

## **PROJECT FINAL REPORT**

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## Executive summary

The SustainValue (Sustainable Value Creation in Manufacturing Networks) project was a small-scale collaborative project within the EU 7<sup>th</sup> framework programme. This three year project started April 1, 2011 and had a total budget of 4 million Euro of which the funding from the European Commission was 2.8 million Euro. The overall aim of the project was to develop industrial models, solutions and performance standards for new sustainable and more performing production and service networks.

The SustainValue project has generated several new methods and tools for developing sustainable manufacturing networks. These include the following:

- Sustainability governance model addresses the rules, processes, metrics and organisational structures needed for effective planning, decision making, steering and control. The SustainValue governance model illustrates the sustainability governance within a value network as a process that guides the activities of all involved actors towards sustainable development and performance over product life cycle. The model process integrates i) requirements and commitment of stakeholders within a business ecosystem as well as ii) business models and self-interest of value network companies.
- Sustainable business modelling (SBM) process is an overarching approach, which considers a wide set of stakeholders across the business network to deliver sustainable value. The SBM process is accompanied by a portfolio of tools and methods that will assist in the design of sustainable business models. The process and tools focus on analysis and design of sustainable business models for company and network level change whilst identifying and mapping various forms of value and its exchanges to deliver sustainability. The tools have been identified and/or specifically designed to focus on generating business model innovation for sustainability from a network perspective. Companies can be at various stages of sustainable business modelling so using the process and toolset will rely on the preference of the participants, the type of the organisation, scope of operations, resource availability (human and financial), scale and size and the position on sustainability.
- Development framework for sustainable solutions combines life-cycle perspective with different functional dimensions. Several tools can be used at different functions and at different stages of the life-cycle. To support tool selection a guideline of appropriate tools has been developed. The framework supports companies in their sustainable development process and creates transparency of the different tasks. The framework can be used in companies as a tool itself to illustrate their own processes, interfaces, gates and communication channels. At the same time weaknesses and inefficiencies in their processes are revealed.
- Sustainability performance framework is a three-fold approach to the measurement and management of sustainability performance. The framework consists of three interlinked

principal components: network conditions, internal structural elements, and outcomes. Sustainability performance assessment consists of two different assessment procedures: one based on metrics and the other one based on maturity measures. The outcomes are assessed based on triple bottom line KPIs. Network conditions and structural elements are assessed based on maturity of the different areas.

## Summary of project context and objectives

The European "Vision for 2020" report calls for understanding manufacturing as a network of complex and development-oriented relations. The significance of manufacturing industry in Europe is widely known and accepted. Manufacturing companies generate, directly and through services, wealth and jobs in all European countries. Globalisation has activated a novel industrial revolution, leading to a new world-wide distribution of production and markets. The increasing demands for sustainability, however, have created new challenges and emerging opportunities for society and for business. The traditional trans-national manufacturing product and service delivery solutions cannot be sustained in the emerging eco-sensitive business environments, where growing trade volumes and commercial operational patterns impose significant environmental challenges across Europe. Hence, a radical shift is required, where industry is considered pivotal in pursuing sustainable consumption and production solutions.<sup>1,2,3</sup>

In the emerging integrated and networked production setting, much of the opportunity to address sustainability rests on the enhanced network management. Thus leading companies are looking for new approaches to manage sustainability impacts effectively – from sourcing and production, to distribution, product logistical support and afterlife. Authors such as Evans et al. (2012)<sup>4</sup>, Krantz (2010)<sup>5</sup> and Munasinghe (2010)<sup>6</sup> suggest 'sustainability as an innovation platform' for a fundamental shift towards a sustainable economy with significant changes in people's lifestyle and behaviour, redesigning business models and value networks 'to embrace a transformational sustainability that moves beyond incrementalism and ecoefficiencies'. If the manufacturing network partners are not managing the future challenges around regulation, reporting and compliance assurance, scarcity of resources, or the effects of climate change on their business, then their ability to operate as a network partner could be dramatically affected. This could be fatal to their business.

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<sup>1</sup> World Economic Forum report (2011), *The Consumption Dilemma: Leverage Points for Accelerating Sustainable Growth*, available at: <http://www.weforum.org/reports/consumption-dilemma-leverage-points-accelerating-sustainable-growth> (accessed 01 May 2013).

<sup>2</sup> Kong, N., Salzmann, O., Steger, U. and Ionescu-Somers, A. (2002), "Moving Business/Industry Towards Sustainable Consumption: The Role of NGOs", *European Management Journal*, Vol. 20 No. 2, pp. 109–127.

<sup>3</sup> Department of Economic and Social Affairs (DESA) report (2010), "Trends in Sustainable Development: towards Sustainable consumption and Production", available at: <http://www.uncsd2012.org/index.php?page=view&type=400&nr=15&menu=45> (accessed 01 May 2013).

<sup>4</sup> Evans, D., McMeekin, A. and Southerton, D. (2012), "Sustainable Consumption, Behaviour Change Policies and Theories of Practice", available at: <https://helda.helsinki.fi/handle/10138/34226> (accessed 01 May 2013).

<sup>5</sup> Krantz, R. (2010), "A New Vision of Sustainable Consumption: The Business Challenge", *Journal of Industrial Ecology*, Vol. 14 No. 1, pp. 7-9.

<sup>6</sup> Munasinghe, M. (2010), "Can Sustainable Consumers and Producers Save the Planet? ", *Journal of Industrial Ecology*, Vol. 14 No. 1, pp. 4-6.

To be successful and resilient in this changing business environment, manufacturers must be proactive. Industrial practitioners need to be creative in recognizing the opportunities that the sustainable economy will present for development of new products, identification of changes in markets and optimizing their internationally operating network according to the new sustainability criteria. A concrete way for exploiting these opportunities is the development and implementation of new sustainability-based industrial models and concepts.

