization O: implementation new servitization cycle	Customer satisfaction
DESIGN & ENGINEERING	Service efficiency Energy saving Connected devices	S: research and development of a proper service infrastructure, creation of a proper ecosystem T: planning of design and engineering actions, consumer data management O: HW and SW implementation	Efficiency in designing (time) Effectiveness in designing (iterations) Service performance Number of new registrations
COMMERCIAL	Increase in service sales Creation of new strategic/commercial partnerships Consumer loyalty	S: service sell planning and ecosystem organization T: order planning and ecosystem management O: validation of service orders and partnership agreements	Demand forecasting accuracy Customer growth rate Brand sales growth

DELIVERY	Efficiency delivery service	S: general planning of the service delivery, planning of the marketing actions, planning of the customized contracts T: annual service planning, planning product-service evolution O: short term service scheduling, high Efficency performance	Time to market for new product+services Number of new registrations
DISPOSAL	Sustainability Recycling/Reusing	S: selection of consortia T: planning of disposal policies, planning of the product reuse O: implementation of the best disposal policy	

Table 5 - Indesit Use case table (servitization/governance)

6.9. List of PIs classified by Use Cases

In this section, we present a Use Cases Table in which PIs have been associeted with End Users case studies (i.e. Ibarmia, Indesit, Bivolino and TP Vision).
This is a first attempt to provide a selection of PIs related to specific Use Cases.
In the final version of this deliverable we suggest to validate our PIs methodology proposal within a real condition enterprise environment. We propose to follow the steps which have been presented in the previous paragraph, using the useful data and information which will be provided by each end user.
A list of KPIs, has been previously identified for the service system (see D13.5), and here has been classified for measuring each case study specifically.
Uses cases represent useful examples to be used to validate the indicators we already generated. The basic idea behind this validation is to optimize the indicators and the whole efficiency of the PIs generation and assessment method.
Apart from the end user cases, MSE context has been considered too. The Ecosystem plays a great role in defining MSEE objectives. Therefore the Ecosystem needs to be monitored as well as single enterprises. In the below table some KPIs have been addressed to monitor the Ecosystem but further research is needed in this field in order to create a concrete monitoring and supporting toolset.

KPIs	Use Cases				MSE
BSM (Business Service Modeling)	Ibarmia	Indesit	Bivolino	TP Vision	
STRATEGICAL					
Stable service mission regularly /week or month			X	x	
Long-term culture and value referred to the SLA		x	X	x	X
Service Brand value		x	X	x	X
Service capabilities	X	x	X	x	
Service guarantee	X	x	X	x	
Service Financial capital guarantee	X	x	X	x	
Service functionality (resources and industry expertise, human capabilities and knowledge, Skills, Seniority, Reusability of resources, R&D, Design Expertise_ human related field)	X	x	X	x	X
Service Innovation	X	x	X	x	X
Service Law and regulation	X	x	X	x	X
Service Standards (internal controls and audit systems) and best practices		x		x	

Service Responsibility (safety issues, reliability, guarantee, recall campaigns, reliability factor (e.g. 100000 km/car), complaints and service breaches)	X	x	X	x	X
Cost (Enterprise investment, service operation cost etc.)	X	x	X	x	X
Service Control Management System	X	x	X	x	X
Service performance goals feasibility	X	x	X	x	X
Service Support management tools	X	x	X	x	X
Service Relationship tools among suppliers/customers	X	x	X	x	X
Number of incentives		x	X	x	X
Number of new services/introduced services			X	x	X
Number of new service requirements added by R&D / total number of new requirements	X	x	X	x	X
Number of projects developed in co-design/ total number of projects developed	x	x	x	x	X
Number of people involved in the service process with full access to service data/total number of people involved in the service process	x	x	x	x	X
number of service designers / numebr of employees engineers	x	x	x	x	X
Service costs/total costs	x	x	x	x	
BEP	x	x	x	x	
NPV to analyze the profitability of service investment	x	x	x	x	X
Profits from new services/profits from all services on market	x	x	x	x	
Expected number of years of presence on the market	x	x	x	x	X
Time to market	x	x	x	x	X
service Development Lead Time	x	x	x	x	X
Service Delivery Value	x	x	x	x	X
Service Chain Agility	x	x		x	X
Service cost ratio / total cost	x	x	x	x	X
Marketing cost ratio / total cost	x	x	x	x	X
Servivce Asset Turnover Cash / total turnover	x	x	x	x	X
Service Innovation Index	x	x	x	x	X
R&D Profit / total profit	x	x	x	x	X
Customer Growth Rate	x	x	x	x	X
Nr of transactions/partner					X
Nr transaction/industry sector					X
Administrative costs/partner, revenue	x	x	x	x	X
Organizational (e.g. size and competencies)	x	x	x	x	X
Financial (P&L, Operational cash flow, turnover related to latest 3 years)	x	x	x	x	X
ICT Technologies (Interoperability, Platform, Security standards)	x	x	x	x	X
Number of resources and industry expertise (human capabilities and knowledge, Seniority, Reusability of resources)	x	x	x	x	
Health and Safety Issues	x	x			
Price	x	x	x	x	X
MSE Turnover (Turnover/partner, Turnover/industry sector, SLAs)	x	x	x	x	X
Number of knowledge exchange events (forum, conferences) / Number of events	x	x	x	x	X
R&D projects in cooperation with customers / R&D project	x	x	x	x	X
Number of new ideas developed in the past years		x	x	x	X
TACTICAL					
Customer satisfaction rating	x	x	x	x	
Number of customer survey / month or year	x	x	x	x	X

