Ecosystem for COllaborative Manufacturing PrOceSses – Intra- and Interfactory Integration and AutomaTION
(Grant Agreement No 723145)

D9.9 Sustainable Business Models for IIMS in Manufacturing Industries

Date: 2018-02-27

Version 1.0

Published by the COMPOSITION Consortium

Dissemination Level: Public

Co-funded by the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement No 723145

Document control page

Document file: D9.9 Sustainable Business Models for IIMS in Manufacturing Industries v1.0.docx
Document version: 1.0
Document owner: IN-JET

Work package: WP9 – Business Models, Dissemination and Exploitation
Task: T9.3 – Business Models for Ecosystem and Applications
Deliverable type: R

Document status: ☒ Approved by the document owner for internal review
☒ Approved for submission to the EC

Document history:

Version	Author(s)	Date	Summary of changes made
0.1	Jesper Thestrup (IN-JET)	2017-09-29	TOC and first content drafts
0.2	Martina Beer (FIT), Mia Nygaard (IN-JET), Jesper Thestrup	2017-11-30	Added BMC for some Intra-Factory and Inter-Factory UC, added marketplace description,
0.3	Jesper Thestrup	2017-12-05	Added Waste Management Marketplace and Software Virtual Marketplace business models.
0.4	Jesper Thestrup	2018-01-03	Added Supply Chain Marketplace business model and introductions to all BMs.
0.5	Jesper Thestrup, Martina Beer, Theofilos Mastos (KLE)	2018-02-11	Updated marketplace BM with input from partners at PB Meeting, expanded definition of marketplace
1.0	Helene Udsen (IN-JET)	2018-02-27	Reviewer comments addressed, minor editing Final version submitted to the European Commission

Internal review history:

Reviewed by	Date	Summary of comments
Mathias Axling (CNET)	2018-02-16	Approved with minor comments
Jesus Benedicto (ATOS)	2018-02-16	Approved with minor comments

Index:

1 Executive Summary

This deliverable looks at different modelling frameworks which are suitable for describing the COMPOSITION value creation capabilities and how the resulting business models can be used to forecast the stakeholders' economic performance under different assumptions. The work has focused on three different business aspects.

- The Intra-Factory use cases largely involve only two actors and the proper business model aspect is a cost-benefit analysis followed by a Business Model Canvas visualisation.
- Software components and solutions are sold to software companies. The main issue here is to find the proper pricing models and revenue streams.
- Integrated Information Management Systems in Manufacturing Industry Marketplaces are multi-stakeholder ecosystems where several value propositions are combined into an end-to-end solution for industrial actors. The Value Based Business Models methodology is used for this ecosystem.

The work on cost-benefit analysis of the Intra-Factory scenarios will be reported in deliverable *D9.7 Cost, Benefit, and Risk Evaluation*. Scientifically sound methods such as the Constructive Cost Model and the BeneFIT method will be introduced and analysed.

The proper pricing models and revenue streams will be selected when the software components are stable and presented in the *D9.11 Final Exploitation Strategy and Business Plans*.

For the complex task of defining new business models for IIMS for Manufacturing Industry Marketplaces, an ontological perspective on the exploration of innovative service concepts based on value creation has been selected. The use cases have been modelled into a value model using the e^{3}value model tool which also calculates the net cashflow for each actor in the value network.

A digital marketplace (or virtual or online marketplace) is a type of e-commerce site where product or service information is provided by multiple third parties. Transactions are processed by the marketplace operator and then delivered and fulfilled by the participating suppliers or wholesalers.

1.1 Waste Management Marketplace

Waste management includes all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling

In the Waste Management Marketplace, the business model shows positive cashflow for all actors. The Metal Recyclers (market segment) buys metal scrap at 10% higher prices from the bidding process. The Metal Recycler participates in the bidding process in order to get more metal scrap. If the capacity of the Metal Recycler is higher that the demand, the Metal Recycler will increase the price offered, and if the reverse is true, lower the price offered. Since the Waste Management Company (the viewport) is able to select the highest bidding Metal Recyclers, the total price obtained for scrap metal will increase thus benefitting both the Waste Producers and The Waste Management Company. The platform will thus also act as a mediator of supply and demand in the metal scrap ecosystem. The net positive cashflow for the Waste Management Company amounts to €320,625. However, the cost of the platform is €280,000 so the net positive cashflow is reduced to €40,625.

1.2 Software Virtual Marketplace

A Software Marketplace is a digital marketplace where software vendors can present their apps/solution to potential buyers and buyers can browse the solutions in order to find the best match with their needs. The actors' activities cover three phases of the Virtual Software Marketplace: The bidding and matchmaking process, the validation and contract management process, and the ongoing execution of the software licensing and functionality.

In the Software Virtual Marketplace, the business model also shows positive cashflow for all actors. The business model for the COMPOSITION Software Virtual Marketplace is constructed to show how actors in this ecosystem can create sustainable business models from a mix of trusted matchmaking and easy deployment of software. The matchmaking creates new customer demands, and more software products will be sold.

Additional SaaS services, e.g., Decision Support Services, can be sold as extension to the deployed software solutions. The Software Vendor (the viewport) has revenues of €1,940,000 from the Software Customer market segment and costs of €1,048,000. The Software Vendor thus has a positive cashflow of €892,000. The Platform Service Provider has a positive cashflow from the operation of €182,000. Revenues from the operation of the platform amount to €280,000 with an additional €300,000 coming from the supply of SaaS decision support, which is requested 30,000 times annually by the Software Customer segment.

1.3 Supply Chain Marketplace

The term “supply chain” denotes the network that exists between a company and its suppliers to produce, manufacture, assemble, distribute and put into operation a specific product (such as a lift or a pacemaker). The Inter-Factory use cases are focused on the supply chain for lifts. An efficient supply chain process requires suppliers that are reliable. This means that they produce a quality product that meets the manufacturer’s needs, and the product is delivered on time. The marketplace can provide a cost-effective way to explore the potential for cost savings from a multitude of suppliers (e.g., a bidding platform for Expression of Interest). It can also greatly reduce the cost of contract management and execution with existing sub-suppliers through standardised exchange of supply chain information and integration with the various IMS in operation at the sub-suppliers.

In the Supply Chain Marketplace, the business model also shows positive cashflow for all actors. The main rationale of this business model is to explore persistent cost savings internally in the organisation of the Manufacturer. Using the marketplace integration tools, data and documents can easily be exchanged and the processes of validating new suppliers and managing contracts for all suppliers becomes much more effective. The realised savings should more than outweigh the added cost of operating the marketplace. The Manufacturer (the viewport) has a total positive cashflow of €71,000 mainly coming from reduction of cost prices from the supplier segment. In addition, savings in organisational cost structures for the validation of suppliers, management of the supply chain and the overall contract management are realised due to efficient exchange of documents and integrated IMS systems. The savings are €244,000; just short of the added costs of the COMPOSITION platform, which is €280,000.