Enterprises must take into consideration not just the economic goals but also the need to meet environmental and social goals in carrying out business; recognising that economic, environmental and social impacts occur at all stages in the value-network. This implies not only being able to manage internal activities and operations of the producing organization but also getting all the value-network partners to follow the same principles and performance standards that have implicit or explicit influence on the sustainable product and service delivery performance. Sustainable value creation is the key contribution of enterprises to sustainability, i.e. to create long-term environmental, social and economic value. More and more enterprises are taking incremental steps toward this goal, but they are limited in using a comprehensive approach to manage sustainability at the value-network level. Individual businesses cannot deliver the system changes required at the value-network level. Collaboration among partners can and must be enabled by developing attractive and common approaches for sustainable production and services

The existing business models are mostly based on creating, delivering and capturing economic value for customers and shareholders, with limited or no attention to environmental and social value and a broader range of stakeholders. These traditional business models are based on linear industrial models that externalise environmental and social impacts. These cannot support the sustainable business creation that is required to meet the future needs of the planet and of increasingly discerning customers wanting features other than economic value.

Where environmental and social value has been created by firms it is often through mere compliance with regulations or add-on Corporate Social Responsibility (CSR) programmes. While important, these approaches have not generally embedded sustainability into the core of the business, and as such their impacts are often limited. As Sommer (2012)<sup>7</sup> explains ‘the business model concept does not solely focus on the organisation but also considers external parties that participate in or benefit from the company’s value creation activities. These external parties are not limited to suppliers or customers but also include various partners that need to be considered for any transformation effort’. The changing business environment, wider range of stakeholders engaging in debate over industry, resource limitations and emphasis on social responsibilities of firms has raised the need for business model innovation to integrate sustainability more fully into the core of the business.

The above observations demonstrate an importance of providing tools and methodologies to maximize sustainability in companies showing how the business can be improved using sustainable

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<sup>7</sup> Sommer, A. (2012), *Managing green business model transformations*, Springer Verlag, Berlin Heidelberg.

guidelines. It also emphasises the importance of doing this at the level of the network, as the impacts do not mainly occur inside the final OEM business. Considering the solutions required for e.g. product logistical support and maintenance, the complex value networks may be composed of OEMs, product users and other intermediaries, depending on how the product-service delivery is organised; further, continued interaction between these actors may be enabled by technological tools (IT systems, intelligent products, etc.), to be exploited, if available, for reaching sustainable objectives. Nevertheless, OEMs are key players because they specify designs and materials, select suppliers and co-ordinate networks

The emerging sustainability megatrend is becoming a central factor in companies' long-term competitiveness and when doing this it will affect their production networks. The involved business partners are integrated within several networks making planning, coordination and management a tedious and a challenging task. The decision making setting in particular is challenged due to the decentralised nature of business decisions and operational activities. In this context, a major impact on the Europe-wide networked production/manufacturing environments could be achieved through holistic and integrated solutions for sustainability of complex value-chains, rather than isolated and/or ad-hoc solutions.

The overall goal of SustainValue was to develop industrial models, solutions and performance standards for new sustainable and more performing production and service networks. The project then developed governance and business models, a new methodology to support sustainable life cycle decisions and sustainability assurance performance standards for complex business processes in integrated production and service networks. SustainValue results aimed:

1. to enhance governance and business models that enable active integration of dynamic and complex production systems towards cooperative and sustainable value adding business networks,
2. to simplify the adoption of sustainable approaches, business models and solutions providing sustainability and performance KPIs together with guidelines of implementation,
3. to deliver a new methodology that supports sustainable, competitive and customer oriented life cycle decisions on products and services in complex production systems,
4. to support compliance verification processes for continuous improvement by developing sustainability assurance performance standards for complex business processes in integrated production and service networks.

## Description of the main S&T results/foregrounds

### *Project structure*

The overall strategy of the work plan of SustainValue was the development of exploitable solutions through collaborative innovation and Europe-wide knowledge integration to enhance development of models and concepts and industry-oriented solutions for sustainable value creation.

The project was organised in seven work packages:

- WP1 Governance and business architecture
- WP2 Business models in sustainable manufacturing value networks
- WP3 Life-cycle-based products and service development
- WP4 Sustainability performance standards
- WP5 Demonstration
- WP6 Dissemination and exploitation
- WP7 Project management

The work plan was designed to ensure that the scientific and research based innovation and the application potential and practicality are effectively blended. Early and active use of prototype models, methods and measures within the consortium was applied as a key strategy. The industrial partners in the consortium offered a wide spectrum of immediate exploitation possibilities. The exploitable results were demonstrated in industrial settings during the project in parallel with the R&D tasks. This will speed up the exploitation of the project outcome and allow further development in commercial projects outside SustainValue. In order to achieve meaningful testing results and illustrate the exploitation possibilities, special use cases were produced.