Service Employee turnover	x	x	x	x	
Service Employee satisfaction level	x	x	x	x	X
Service Social/Relational (reputation, brand identity, satisfaction level)		x	x	x	X
Service Retention bonds / total service price	x	x	x	x	X
Price	x	x	x	x	
ICT Technologies related to the Service (Interoperability, Platform, Security standards)_ IT related field	x	x	x	x	X
Service Information sharing tools				x	
Human Resources management tools	x	x	x	x	X
Services Maintenance	x	x			
Service Investments/profit	x	x	x	x	X
Service Control Management tools	x	x	x	x	X
Number of Service Accessibility tools	x	x	x	x	X
Service Documentary tools (create data base)	x	x	x	x	X
Service Flexibility, disaster recovery, resources reconfigurability, etc	x	x	x	x	X
Service Quality Management tools	x	x	x	x	X
On time Service Delivery	x	x	x	x	X
Number of new introduced services			x	x	X
Cost ratio service operation / total cost	x	x	x	x	X
Cost Ratio Logistics / total cost	x	x	x	x	X
Number of recruited partners					X
Number of partners by type of organization					X
Reaction to complaints	x	x	x	x	X
Nr of complains/partner					X
Association fees	x	x	x	x	X
R&D (investments in Technology)					
Quality and reliability	x	x	x	x	X
On time delivery					X
Number of applications/industry sector					X
Nr of contracts/industry sector					X
Value of incomes generated per period	x	x	x	x	X
Mean value of incomes per patent				x	X
Financial backlog (short, medium, long term)	x	x	x	x	X
Operational cash flow	x	x	x	x	X
Turnover	x	x	x	x	X
Repository Size for Tangible and Intangible assets management	x	x	x	x	X
Number of Periodical Issuing of MSE KPIs and SLAs	x	x	x	x	
Number of communication events (forum, meetings, Advs)					
Number of tangible and intangible assets available as a service	x	x	x	x	X
Claiming costs	x	x	x	x	
Number of new services implemented / number of projects generated	x	x	x	x	X
OPERATIONAL					
Number of adopted Service International / national quality standards	x	x	x	x	X
Operational cash flow	x	x	x	x	
Number of Service Technological facilities (tools and device)	x	x	x	x	X
Service maintenance employee / hour	x	x	x	x	X

Service maintenance employee / month	x	x	x	x	X
Number of tools for evaluating the service quality (checklists etc)	x	x	x	x	X
Number of HW/SW for Controlling service processes	x	x	x	x	X
Number of Aftersale services / service (number of repair shops, number of customer services, etc)	x	x	x	x	X
Intangible factors management tools for service (to evaluate direct knowledge, long-term relationship, shared values, direct experience)	x	x	x	x	X
Service On time delivery (Internet base services)	x	x	x	x	
Number of entries and exits in the Ecosystem					X
Number of entries and exits by type of organization					X
Number of complaints/partner					X
Average time to address the problem	x	x	x	x	
Number of established agreements					X
Number of satisfied/unsatisfied agreements					X
Number of conflicts arisen					X
Number of conflicts solved					X
Mean revenue for exploited result					X
Timeframe in which the result is exploited					X
SLA	x	x	x	x	X
Contract costs/partner revenue					X
Legal costs/partner, revenue					X
Claiming costs	x	x	x	x	
Recalls	x	x	x	x	X
Business hold/partner					X
Number of contracts	x	x	x	x	X
Number of suppliers				x	X
Number contracts breached					X
Number of long-term strategic collaboration partnerships					X
Number of partnerships per country					X
Number of approved patents,		x		x	X
Number of pending patents		x		x	X
Patent/partner	x				X
Patent costs/partner	x				X
Mean number of partners involved in a patent					X
Number of copied services without agreement	x	x	x	x	X
Number of communication channels (blogs, platforms, internal mail system, posts)				x	
Number of physical and online events organized for service development / year					X
numebr of service events attended/partner					X
Number of service events participants/event					X
Number of service events unattended/partner					X
Number of customer filled surveys/partner	x				X
Number of received feedback and suggestions/partner	x	x	x	x	X
Number of shared documents	x	x	x	x	X
Number of enquiries to the knowledge management data-base/partner/month					X
Number of expert advice					X