2 Abbreviations and Acronyms

Table 1: Abbreviations and Acronyms

Acronym	Meaning
BMS	Building Management System
CMMS	Computerised Maintenance Management System
DSS	Decision Support System
EAM	Enterprise Application Management
ERP	Enterprise Resource Planning
IIMS	Integrated Information Management System
JIT	Just in Time
KPI	Key Performance Indicator
MES	Manufacturing Execution System
PCBA	Printed Circuit Board Assembly
QA	Quality Assurance
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Quotation
SaaS	Software as a Service
SCM	Supply Chain Management
SPI	Solder Paste Inspection
UC	Use Case
VSX	VMware Solution Exchange
WMC	Waste Management Company

3 Introduction

3.1 Purpose, Context and Scope of this Deliverable

The focus in this deliverable will be to report on the work undertaken on analysing the business system and its stakeholders, modelling different potential ecosystems and developing sustainable business cases for important actors.

This deliverable relates to several other deliverables:

- The work on cost-benefit analysis of the Intra-Factory scenarios will be reported in deliverable *D9.7 Cost, Benefit, and Risk Evaluation*
- Several use cases have been defined in *D2.1 Industrial Use Cases for an Integrated Information Management System* and *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry*, which will eventually be developed and evaluated by the end users in the pilots. It is the intention to submit a final version of *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry* focusing on the industrial markets for intra-factory and inter-factory solutions. The updated deliverable will be submitted, when the results of the pilots are available, anticipated in M32 (April 2019)
- The business models also form the basis for the partners' individual exploitation planning. The context will be demonstrated in *D9.10 Exploitation Planning Framework and First Draft of Exploitation Plans*
- When the software components are stable, the proper pricing models and revenue streams will be selected and presented in *D9.11 Final Exploitation Strategy and Business Plans*.

3.2 Content and Structure of this Deliverable

This deliverable is structured as follows:

Chapter 3 explains the business aspects of COMPOSITION outcome and how the different outcomes of the COMPOSITION project are handled in terms of business analysis and planning.

Chapter 4 is connecting the Intra-Factory business analysis to the cost-benefit analysis and provides the methodology for this.

Chapter 5 deals with the software components and how software developer partners in the consortium will choose a suitable pricing model and calculate the revenue streams. The methodology for pricing modelling is presented.

Chapter 6 reports on the findings of the business modelling work performed in ecosystems of IIMS for Manufacturing Industry Marketplaces. The Value Based Business Models methodology is used for this ecosystem. Three business models are presented for market places, each starting with a short description of the nature of the marketplace. The three marketplaces are: Waste Management Marketplace, Software Virtual Marketplace, and the Supply Chain Marketplace.

4 Business Aspects of COMPOSITION Outcome

In this chapter, an overview of how the different outcomes of the COMPOSITION project are handled in terms of business analysis and planning will be presented. We have looked at different modelling frameworks which are suitable for describing the COMPOSITION value creation capabilities and how the resulting business models can be used to forecast the stakeholders' economic performance under different assumptions. The work has focused on three different business aspects:

1. The Intra-Factory solutions are dealt with using *Cost-Benefit Analysis* tools combined with the *Business Model Canvas*. The solutions, and the use cases describing them, largely involve two actors: The pilot owner (buyer) and the supplier of the software (seller). The economic benefits experienced by the buyer may vary; the pricing model, cost of ownership, etc., of the software may vary. The cost-benefit analysis will thus point to the optimal solution for both parties.
2. The software components and solutions are dealt with using *Pricing and Revenue Models* combined with the *Business Model Canvas* overview method. The most important business aspects here is for the supplier of COMPOSITION software to find the proper revenue streams (one-off, licence, click fees, etc.) and the right pricing that maximises the revenues and customer relationship for the COMPOSITION software vendor.
3. Finally, the business potential for IIMS in Manufacturing Industry Marketplaces are dealt with using Value Business Model tools that allows for identification of value propositions in a multi-stakeholder ecosystem and how the marketplace can help different actors to form value constellations by combining several value propositions into an end-to-end solution for industrial actors. The Value Based Business Models allows for simulation of a number of parameters and for experimentation of the value constellations in order to optimise the benefit for all actors in the ecosystem.

The work is intimately related to other business analysis tasks performed in the project, all aiming at supporting the exploitation planning at the end of the project

Deliverable *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry* was issued in an initial version describing the products and markets relevant to the COMPOSITION platform. This work provides the foundation for the three focus areas described above.

Using the business results presented in the present deliverable, D9.8 will be updated and combined with the exploitation planning framework in *D9.10 Exploitation Planning Framework and First Draft of Exploitation Plans*.

Moreover, deliverable *D9.7 Cost, Benefit, and Risk Evaluation* will provide the business foundation for the Intra-Factory solutions in focus area one.

The final results will be presented in *D9.11 Final Exploitation Strategy and Business Plans*.

5 Intra-Factory Business Analysis

The Intra-Factory scenarios and their use cases largely involve two actors: The pilot owner (buyer) and the supplier of the software (seller). The economic benefits experienced by the buyer may vary; the pricing model, cost of ownership, etc., of the software may vary. Hence the cost-benefit analysis will point to the optimal solution for both parties. Once the optimum solution has been found, the Business Model Canvas will be used to lay out the specific business cases for the involved actors.

5.1 Cost-Benefit Analysis

The work on cost-benefit analysis of the Intra-Factory scenarios will be performed in deliverable *D9.7 Cost, Benefit, and Risk Evaluation*. Scientifically sound methods such as the Constructive Cost Model (Boehm, 1981) and the BeneFIT method (Blumberg et al, 2012) will be introduced and analysed. Interviews with experts, research, and empirical data will be used to find and calculate performance numbers and key figures needed for the analysis and evaluation of costs, risks, and benefits of the proposed solutions.

The calculate performance numbers regarding costs, risks, and benefits of the COMPOSITION-situations will be compared with the corresponding values of non-COMPOSITION-situations to determine how COMPOSITION affects the performance of each pilot partner's business system.

Moreover, an information-dense risk report will be prepared to give a broad view of COMPOSITION-project relevant risks, their probabilities and impacts, and counter-measures.

5.2 Business Model Canvas

The Business Model Canvas, developed by Alexander Osterwalder and Yves Pigneur in the context of the Business Model Framework (Osterwalder 2010), offers a tool to visualise the framework of the specific business model, mapping the different building blocks and making the model easier to communicate and understand. This tool is used to map out all details of the business model and the business ecosystem once the value proposition has been identified. It is a dynamic tool which can be updated and adapted to the business model so that it matches the current challenges and meets the customer demands at all times.

5.2.1 Use Case UC-KLE-1 Maintenance Decision Support

The COMPOSITION solution provides the following features:

1 The status of machines is monitored by the BMS. COMPOSITION system retrieves data from the BMS continuously

2 COMPOSITION system stores information about machines

3 Analysis is performed by the COMPOSITION system using machine learning techniques applied on both real-time data coming from sensors as well as on historical data

4 COMPOSITION system makes suggestions for machine maintenance based on the results of the analysis

5 COMPOSITION system sends notifications to maintenance manager and maintenance planner.

Additional features are:

1 The status of polishing machines is monitored by the BMS COMPOSITION system receives continuously real-time data from BMS about status of polishing

2 COMPOSITION system stores information about polishing machines

3 Analysis is performed by the COMPOSITION system using machine learning techniques applied on both real-time data coming from sensors as well as on historical data

4 COMPOSITION system makes suggestions if a threshold of degradation is reached

5 COMPOSITION system sends a notification to Maintenance Manager.

The goal of all actors is to optimise maintenance services and procedures. More specifically:

1 The goal of the Technician is to reduce machine failures/breakdowns. The technician receives work order for fixing the machines

2 The goal of the BMS system is to collect data from the machine continuously, and sends them to COMPOSITION system

3 The goal of the Maintenance planner is to minimise the required paperwork

4 The goal of the Maintenance manager is to get the best decision about maintenance based on COMPOSITION system's suggestions. Another goal is to reduce machine failures/breakdowns, costs, and the mean time to repair (MTTR).