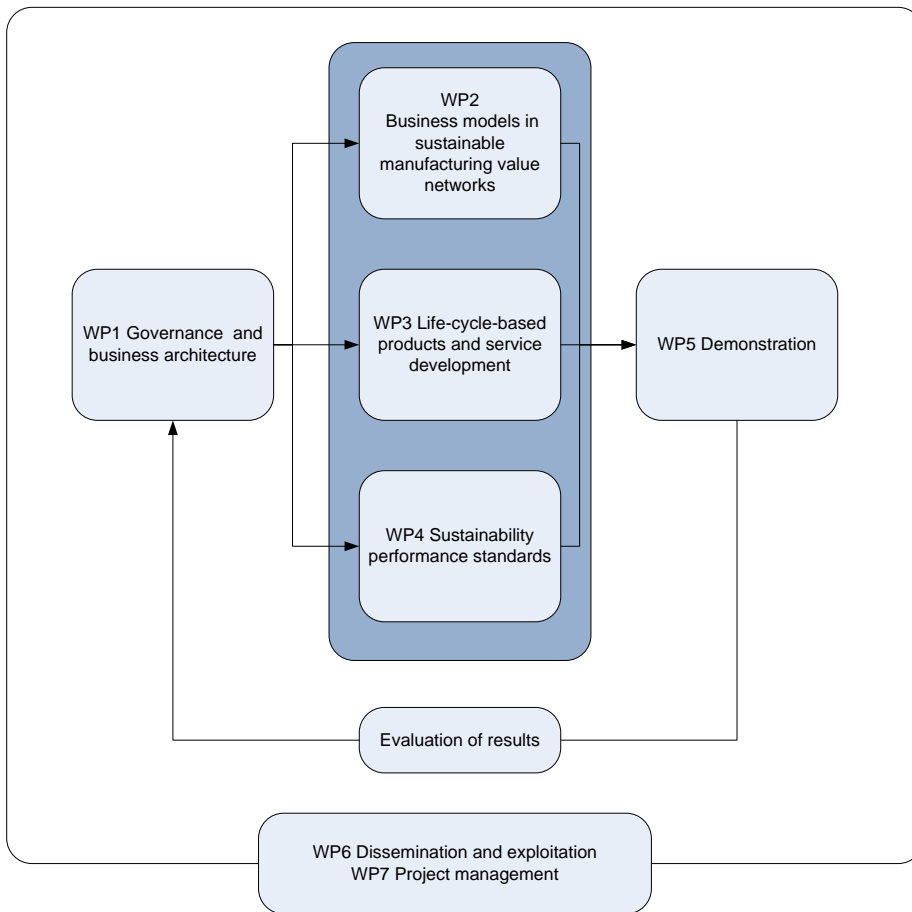


Figure 1. SustainValue project structure

### ***Governance and business architecture (WP 1)***

WP1 was aimed at undertaking requirements analysis from different perspectives to guide the formulation of the SustainValue governance model, architecture specification and project success criteria. Specific objectives included the following:

1. Produce a set of major sustainability gaps in current outlying business models in EU manufacturing industries of different size to be addressed by the project.
2. Analyse the requirements of key stakeholder groups in the context of sustainability gaps by taking into account market analysis, risks and regulatory obligations.
3. Design governance model and architecture specification for the core development work (WPs 2-4) with particular attention to business models, risk management, optimal life-cycle-based products and service environments and sustainability performance standards.
4. Specify criteria for measuring project success in terms of outputs, key performance indicators and impact.

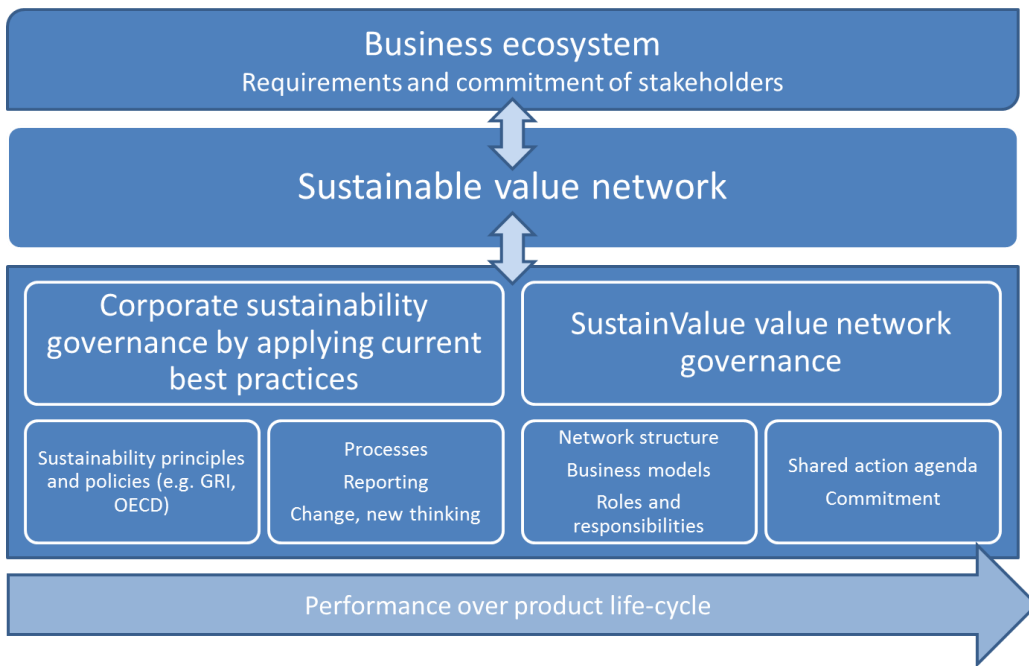
## **Governance model for sustainable manufacturing networks**

The SustainValue governance model developed during the project consists of three parts.

- Part I “Analysing” deals with analyses of value network and broader business ecosystem around the network. Through these analyses network actors are able to identify total sustainability impacts over the product life cycle and requirements of all involved actors as well as create joint strategic sustainability objectives.
- Part II “Organising” offers tools and methods for understanding and discussing the collaboration models, network structure, roles and responsibilities both inside the value network and with other stakeholders within business ecosystem.
- Part III “Developing” focuses on sustainable development as a value network thus considering the value network as an entity, and discusses evaluating the progress and future development needs.

Sustainability, as well as network development, is a continuous process where involved parties must work together in order to gain shared objectives. The objectives may often be seen as equivocal and ambiguous. Moreover, the benefits cannot always be assessed in monetary terms and network members may reach them within different timelines. Thus, one of the main challenges in network governance towards sustainability is to ensure that all stakeholders and value network members perceive positive value outcomes. In a value network, network members need to work together to ensure both present and future competitive advantage for all parties, but sustainability thinking challenges them to consider also stakeholders’ and other networks’ viewpoints and thus to have an even broader perspective to the positive value outcomes.