Number of upgrading occurrences on the knowledge management database/partner/month					X
Number of services, patents, white papers, percentage of responses to demands for each stakeholder,					X
Number of assets put at MSE's disposal					X
Number of VME joining/partner					X
Number of VME dissemination actions					X
Number of newsletters					X
Number of press releases, Number of appearance in the media					X
Number of published news/partner/month					X
Number of used communication channel					X
Number of information requests/partner	x				X
Number of inherited assets/outputs/contacts					X
Number of created spin-offs					X
Number of joint-ventures	x	x		x	X
Mean share capital when creating a spin-off					X
SLA for ICT	x	x	x	x	X
Uptime	x	x	x	x	X
MTTR/service	x	x	x	x	X
MTTF/service	x	x	x	x	X
MTBF/service	x	x	x	x	X
Band width capacity					X
Number of transaction to the repository					X
Number of Failure logs					X
number SLAs related to tangible and intangible assets	x	x	x	x	X
Number of R&D researches	x	x	x	x	X
Value of new services implemented/turnover	x	x	x	x	X
TIM (Technical Independet Modeling)	x	x	x	x	X
Service guarantee	x	x	x	x	X
Organizational functionality for service (Number of R&D missions, Customer focus, etc)	x	x	x	x	X
Customer satisfaction rating	x	x	x	x	X
Number of Service Communication/Information exchange tools (communication channels, HW/SW facilities, available protocols etc)	x	x	x	x	X
Number of R&D missions/partner	x	x			X
Subgoals for customer satisfaction	x	x	x	x	X
Type of standards/partner	x	x			X
Number of collaboration activity (internal and external)/partner	x	x	x	x	X
Upgrading technology/service/year	x	x		x	
Service Performance Management (number business goals attended/proposed, number business subgoals attended/proposed, positive feedbacks, monitoring main outputs, evaluating performances)	x	x	x	x	X
Service Periodical Control Processes	X	x	x	x	X
Use and update of service information/partner	X	x		x	X
Anthology of relationships with supplier and customers	X	x	x	x	X
ServiceOrder fulfillment time/partner	X	x	x	x	X
Web ordering downtime/partner	X	x	x	x	X
Number of tools for evaluating the service quality (checklists etc)	X	x	x	x	X

Service Monitoring performance tools (human/automated system monitor, analytic tools, anomaly detections)	X			x	X
IT oriented service architecture/ IT infrastructure capability/partner	X	x	x	x	X
Number customer or suppliers complaints/partner	X	x			X
Number of standard tasks for service operation/total number of tasks	X	x			X
Number of tested parts/ number of supposed critical parts	X				X
Number of times that a design had to be reworked	X	x	x	x	X
Number of projects ongoing at the same time/partner	X	x	x	x	X
Number of new services/ projects/partner	X			x	X
Number of alternative solutions to new designs	X	x	x	x	X
Customer satisfaction rate/partner	X	x	x	x	X
Service Delivery Performance/partner	X	x	x	x	X
TSM (Technical Specific Modeling)					
Type of standards adopted/partner (domestic and international certificates issued by original manufacturers)	X	x	x	x	X
ICT Technologies tools/partner (Platform, Security standards)_ IT related field	X	x	x	x	X
Information sharing tools/partner (i.e. network tools like Joinme, Facebook, etc..)	X	x	x	x	X
Service Performance Management tools/partner (number service goals attended/proposed, number service subgoals attended/proposed, positive feedbacks, monitoring main outputs, evaluating performances like for example Service delivery softwares)	X	x		x	X
HW/SW for Controlling service processes/partner	X	x			X
Service documentation tools/partner (reports , record retentions, paper based/digital Drawing, technical specifications, cd, external hard/software, etc)	X	x	x	x	X
type of IT architecture-IT infrastructure/partner (i.e. C++, Java, etc…)	X	x	x	x	X

Table 6 - Use cases table

7. Conclusion

The main aim of this deliverable was to design, implement and select PIs and SLAs according to a Reference Governance framework which has been identified as a supporting decisional tool to govern MEs, VMEs and MSE.