The business model canvas is shown in Figure 1.

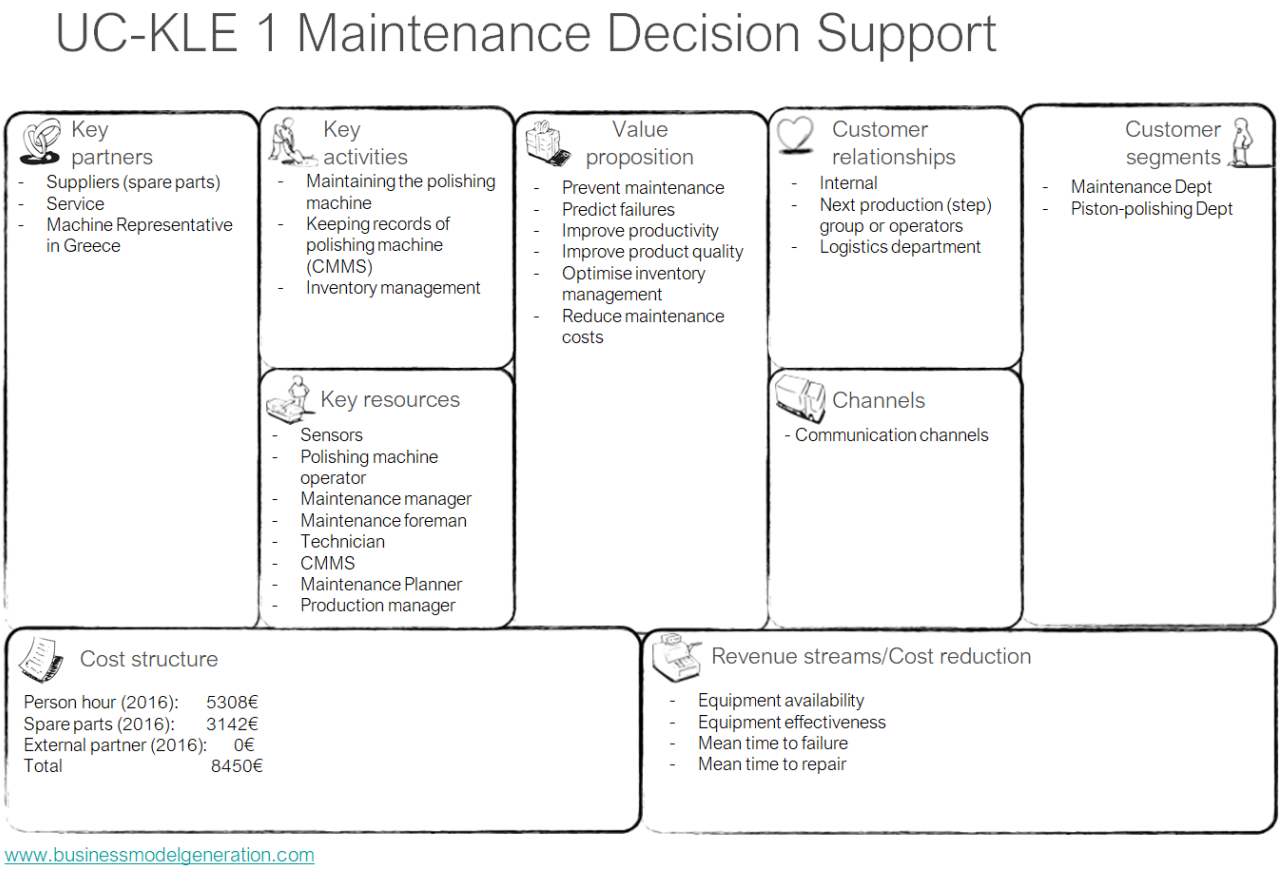

Figure 1 Business Model Canvas for UC-KLE-1 Maintenance Decision Support

5.2.2 Use Case UC-BSL-2 Predictive Maintenance

The COMPOSITION solution provides the following features:

1 The fan parameter measurements are displayed on the factory Visualisation Screen

2 The parameters are compared against pre-set limits

3 If the limits are exceeded an alarm about exceeded fan limits is displayed on the Visualisation Screen

4 The Process Technician and Technician Supervisor are notified

5 The Process Technician decides with the rest of the team whether to change the fan at this point or to change it later

6 Once changed the Process Technician resets the alarm and system continues monitoring.

The goal is to optimise maintenance services and procedures. More specifically:

1 The goal of the Process Technician's and Technician Supervisor's goal is to have access to fan performance data and to be notified of impending fan failure

2 The goal of the Visualisation Screen is to display fan performance data as well as an alarm when this data reaches levels which indicate impending fan failure.

The business model canvas is shown in Figure 2.