In addition to the need for multiple value outcomes, renewal is another key issue in the current dynamic business environment. Sustainable value network should find a balance also between exploitation of resources and exploration of new business opportunities. The network members need to support each other to find new business opportunities and aim to co-creation of common good instead of acting in their own self-interests. The pursuit towards sustainable value networks and sustainability is nothing but simple, and requires guiding and governing on multiple levels.



**Figure 2. Sustainable value integration into manufacturing industry.**

Therefore, the present – and especially the future challenge – is to govern sustainability within various value networks and business ecosystems. The framework illustrates the many parts that play a role and interact in this. Besides the governing of the whole network towards the same target, also sustainability governance at a company level by applying the current best practices has a significant role in the sustainability development. Thereby, present norms, standards and practices must be recognised, followed and even surpassed. In addition to the company level, the norms of good governance, accountability, transparency, responsibility, and fairness must be complied also at the value network level. In this, the shared action agenda is an important mechanism for transition management guiding the actions of individual network members towards sustainability.

It should also be understood that due to their changing roles the same stakeholders and network actors can have different requirements in different stages of product life cycle. This being the case, company level practices and procedures cannot directly be utilised for network level sustainability development and its governance.

### **Business model architecture**

The SustainValue business model architecture has been developed according to a comprehensive list of requirements encompassing a set of general requirements coming from the original definition of the project and specific requirements for including sustainability which were deduced considering both a literature review on sustainability frameworks and the sustainability gaps identified during SustainValue project. The development of the business model architecture (BMA) resulted in three main outcomes:

- The first outcome is a working definition of the concept of BMA. The purpose of using this term is mainly to take advantage of the generic roles played by business architecture, while paying a special attention to the role of BMA as provider of the blueprint for business transformation. In SustainValue project context, this business transformation is not rooted necessarily to IT solutions, hence the BMA concept proposed has to separate the concept from the IT domain as a way to avoid misunderstanding and confusion. Hence, the definition is the following:
  - o *A business model architecture as a common understanding of the company organisation considering the value stream from a strategic viewpoint to high level description of business processes. Such a common understanding is a mechanism to support transformational changes within the company.*
- The second outcome is the SustainValue BMA blueprint and the identification of its components: Organizational Culture, Technology Management, Strategy & Business Model/s, Product & Service Management, Operations Management and Performance Management System. The SustainValue BMA provides a basis for designing business structure and solutions for manufacturing companies and its main potential use is to guide business transformation towards more sustainable business while creating the necessary connection with the network level. The SustainValue BMA considers that different companies may have different approaches towards their business activities, some of them enhancing a disruptive product innovation, others pointing out to e.g. a strong business model. The transformation of current businesses would lead to different paths towards sustainability.
- The third outcome is the identification of links between the SustainValue BMA and the SustainValue governance model, which would help the alignment between sustainability at company level and at network level.

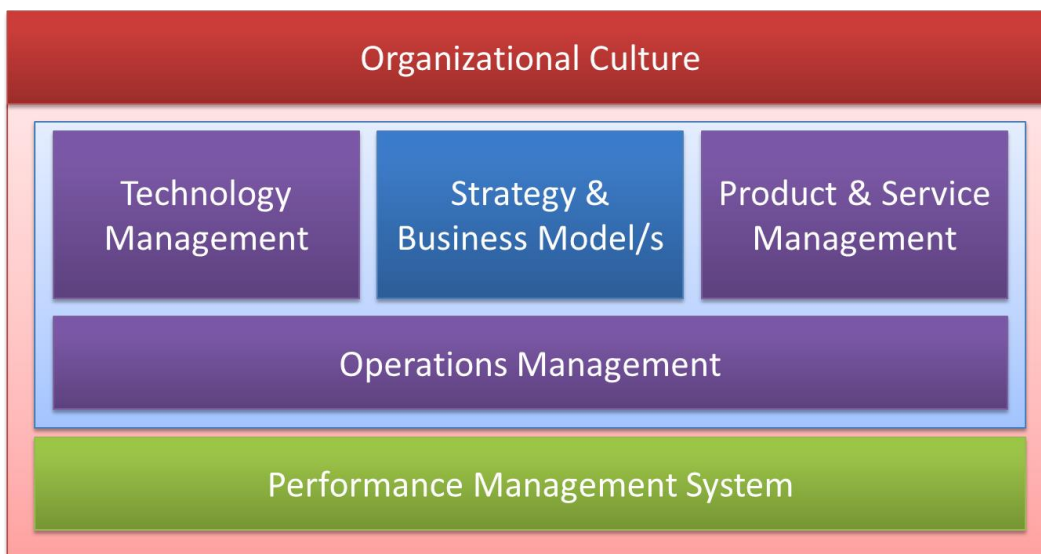


Figure 3. SustainValue business model architecture

### ***Business models in sustainable manufacturing value networks (WP2)***

WP2 began by the reviews of state-of-art followed by state-of-practice (six case studies conducted) on business model, business modelling, manufacturing and value network with an implication towards possible multiple solutions to integrate sustainability (through redefining value and including a wider range of stakeholders) into business models and modelling framework. Following on from this review, the gaps in business modelling process, visibility of stakeholders and the need to explore new forms of value to deliver sustainability were identified. Based on these findings a sustainable business modelling process with the selection of tools to support each step was identified and/or developed.

The process and toolset were used and tested extensively in individual session/s with the industrial partners – Riversimple, CLAAS, Elcon and FIDIA and with external organisations (start-ups, small and medium enterprises - SMEs, multinationals, universities – teaching material). The feedback and observations on the efficacy of the process and tools was captured by the facilitators and participants (who vary given that the tools in the portfolio are across WPs and in some cases have been used by external facilitators). The summary of lessons learnt and areas for improvement for each tool based on the trial sessions covered questions such as - what worked? what didn't work? what are the changes envisaged? and results and impacts. This input gathered were then integrated into the final working process and toolset that enable analysis of future oriented, novel, sustainable, value adding business-models and value-networks.