In this document a MSEE Governance methodology has been proposed in order to support and define a clear governance framework to be used by End Users.
Several methods have been studied and synthesized in order to create a MSEE governance framework for service: GRAI method (Graph with Results and Activities Interrelated), UGF (Unified Governance Framework) and MDSEA (Model Driven Service engineering Architecture).

Then, starting from this basis, we study a method to generate and classify specific KPIs related to the precise Use case objectives.
In the final version of this deliverable specific PIs and SLAs will be created and selected for precise Use cases following the MSEE governance for VME.

As shown on the figure below, ECOGRAI has been selected as the reference method to design PIs within a manufacturing service ecosystem, based on models determined in WP 1.1.

VRM has been defined as a supporting tool for the selection of the main business processes end users have to take into consideration while structuring the governance.

The interaction among different SPs has been herewith summarized: the method, defined by SP1, is integrated by the list of PIs and SLAs, provided by SP5, aiming at controlling and monitoring the servitization process and service innovation governance within a manufacturing ecosystem, as detailed in SP2. Finally, use cases are tested to verify feasibility and effectiveness of the relevant methods and processes accordingly.

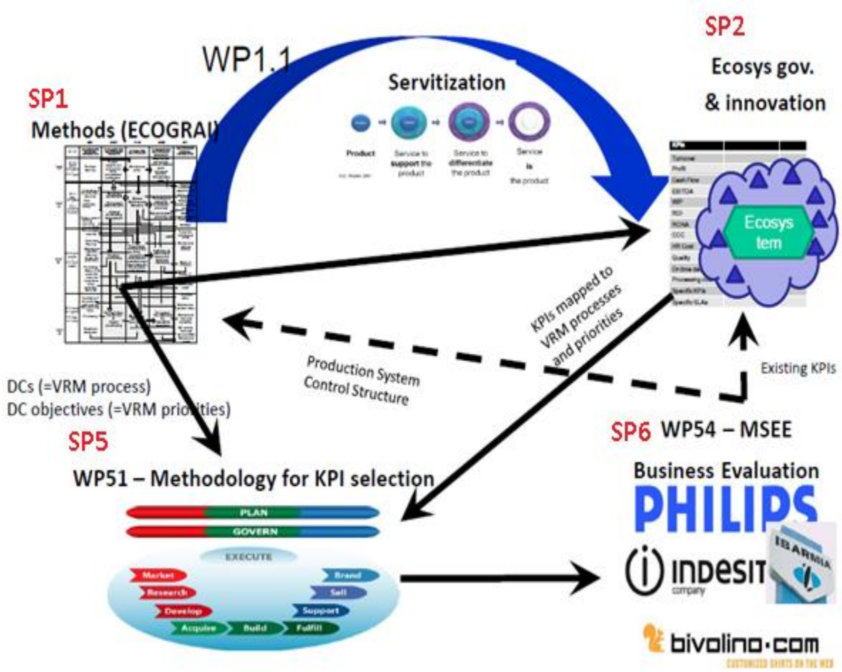

Figure 40 - PIs management method

PIs and SLAs will be used to monitor and control performances both at design and a run time stages. In this way, enterprises will be able to provide the required information in the correct timing in order to enable the full usage of PIs and SLAs during the operational phase and the relations with other partners.

Further steps are needed in order to validate the mentioned methodologies. In the final version of this deliverable we suggest to validate our PIs methodology proposal and the Governance framework within a real condition in an enterprise environment. We propose to validate this MSEE PIs methodology through the Use cases.
First of all a definition of objectives and functions needs to be provided by the Use cases in order to define their governance rules through MSEE Governance framework method.
Following the objectives structured by the governance reference method we can then select the processes and the PIs using VRM. Following the same governance rules we can generate specific PIs using ECOGRAI method. After this phase Use cases will be involved again so to test all the defined PIs in order to maximize their efficiency.

Finally, this deliverable represents an iteration step towards the final goal, which is the definition of appropriate PIs and SLAs, methods and tools for the transition from product to product+service companies within a manufacturing service ecosystem, aiming at exploiting effective service innovation.

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