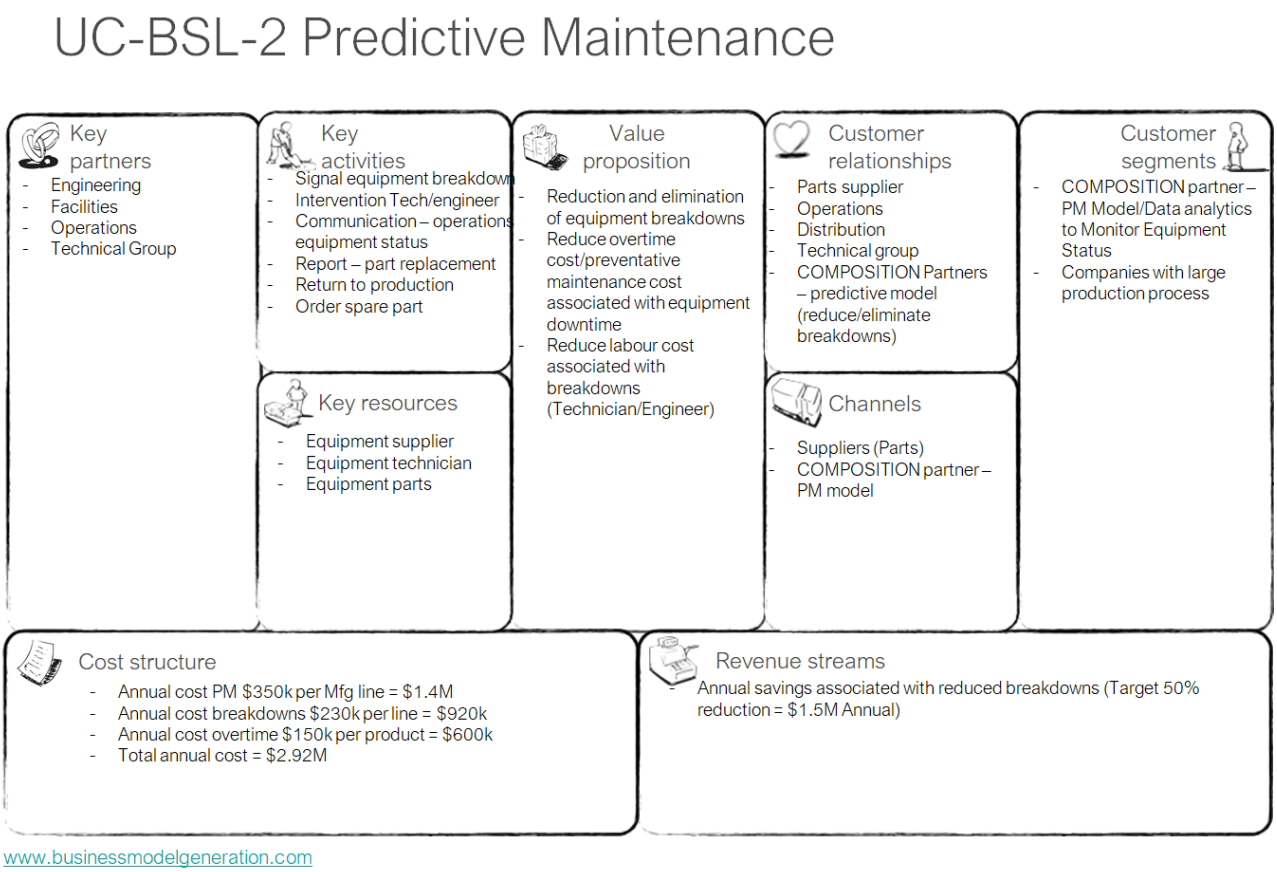

Figure 2 Business Model Canvas for UC-BSL-2 Predictive Maintenance

5.2.3 Use Case UC-BSL-3 Component Tracking

The COMPOSITION solution provides the following features via a Visualisation Screen:

1 Sensors detect that a component has entered the factory or moved within the factory

2 The sensors send component location data to the system

3 The system updates a database with the component location data and the time the data was obtained

4 The current component location data is visualised on the Visualisation Screen.

The goal of the Visualisation Screen is to display all components with their location.

The business model canvas is shown in Figure 3.

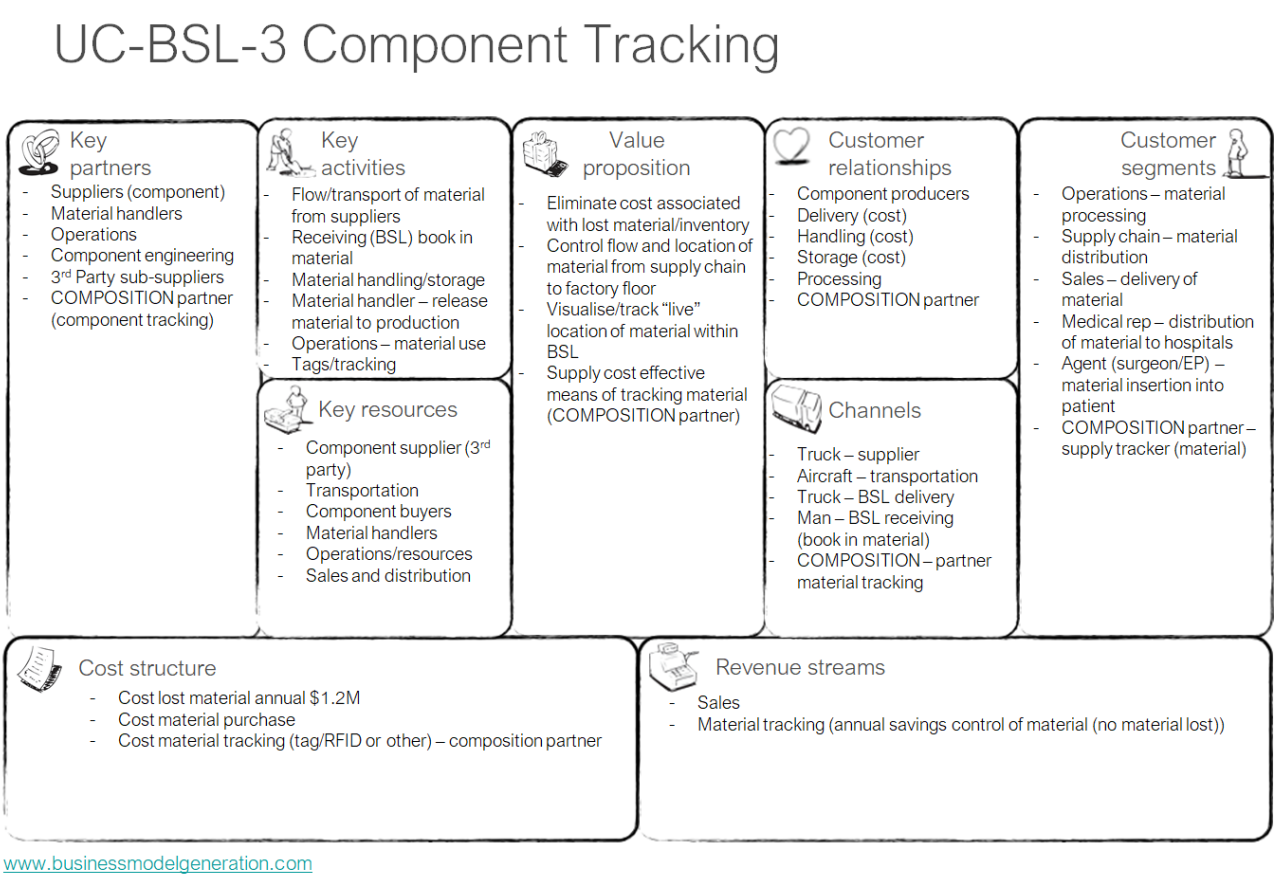

Figure 3 Business Model Canvas for UC-BSL-3 Component Tracking

5.2.4 Use Case UC-BSL-4 Automatic Solder Paste Touch Up

The COMPOSITION solution provides the following features:

1 The Solder Paste Inspection (SPI) fails a PCBA for, e.g., Circuit 1 Pad 2 on C3

2 The SPI directs the PCBA to the Dispense System

3 The SPI al this time sends a signal and correct file to the Dispense System to tell that system what location needs additional solder paste

4 The Dispense System tops up the particular pad and sends the PCBA back through SPI. This process continues until the SPI gives a passing result.

The goal of both actors is to reduce NCs using automatic solder paste-up. More specifically, the goals are:

1 SPI is to automatically send information about the solder paste volume on each pad to the dispense system

2 Dispense System is to top up the correct solder pads using information received from the SPI.

The business model canvas is shown in Figure 4.