WP2 overall objectives:

1. Understand the detail state-of-practice in business modelling and value-networks, with a focus on innovative business models that have the potential to deliver sustainable value.
2. Compare future-oriented, leading practice with state-of-the-art tools & methods.
3. Identify specific gaps in current tools & methods.
4. Design and develop new methods & tools.
5. Learn from early use of these methods & tools in industrial settings. Assess their competence at enabling novel, more sustainable business models and value-networks, (with WP5)
6. Revise the design of tools & methods based on experience.
7. Deliver a proven set of tools & methods that are accessible to large and small companies.

The key outputs from WP2 include the sustainable business modelling (SBM) process and the toolset, case studies (state-of-practice), state-of-art and gap analysis, which have been presented through the deliverables mentioned above.

The SBM process is a five step approach that considers a network-centric perspective to deliver sustainability. The SBM process accompanied by the portfolio of tools provides companies with assistance in the analysis and design of sustainable business models for firm level and network level change. This approach introduces the sustainability dimensions (environmental, social and economic) and priorities, language around multi-stakeholder value and shared-value creation across the industrial network and harmonising stakeholder objectives through the identification of conflicting interests between them. Business model innovation and redesign can assist in embedding sustainability into the core purpose and operations of companies, through a comprehensive consideration of a network-wide perspective to rethink the value proposition and to create, deliver and capture sustainable value. The process is iterative, in that as changes occur in one step it not only impacts on the following step but also on the preceding ones and occurs over a period of time. Companies can be at various stages of the SBM process so using the process and toolset will rely on the preference of the participants.

The toolset consists of tools developed by UC in WP2 and by partners - FIR, POLIMI and VTT (across the consortium), particularly in WP3 (development methodology for sustainable solutions) as well as tools identified (existing and in use) to assist in the development of novel and value-adding sustainable business models.



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| <p><i>Step 1 – Setting the scene</i><br/>Purpose of the business, potential stakeholders and sustainability drivers</p>   | <ul style="list-style-type: none"> <li>▪ Primary: Value mapping tool (<i>developed by UC in WP2</i>)</li> <li>▪ Support: <ul style="list-style-type: none"> <li>• System SWOT analysis – SUSPRONET (<i>Tukker and Tischner 2004, 2006</i>)</li> <li>• PESTLE/STEEPLED</li> <li>• Sustainability continuum</li> </ul> </li> </ul> |
| <p>Step 2 – Value mapping<br/><br/>Current, destroyed and missed value</p>  | <ul style="list-style-type: none"> <li>▪ Primary: Value mapping tool</li> <li>▪ Support: <ul style="list-style-type: none"> <li>• GRI guidelines, SASB (industry-specific)</li> <li>• Scenario management tool (<i>developed by FIR in WP3</i>)</li> </ul> </li> </ul>   |
| <p><i>Step 3 – Idea generation</i><br/>Identifying and /or extending the sustainable value proposition/s, opportunities for shared value creation, harmony of stakeholder interests</p> | <ul style="list-style-type: none"> <li>▪ Primary: <ul style="list-style-type: none"> <li>• Value mapping tool</li> <li>• Sustainable business model archetypes (<i>developed by UC in WP2</i>)</li> </ul> </li> <li>▪ Support: Scenario management tool (<i>developed by FIR in WP3</i>)</li> </ul>                              |
| <p>Step 4 – Business model/s or solution/s selection<br/><br/>Concept generation and selection for the sustainable value proposition/s</p>  | <ul style="list-style-type: none"> <li>▪ Primary: Sustainable business model archetypes</li> <li>▪ Support: Sustainability impact calculation tool (<i>developed by FIR and POLIMI in WP3</i>)</li> </ul>  |
| <p>Step 5 – Configure and coordinate<br/><br/>Define and develop the value creation and delivery</p>  | <ul style="list-style-type: none"> <li>▪ Primary: <ul style="list-style-type: none"> <li>• Business model canvas (Osterwalder and Pigneur 2010)</li> </ul> </li> </ul>   |

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| system, and the value capture mechanism for network level change | <ul style="list-style-type: none"> <li>• Strategic roadmapping tool – emergence roadmapping method (<i>Phaal et al. 2012</i>)</li> <li>▪ Support: Life cycle cost estimation tool (<i>developed by VTT in WP3</i>)</li> </ul> |
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**Table 1: Sustainable Business Modelling process and toolset**

### ***Life-cycle-based products and service development (WP3)***

The objective of WP3 was to develop a methodology for sustainable solutions. The objective was reached through five tasks:

- Analyse the requirements of sustainable solutions
- Analyse existing methodologies for innovation and solution engineering
- Identify gaps in existing methodologies
- Complete the development methodology
- Implement methods and tools

The methodology was designed according to the constraints given by the industrial context and life-cycle phases considered in the industrial partner premises. The work package dealt with the development of solutions that ensure maximum value of products and processes throughout the complete life-cycle. Additionally to the goals of current solutions, solutions within sustainable business models have to deliver environmental and social aspects (e. g. carbon emissions and others).

The new solution development methodology will ensure structured and efficient development processes to create goal-orientated solutions. The methodology was designed to take into account the constraints given by the industrial context and life cycle phases considered in the industrial partner premises. Hence, when the developed methodology will be deployed into a target value network, the methodology will enable industry to take into account its specific constraints and features.

Main result is a development framework for sustainable solutions which was developed and validated within the consortium and additional external actors. During the early phase of research when approaches for service or product development were identified and during the early interviews with the industrial partners, a first finding was that the development of sustainable solutions is not a task for single persons or a single division in a company. To develop and implement a sustainable solution several areas within and beyond the company boundaries must be considered. On different levels e.g. on network level with partners, strategic issues from top management, business model decisions, conceptual division like product engineers, operative



division for logistics etc. must be involved to provide a (more) sustainable solution as a result. Hence there are several sustainability potentials on different levels which are so called dimensions. The expression “development methodology” was changed to “development framework” to show and express the complex interdependencies between the different actors. Within this framework, which is a matrix combining a lifecycle perspective and an overview of different functional dimensions, different methodologies approaches are integrated and interconnected.