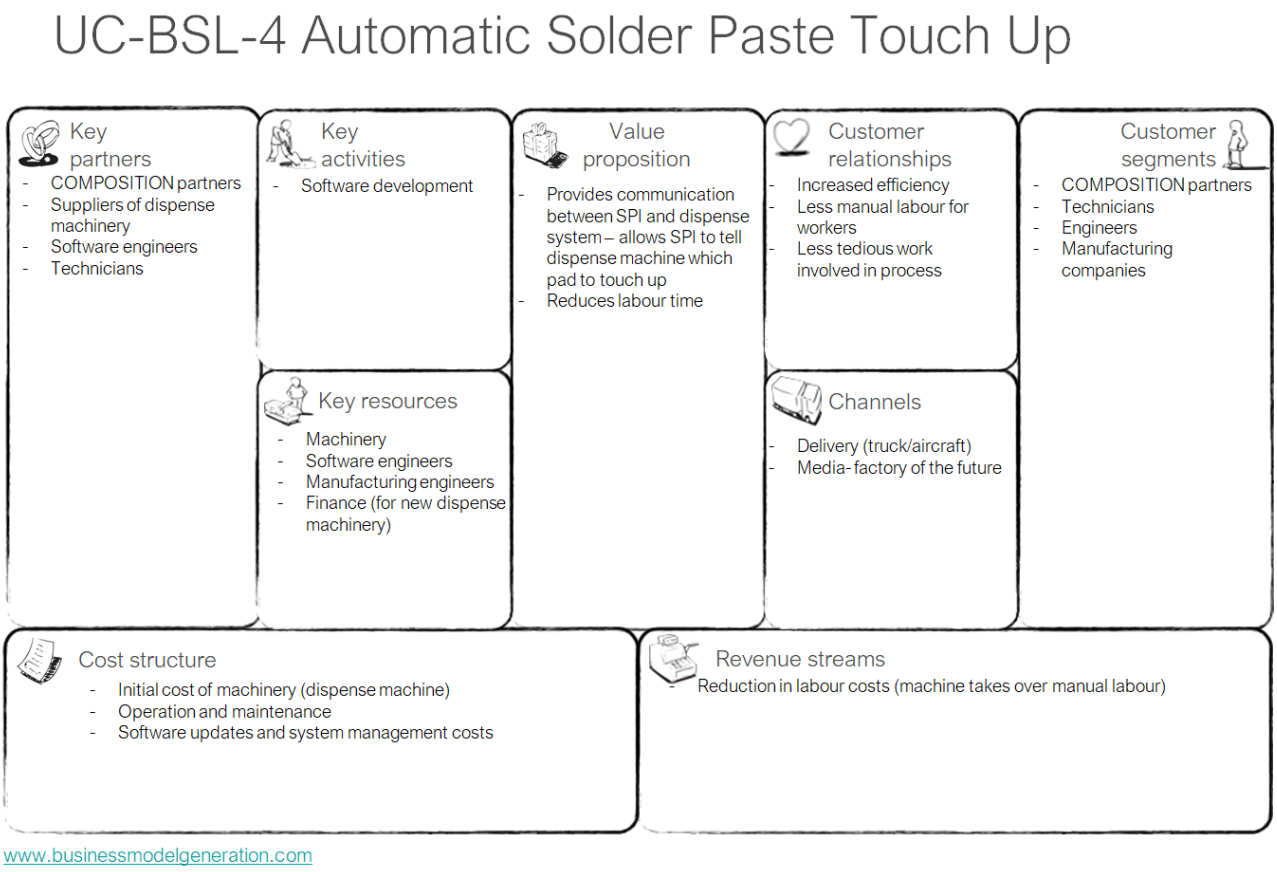

Figure 4 Business Model Canvas for UC-BSL-4 Automatic Solder Paste Touch Up

5.2.5 Use Case UC-BSL-5 Equipment Monitoring and Line Visualisation

The COMPOSITION solution provides the following features via a Visualisation Screen:

1 Equipment status and production rate are monitored and visualised

2 Equipment status is shown as green (production ready/in production), amber (alert state), red (down)

3 At change in equipment status, relevant actors are notified

4 When issue is handled, the alarm is reset.

The goal of all actors is to catch issues early and reduce scrap. More specifically:

1 The goal of the Visualisation Screen is to provide information in a structured way and inform the involved parties instantly if an issue occurs

2 The goal of the involved parties is to keep track of equipment issues and be informed instantly on changes in equipment status, including keeping track of the actual versus target production.

The business model canvas is shown in Figure 5.

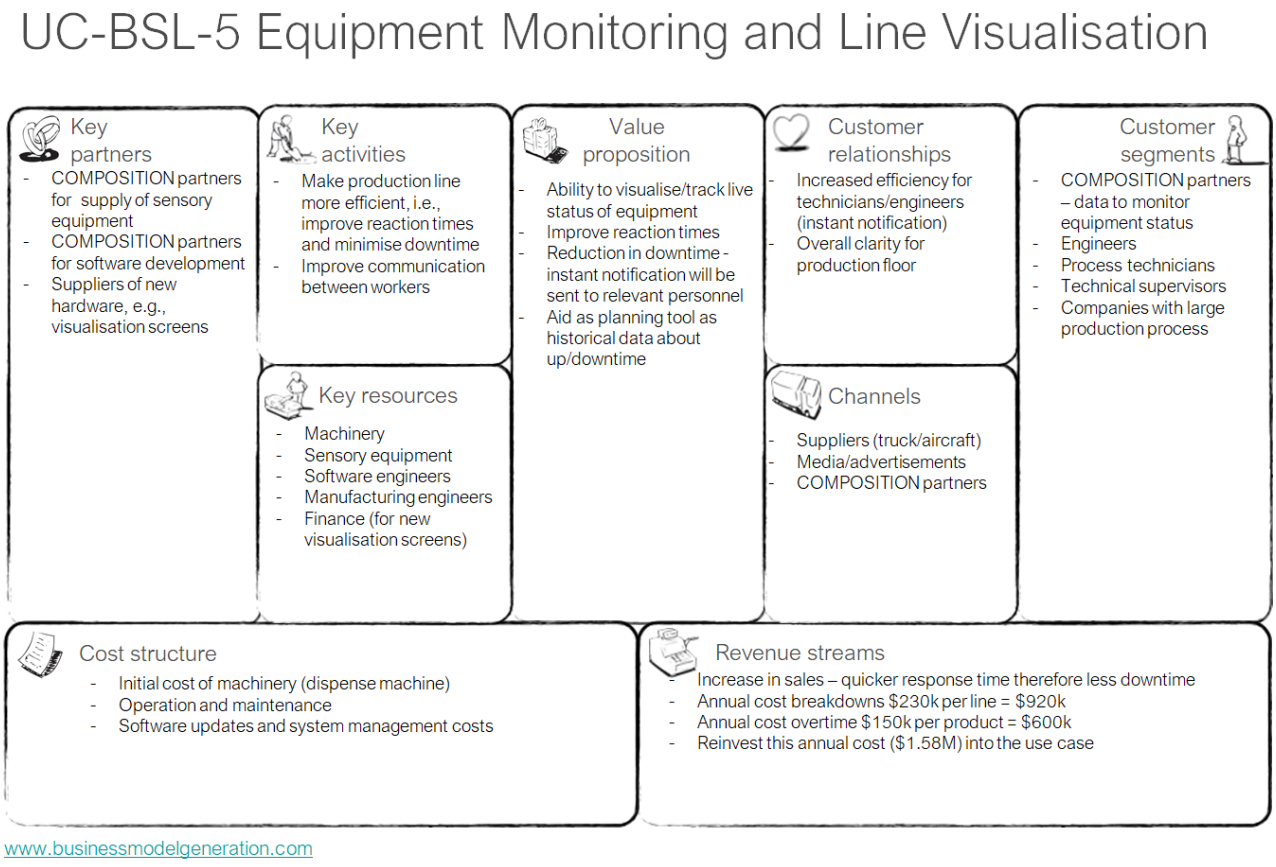

Figure 5 Business Model Canvas for UC- BSL-5 Equipment Monitoring and Line Visualisation

6 Business Models for Software Components

The business models for software components involves selling of software components and services, including development and support, to companies and organisations supplying IMS, IIMS, BMS, BEMS and other types of large software complexes for industrial customers.

The main aspect of these business models is centred around how the software components are prices. Is it a single licence? Or an Open Source with development and support services? Or an annual licence with usage fees? The entire business model depends on the choice of pricing models which defines the resulting revenue streams.

At this stage, the software components are not sufficiently well described to allow the developers to decide on a suitable pricing model. When the components are stable, each software developer partner in the consortium will choose a suitable pricing model and calculate their revenues. This will be presented in the *D9.11 Final Exploitation Strategy and Business Plans*.

An explanation of the different pricing models that can be used is provided in this chapter.

6.1 Revenue and Pricing Models

A business model can consist of several revenue models. For each product and service, a company is selling to potential customers, a revenue model has to be defined. Each defined revenue model must consist of at least of one or more pricing model.

One of the most important entrepreneurial decisions is the determination of revenue sources and the amount of revenues needed to finance the business activity. According to Zerdick (Zerdick, 1999) the decision consists of two parts. On the one hand, it is a decision about revenue sources and the other hand a decision about the price policy. Thereby the decision on the revenue sources has to be made before determining the pricing model.

Hence, a revenue model is a description showing the sources from which an enterprise obtains its income. The revenue model can be directly attributed to the value exchange elements in the value model thus creating a full overview of the revenue streams in the business system.

The second important part for the determination of a revenue model contains the determination of pricing models. There are different possibilities, depending on different factors, to determine the price. In the following, a few of these different pricing methods are described according to their relevance to the COMPOSITION platform and services.

6.1.1 Value-Oriented Pricing

This pricing method is a particular form of the demand-oriented pricing. The central task is the determination of a customer's benefit arising from a product or service. The idea is that the customer makes a trade-off between the price and the individual benefit resulting from the purchased service or product (Meffert, 2000). This recognised value (benefit) determines the customer's maximum willingness to pay, which is equal to the ceiling price for a product. The price of a product has to be smaller than its benefit, which means there must be a positive net benefit (Meffert, 2003).

Net value = Performance value – Price

With this method, valuable information is gathered for product measures besides pricing in order to meet the customer requirements, but the compilation of the subjective benefits is rather comprehensive, for example with a "Conjoint Analysis". Another disadvantage is that it is not possible to deduce the actual purchase behaviour of the customer directly from the found benefit. Moreover, the value-oriented pricing model breaks down in value networks where more actors and more value objects are aggregated into a final value proposition.

6.1.2 Usage-Oriented Pricing

When looking for a tariff, customers will choose the charge method bearing the maximum benefit for them. Here, literature distinguishes between use-dependent and use-independent tariff models.

The use-dependent models are based on the use behaviour of the customer. The price depends on the actual quantity, frequency, duration or the volume of use. The user does not have to pay a base price but only a price

for its usage (Skiera, 2006). One important advantage of this model is that the supplier is paid for his efforts – there is no risk of loss. The resulting disadvantages for the user are unlimited costs and varying invoices. The customer cannot calculate his costs exactly and will therefore abstain from a too high usage, which may lead to a possible drop in orders for the supplier.

At the use-independent model a service at a basic fee is offered to the customer. The customer pays a flat rate for a fixed service and additional services are charged separately (Betsch, 2001). Flat rates are use-independent tariffs. A main characteristic of these models is that the customer has to pay for the whole package independent of its usage intensity. The turnover of the supplier and the costs of the user can be calculated. Thus, the customer can be sure of his budget, because the price is fixed, and he can save money by using the service at a high degree. One disadvantage for the supplier is to calculate the turnover only, instead of the actual profit, because he can only estimate the use roughly. There are high estimation insecurities for the supplier, but a profit chance can arise from this estimation if the customer uses the service lesser than predicted. Although the use behaviour of the customers would have led to cheaper invoices at other tariffs, customers may opt for a flat rate. When choosing the optimal tariff, many customers do not decide in favour of the price alone.

These pricing models can be applied separately or in combination with each other. The customer can be charged by two separated prices for one product – a fixed fee and a price per unit. There is often a positive willingness to pay at the usage-based pricing model.

6.1.3 Benefit-Oriented Pricing

Benefit-oriented pricing models are also called gain sharing or risk sharing. If the price is linked to a pre-defined benefit (success or output), there are basically two variants: the performance-based pricing and the profit-based pricing of the customer's output. With each variant, the customer is charged different prices for the same product or service, based on the distinction in the generated value (Nagle&Hogan, 2007).

The performance-based pricing model is centred on the proficiency level of an investment. The customer pays for the actual performance of the product or service. Possible parameters are: performance (e.g., maximum work performance per hour), availability (e.g., operating time of a machine or system), quality (e.g., manufacturing tolerances, rejects). For example, when customers have an urgent need for express services they can get a guaranteed fast delivery at extra charge. Another example often used at the performance-oriented pricing model is the pricing of advertisements in the Internet. These are paid per click on the banner ad instead of the unit costs per visitor.

The profit-based pricing model depends on the economic result of the transaction. Possible parameters are: realised cost savings, generated turnover and contribution to profit. For example, lawyers often get their expenses reimbursed and receive part of the money adjudged in court instead of their actually worked hours. Control systems for lights, heating and cooling systems in office buildings are charged on the basis of energy cost savings instead of calculating the price for the installed devices (Nagle&Hogan, 2007).

Both price models require a high communication and cooperation effort between the customer and the supplier. Thus, these models are suitable for rather insecure and complex situations only. An additional effect is the transfer of the performance risk from customer to supplier. The customer can be sure to get the service he demanded because this is the basis for the price. Due to this, the supplier's intention is not to perform a minor service because this will decrease his profits.

7 Business Models for IIMS for Manufacturing Industry Marketplaces

7.1 Introduction to the Manufacturing Industry Marketplaces

Requirements of modern production processes demand greater agility and flexibility in order to yield faster production cycles, increased productivity, less waste and more sustainable production. In such a potentially worldwide and dynamic environment, the ability of automating coordination and negotiations of activities related to management of supply chains can be transferred to open marketplace-like platform, which would greatly improve the ability of actors to react quickly to external challenges.

A digital marketplace (or virtual or online marketplace) is a type of e-commerce site where product or service information is provided by multiple third parties. Transactions are processed by the marketplace operator and then delivered and fulfilled by the participating suppliers or wholesalers. Other capabilities might include auctioning (forward or reverse), catalogues of products and services, ordering, trading of product functionality and capabilities as well as requests for quotations, information or proposals (RFQ, RFI or RFP).

Figure 6 Virtual Marketplace Model (Source: www.slideteam.net)

Digital marketplaces are the primary type of multichannel e-commerce and can be a way to streamline the production process. Since 2014, digital marketplaces are abundant. Some have a wide variety of general interest products that cater to almost all the needs of the consumers - some are consumer specific and cater to a particular segment only.