The framework supports companies in their sustainable development process and creates transparency of the different tasks. Beside it gives several hints for useful approaches and tools. Further the framework can be used in companies as a tool itself to illustrate their own processes, interfaces, gates and communication channels. At the same time weaknesses and inefficiencies in their processes are revealed.

The framework has been validated within a big company with over 9000 employees where different division represent the dimensions as well as a small start-up company where the different dimensions are represented by only few persons. The framework introduced in this deliverable is the basis for the tools enhancing the several approaches.

## **Sustainability Impact Calculation Tool**

Target of the Sustainable Impact Calculation tool is to measure and assess sustainability impacts of products, services or product service systems on society, environment and economy. During the development process of new solutions (in form of services, products or a combination of both) a clear transparency of the long-term consequences of these solutions is needed. Even promising ideas which seems to be an improvement regarding sustainability could lead to an unexpected negative impact regarding sustainability. For instance, the environmental impact occurring from the production of hybrid cars (inclusive the needed batteries) have a more negative consequences than the benefits from a lower fuel consumption if the whole life cycle is considered. To avoid such surprising negative developments or negative impacts the Sustainability Impact Calculation Tool should help to create transparency and gain an overall view of the possible sustainability impacts. Therefore the three pillars of sustainability were assessed with the help of different KPIs. The underlying idea is that the same input data may be used to calculate impacts in different dimensions: for example data about energy consumption are affecting costs (economy), but also resource depletion and emissions (environment). Besides, a combination of different methodologies (like the MIPS methodology) and a consolidation of different databases try to assess the new holistic solution.

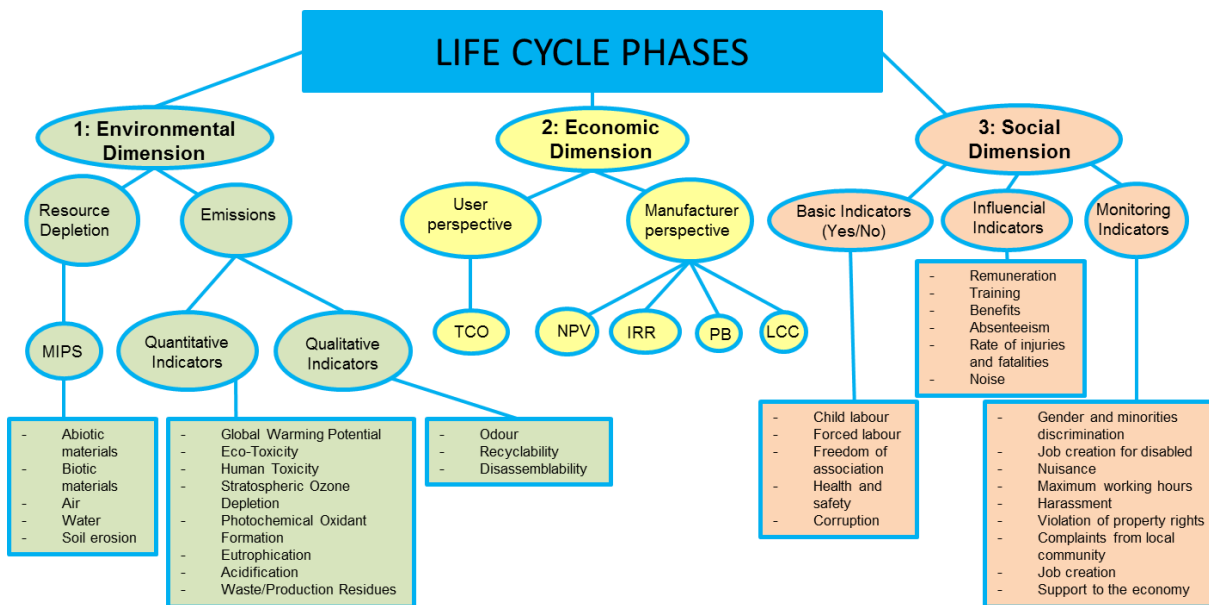


Figure 4: Life Cycle Phases

## Life-Cycle-Costing Tool

In SustainValue project a Life Cycle Cost (LCC) estimation tool was developed for assessing and evaluating of the costs and effects of a product during its entire life cycle. The LCC tool assists in selecting the cost effective and sustainable solution. Originally the tool is developed for power supply systems but the same approach can be utilised in other products as well.

The LCC tool calculates and estimates the costs and effects of products or solutions during their life cycle. Up to five solutions can be compared simultaneously according to their annual and life time costs. The tool has three main cost categories it takes into consideration in estimating the lifetime costs: acquisition costs, use costs and disposal costs. The acquisition costs include all the costs related to acquisition and installation of the solution. The use costs are annual costs, such as maintenance costs and electricity costs. All costs that relate to recycling of components and materials as well as waste management costs are considered disposal costs. The input data for cost estimates have to be collected for various sources. For example, the suppliers for equipment or components can provide information, the experts that have used the solution can provide estimates or other relevant sources for information can be utilised. As a result of the LCC tool calculates the life cycle costs for the compared options.

## Sustainability performance standards (WP4)

The importance of this WP emerges from the growth of global move on sustainability that implies that business partners of complex integrated product-service value-chains are seriously challenged in measuring and understanding their performances on sustainability, setting necessary performance

standards and devising, based on standards guidelines, strategies and road maps for continuous improvement among the value-networks. Thus, WP4 aims at the development of a governing framework for sustainability. This was achieved through 3 R&D tasks:

- Define and specify multi-objective sustainability performance requirements within complex integrated product-service value networks,
- Define sustainable metrics, sustainability-performance KPI and supporting integrated platform, and
- Develop sustainability guidelines and define a verification processes for continuous value networks improvement.