7.2 Marketplace Definitions

Generally, the actors in the market place have different roles as seen in Figure 7:

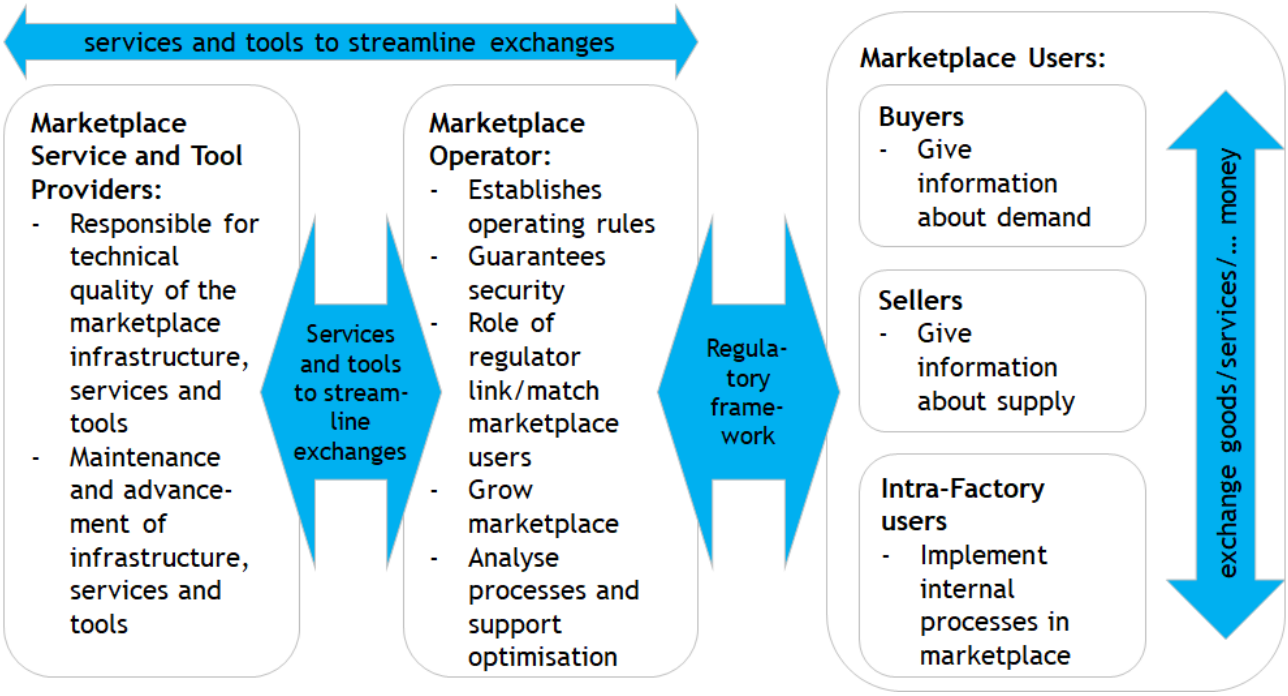

Figure 7 Definition of the COMPOSITION marketplace - roles

7.2.1 Marketplace Service and Tool Providers

The Marketplace Service and Tool Providers are responsible for the technical quality of the marketplace infrastructure, services, and tools and also provide maintenance and advancement of the marketplace. The following revenue streams may be considered:

1. Sell services and tools to marketplace operator and marketplace users (leasing, selling, etc.)
2. Sell maintenance of services and tools
3. Increase sales with growing marketplace users

7.2.2 Marketplace Operators

The Marketplace operators deploy and operate the marketplace platform. The following types of operators are active:

- Hybrid operators: these operators also sell products or services on their own Marketplace. They manage the marketplace whilst at the same time, having their own sales activity. (e.g., google play store)
- Pure player operators: these are operators who from the outset, position themselves as purely intermediaries between sellers and buyers. In contrast with hybrid operators, pure players do not have a sales activity that could be in competition with sellers on their marketplace. (e.g., Airbnb)
- Buyer or seller consortiums: These are groups of buyers or sellers who come together to create a forum for exchange. These are generally very B2B-oriented. (e.g., Hubwoo[1])

7.2.3 Marketplace Users

The Marketplace Users consist of Buyers, Sellers and Intra-Factory users, the latter implementing the internal processes in the marketplace.

The following value objects may be considered by marketplace users:

1. Buyers get the best supply and the best prices, reduce their costs and risk and optimise their Supply Chain Management

[1] www.hubwoo.com

2. Sellers may increase their sales, simplify the selling process, and reduce their costs and risk
3. Intra-Factory users may optimise their internal processes, use big data analytics and reduce costs and risk.

7.3 Marketplace Pricing Models

Generally, there are various pricing and business models associated with marketplace activities for the different actors:

A Commission:

The most popular business model for modern marketplaces is to charge a commission from each transaction. When a customer pays a provider, the marketplace facilitates the payment and charges either a percentage or a flat fee.

Pros:	Cons:
Providers are not charged until they get some value from the marketplace The most lucrative for marketplaces and scalable	How to provide enough benefits for marketplace users? How to do pricing Immense exchanges do not justify the commissions

B Membership:

A membership fee is a model where either some or all of a marketplace's users are charged a recurring fee to access the marketplace.

Pros:	Cons:
Value for sellers is that the marketplace helps them find new customers. Value for buyers is that it helps them save costs If the value you provide is high and a typical user will engage in several transactions, but facilitating a payment is challenging or impossible	Need enough users on marketplace to make it valuable for both sides Mandatory payment discourages users from signing up (suggestion: offer heavy discounts for early adopters, or even lifting the fee completely to build the initial user base)

C Listing fee:

Charge of a fee from users when they post new listings. This model is typically used when providers get value based on the number of listings they have on the site, and the potential value per listing is big.

Pros:	Cons:
Can be combined with other business models Listing fee can be better than a membership when users don't want a continuous subscription, and only want to sell certain items	Does not guarantee value for users, and thus the fee must not be too high. No guarantee that anything is sold, so the marketplace will have a harder time proving that it provides actual value to its providers

D Lead fee

Lead fees are somewhere between the listing fee and the commission models. In a typical lead fee model, customers post requests on the site, and providers pay in order to make a bid for these customers.

Pros:	Cons:
Gives a better value proposition than the listing fee model: you only pay when you are put in touch with a potential customer	Possibility of building the relationship outside the marketplace once they have the lead.

F Freemium

The basic experience is free for all the users of the marketplace. Revenues by offering premium services (e.g., insurance) that give value-added features to paying users.

Pros:	Cons:
Unique Selling Points of premium service must be clear and high Often used as a start of marketplaces before commission is used	Critical mass of premium users needed Less scalable than commission

G Featured listings and ads

Listing in the marketplace is typically free, but users can pay to have their listing be featured to get higher visibility.

Pros:	Cons:
	Require a significant number of users to generate relevant revenue Work best for niche products

7.4 The COMPOSITION Marketplace

By building on paradigms based on marketplace theories, the COMPOSITION system will extend the factory IIMS into a holistic and collaborative digital marketplace incorporating the entire *Supply* and *Value Chain.* The main characteristics of the COMPOSITION marketplace are:

- It is a digital site that is:
  - Transactional
  - Online
  - Extended from the actors' internal IMS
- Product or services are provided by multiple suppliers:
  - Multi-actor value propositions
- Product or services are sought by multiple buyers:
  - Multi-actor RFQ with bidding
- A marketplace operator provides the functionality and supports the transactions:
  - Secure processing capability
- Transactions are physically delivered and fulfilled by the participating actors:
  - It has physical world interfaces
  - It is supported by sustainable business models

The digital marketplace is related to the following COMPOSITION use cases:

- Inter-Factory-1 Use Case: Scrap Metal Management
  - BM: Waste Management Marketplace
- Inter-Factory-4 Use Cases: Software Distribution and Inter-Factory-5 Use Cases: System Connection over Marketplace
  - BM: Software Virtual Marketplace
- Inter-Factory-3 Use Case: Supply Chain Management
  - BM: Supply Chain Marketplace

7.5 Value Based Business Modelling

For the complex task of defining new business models for IIMS for Manufacturing Industry Marketplaces, the COMPOSITION project will adopt an ontological perspective on the exploration of innovative service concepts and for quantifying value creation (Thestrup, 2008). This methodology has proven to be very successful in a number of cases involving creating business from new, innovative IoT services and solutions.