The first aim was to define and specify multi-objective sustainability performance requirements within complex integrated product-service networks. A governing framework for sustainability performance was developed combining essential elements of other SustainValue work packages with additional research. The framework took into account the dynamic nature of modern manufacturing networks as well as the complexity of inter- and intra-organizational performance. The result was a governing framework that encapsulates a wide array of factors for sustainability performance; inclusive of both so-called Structural elements and Network conditions that took into account the various product-service value network needs.

This provided the general structure for further work. The next step was proposed criterion to measure sustainability performances based on metrics and KPIs. The R&D work thus resulted in; an initial structure of an integrated assessment platform based on maturity levels, detailed definition of specific performance attributes under network condition and structural elements, technique for maturity assessment based on a 5-point maturity scale, demonstration of an excel based maturity analysis tool, and a set of KPIs for assessment of economic, social, and environmental performance. To avoid reinventing the wheel, the R&D work was based on a wide review, and used – when possible – a number of standards to deliver the outcomes.

Continuing, the further work focussed on sustainability performance guidelines for value-networks continuous improvement. This lead to provide an illustration of the logic as to how the core steps should be followed for continuous improvement sets of tools-techniques-methods that can help support the companies to improve the maturity level of each performance attribute indicating the expected sustainability returns, a colour-coded portal for performance verification. Thereafter, two assessment cases for demonstrative purposes based on some preliminary data were also accomplished.

### ***Demonstration (WP5)***

The demonstration phase aimed at implementing and demonstrating practices and business models developed within SustainValue. Hence, core research carried on in the project was validated in collaboration with end-users (industrial case studies). The validation process followed a specifically

designed methodology, which employed a versatile set of performance metrics for measuring both tangible and intangible benefits.

The methods and tools developed and identified in SustainValue have been assisting manufacturing companies in developing business models and solutions for sustainable and efficient production. They provide support at strategic and operational levels of the companies to deliver sustainability. During the industrial application of the tools it was observed that the companies adopt different approaches and are varied in the level of receptiveness to change, to sustainability. Start-ups and small scale businesses seem more receptive to exploring new business models and opportunities compared to larger companies (multinationals). One of the reasons maybe that larger companies have relatively more rigid organisational structures and broader networks, which makes exploring and adopting new ideas and business models for sustainability more gradual. A key consideration in the SustainValue methods and tools is assisting companies in understanding the true scope of the impact of their activities on the broad range of stakeholders and identifying possible pathways to adaptation, while persuading companies to adopt sustainability, when the business case is not very clear. A transition (transformation and implementation) path towards sustainability will follow a long-term vision with an evolutionary/incremental path and this need to be considered when using the methods and tools.

### ***Standardization (WP6)***

Standardisation in SustainValue is a key part of SustainValue results and an important component of the project related to knowledge management and dissemination. Standardisation is an avenue through which the results are transferred into European and international knowledge.

The Dissemination and Exploitation Work package of the project supported the standardisation activities through the use of appropriate methods. These included the analysis of existing standards, the analysis of needs, and the identification of gaps between existing standards and needs; the development of a strategy how to handle the gaps, including e.g. the identification of potential stakeholders and of a timescale for potential standardisation.

Activities have resulted in the elaboration of a specification (a CEN Workshop Agreement) making use of the standardisation infrastructure available for documentation and dissemination of results. The CWA document as a final result is available at all CEN member organizations and can be adopted as a national document by any standardisation organization.

The CWA titled "Sustainable Value Creation in manufacturing networks - SustainValue" consists of seven main chapters. The first three chapters (scope, terms and definitions, list of abbreviations) in general serve as supportive chapters within standards, in order to structure and organize the content of the standardisation document. The main chapters talk about the "Sustainability governance in manufacturing networks and the governance model", "Sustainable business modelling", "Sustainable solutions development" and the "Sustainability Performance Management". The Annex 1 speaks about the special tools that may be used in the development framework. The scope



of the SustainValue Workshop Agreement is to take the necessary initial steps towards the development of a generic standard applicable across various industrial sectors based on the outcomes of the SustainValue project.

## ***Potential impact***

Sustainable manufacturing is the main enabler of sustainable development as it generates wealth, maintains jobs and manages human and physical resources. Growing concerns of environmentally conscious consumers and increasingly demanding legislation sets new goals for actors to keep their competitive advantage. SustainValue project contributes to a step-change in the performance of European industry, and improves reactivity to sustainability requirements of customers and society. The savings potential in utilising more sustainable design of production could be more than 40 % in terms of energy, resource and space usage compared with traditional design.

SustainValue project contributes to extended product utilisation by creating new business models and value-adding services. New business models that emphasise long-term relationships and sustainability performance are more resilient and reward manufacturers that learn to deliver more value with less material and offer higher customer value. Such business models allow competition with low-cost countries as well as reduce environmental impacts. Business model and networking related innovations provide considerably more value in comparison to product development related innovations. The outcomes of SustainValue will provide innovative solutions at value network level in order to guarantee sustainable and economically feasible business.

The expected impacts also include:

- step-change in the performance of European industry, small and medium-sized enterprises (SMEs) in particular, can be achieved and can be characterised by a higher reactivity to customer needs by at least 20 % in terms of real time economics and legislation monitoring and inclusion;
- extended product utilisation by at least 20 % through value-adding services; a more economically and ecologically compatible products / services design and production systems networks should also allow a more efficient use of material resources.

SustainValue project will generate direct, short-term impacts through industrial use cases and dissemination of the project results but special emphasis is laid also on the sustainability of the results and subsequent long-term impacts. The research and development (R&D) results and solutions are validated in the demonstration WP5 where the main outcomes (e.g. industrial use cases) are realised. Also the early adopters or lead users outside the project may adopt the results as the active dissemination of the project results increases awareness and interactions. The exploitation plan developed in WP6 will ensure long-term effect and afterlife of the results. SustainValue supports standardisation activities, and appropriate methods will be used to transfer the results into European and / or international standardisation. Especially the standardisation infrastructure is made available for documentation and dissemination.

The expected benefits and impacts for the industrial partners are manifold. Through the SustainValue project, industrial partners can widen and improve their service offering, and thus

have a possibility to improve profitability and customer loyalty, and gain differentiation advantage, amongst other things. The findings can also be forwarded to the benefit of customers, for example through educating customers to consider life cycle costs of their products instead of the purchasing costs only. Outputs of WPs, such as the frameworks, tools, methods and processes from WP2 can enable firms to integrate sustainability into the purpose of the firm and various business operations and activities process can assist an organisation to deliver sustainability. In particular, business model innovation and transformation for delivering sustainability may assist firms to rethink their value proposition to integrate environmental and social benefits in addition to the economic objective through a network centric view. The new solution development methodology will ensure structured and efficient development processes that help create goal-orientated solutions, and the methods and metrics, governing framework and verification processes influence the planning, management and optimisation of business transactions and decision-making processes within network, which in turn has major impacts on the competitive value-adding performance.

The concept and use of the methods and tools will be extended and developed through further use and dissemination by the research partners, industrial partners and external organisations. Some of the key results and impacts generated for the industrial partners include the following:

- CLAAS – the use of the SustainValue methods and tools involved the development of documented value maps, written and proven scenarios, analysis of influencing factors and collection of generated and described ideas and improved understanding of the stakeholder la
- Elcon - the implementation of the new business model and value proposition (selling service) through the use of the methods and tools resulted in operational arrangements and new requirements for product development. In this case operational changes were accomplished by networking with another manufacture company. In this new setting Elcon's responsibilities are in operations related to sales, services, product and service design and development while their partner is responsible for the manufacturing of the products.
- FIDIA – The maintenance service planning tool improved the ability of FIDIA to deliver a more sustainable service to its customers / stakeholders. Through the use of the tool an enhanced planning of field service, needed to deliver maintenance services to machines of FIDIA's customers located in one or more target regions, was achieved.
- Riversimple – A significant impact of the work resulted from using the SustainValue tools are associated with the change in company's legal structure. SustainValue has helped in implementing a multi-stakeholder governance model in a conventional Ltd legal structure, which has had a very positive impact on the way potential investors see the company. Adopting a company limited by guarantee (Ltd) structure has led to an improved interaction with the wider investment community.

The final results of the project are positioned within the two most important project target groups, SMEs in production networks that are interested in improving their sustainability performance and manufacturers. For SMEs the most relevant project results are Sustainable business modelling process and toolset, Scenario analysis tool, and Life cycle cost estimation tool. For SMEs the impacts are as follows:

- The sustainable business modelling process and toolset provide SMEs with assistance in the analysis, design and development of sustainable business models, exploration of sustainable value propositions and opportunities as well as value destroyed, understanding of the strengths and weaknesses of the organisation and macro-environmental factors. The process and the related toolset helps companies better integrate sustainability into the business purpose and operations, suggests ways how to support and develop their value network, and assess the progress towards sustainability.
- Scenario analysis tool supports organisations in developing a better understanding of strategic threats and opportunities, and in identifying requirements for the future. Thus also this tool supports in the change process towards more sustainable business.
- Life cycle cost estimation tool forecasts the costs and effects of products throughout their life cycle, and compares different options thus helping understand the economic returns of potential sustainable solution/s and sustainable value proposition/s. Supports companies in choosing the economically and environmentally best option.

Nearly all the exploitable results are relevant and useful the customer group of manufacturers. For the manufacturer customer groups the impacts are as follows:

- SustainValue governance model: The process model presents important steps for developing a network towards sustainability, and proposes tools, tasks and viewpoints that support the manufacturer that is going through the process of developing its network to more sustainable. Creates understanding of e.g. the key players, the relationships with them, the network and the ways to affect each other, the alignment of different business models, and suggests relevant development measures.
- As with SMEs above, the sustainable business modelling process and toolset provide manufacturers and their network actors with assistance in the analysis, design and development of sustainable business models, exploration of sustainable value propositions and opportunities as well as value destroyed, understanding of the strengths and weaknesses of the organisation and macro-environmental factors. The process and the related toolset helps companies better integrate sustainability into the business purpose and operations and coordinate and configure their value network, resources and activities, as well as trace and assess the path and progress towards sustainability



- Framework for sustainable solutions supports companies in their sustainable development process and creates transparency of and between the different tasks. Suggests useful approaches and tools. Further the framework can be used in manufacturing companies as a tool itself to illustrate their own processes, interfaces, gates and communication channels. At the same time weaknesses and inefficiencies in their processes are revealed
- Scenario analysis tool supports organisations in developing a better understanding of strategic threats and opportunities, and in identifying requirements for the future. Thus also this tool supports in the change process towards more sustainable business.
- As in the case of SMEs, the life cycle cost estimation tool can be used to forecast the costs and effects of products throughout their life cycle, and to compare different options thus helping understand the economic returns of potential sustainable solution/s and sustainable value proposition/s. Supports manufacturing companies in choosing the economically and environmentally best option. Moreover, with the better understanding of the costs and of the affects each choice and e.g. product configuration has, manufacturing companies can also have an effect on their network members and their mindsets and decision making relating to sustainability issues.
- With the maintenance service planning tool, unplanned maintenance interventions can be reduced, and maintenance interventions can be scheduled efficiently and effectively, by balancing preventive and corrective maintenance within the service offer. This would allow properly concerned respect to the customer requirements and environmental effects. All in all, these would bring value through optimised service logistics, cost savings, and more sustainable products and services, as well as more comfortable working conditions specifically to service technicians.
- Sustainability performance framework offers manufacturers a guideline, tools and methods for improvement of sustainability in their value network, performance requirements of organisations and their value-adding partners as well as verification processes.