7.5.1 The Value Proposition of a Business Model

The basic questions to be answered in the business model are the fundamental questions of any business: What do we offer to the customer, who are they and how do we operate to deliver the product or service so that we can create a profitable and sustainable business?[2] In other words, we need to identify and analyse the value proposition in the intended COMPOSITION based service, to which customer group the service is targeted and how we organise ourselves to deliver the service in the most efficient way.

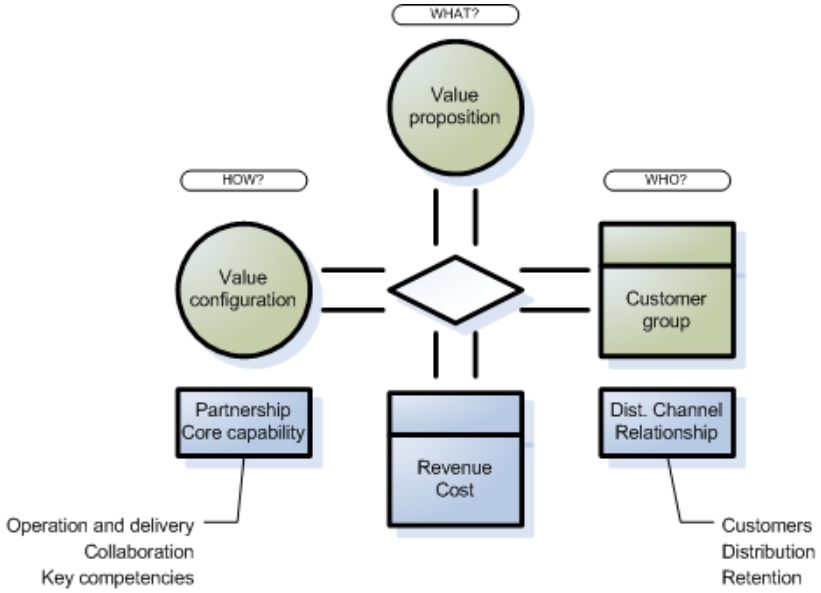

Figure 8 Fundamental elements of a business model

When the three questions have been answered, it is possible to analyse the revenue streams and cost models and derive the financial return and thus evaluate the sustainability of the proposed business.

The value proposition is an overall view of all the products and services that a company offers and which together represent a value for the customer.

Customer groups are targeted by the actual value proposition. When the customer group has been defined, the next step is to evaluate how the company can actually gain access to this target group, i.e., which distribution channel can be activated. A distribution channel can be defined as a set of links or a network through which a company 'goes to market' to deliver its value proposition.

[2] The methodology and illustrations in this chapter are adopted from (Pigneur, 2005).

The value configuration involves structuring the infrastructure of the company to be able to deliver the value propositions to the target groups. The value configuration is thus closely related to the core competencies and operational infrastructure of the company.

The final step in business modelling involves getting all things to work together for a sustainable business case. This step will therefore involve putting monetary values on the model elements, establish the revenue sources and streams and calculate the resulting financial aspects, all of which may be realised in a variety of ways.

7.5.2 The Value Based Business Model

The purpose of the value model is to describe who exchanges objects of value with whom, while a process model describes the way a value model is put into operation: the activities needed, as well as their sequence, to create, distribute, and consume value. The concepts in a value model are thus centred around the notion of value, while in process modelling concepts focus on operational aspects of a process

Value is co-produced by actors who interface with each other. They allocate the tasks involved in the value creation process among themselves and to other actors. It follows from the basic human character that a sustainable business can only be built, if its transactions are creating true, lasting values. If there is no added value for the stakeholders, the business will eventually disappear. In this respect, it also makes sense to look at the definition of added value. You *add value* to an organisation when enabling it to grow its business. You *destroy value* from an organisation when reducing its business.

A value model thus captures decisions regarding who is offering and exchanging what with whom and expects what in return whereas a process model focuses on decisions with respect to how processes should be carried out, and by whom. For example, the model will capture how manufacturers and recyclers are exchanging information about waste collection. The value objects are “information” and “monetary compensation”. The exchange of these objects is facilitated by the COMPOSITION platform, which is provided by a third actor, the COMPOSITION service provider.

In Summary, a value model predicts to which extent actors are profitable, and whether actors are willing to exchange objects of value with each other. A process model states what activities to be performed, in which order, and which objects flow between activities.

A value model captures other stakeholder decisions than a process model does. A value model shows the essentials (the strategic intent) of the way of doing business in terms of actors creating and exchanging objects of value with each other, while a process model shows decisions regarding the way a business is put into operation.

Finally, value modelling uses decomposition of value activities as a way to discover new profitable activities, where decomposition of activities in process modelling serves the goal of clarity, or studying various resource allocations (e.g., operational actors) to activities.

7.6 Waste Management Marketplace

Waste can take any form that is either solid, liquid, or gas and each have different methods of disposal and management. Waste management normally deals with all types of waste whether it was created in forms that are industrial, biological, household, and special cases where it may pose a threat to human health. It is produced due to human activity such as when factories extract and process raw materials. Waste management is intended to reduce adverse effects of waste on health, the environment or aesthetics.

7.6.1 Introduction to Waste Management

Waste management includes all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling.

The waste management cycle[3] includes the following activities and actors:

- Analysis
  - Waste producer
  - Certification
- Collection
  - Waste producer
  - Storage
- Transportation
  - Logistics
  - Certification
- Recovery
  - Waste Management
  - Sorting, recovery
  - Certification
- Recycling
  - Recycling plants
  - Certification

Figure 9 The Waste Management Cycle (Source: Druk Waste Collection)

Waste Management is one of the closest regulated industries in the EU. The EU Waste Management Framework Directive is the umbrella for a wide range of detailed directives and regulations covering the entire Waste Management in the EU. It covers 11 different areas of waste management as outlined in Figure 10.

The EU-Waste Framework Directive Outline

1. Introduction
2. Definition of waste
3. Differentiation waste - by-products
4. Waste hierarchy
5. Producer responsibility and waste prevention
6. Differentiation waste recovery / waste disposal
7. National waste management structures
8. Waste recovery requirements
9. Targets for Re-use and Recycling
10. Waste management planning
11. Hazardous waste

Figure 10 Areas Covered by the EU Waste Directives

7.6.2 Use Cases for the Business Model

The business model use case for Waste Management Marketplace has been derived from the following Inter-Factory uses cases described in deliverable *D2.1 Industrial Use Cases for an Integrated Information Management System* and later revisions:

- UC-KLE-4 Scrap metal collection process
- UC-KLE-5 Scrap metal bidding process
- UC-KLE-6 Determining price for scrap metal

These use cases have been combined as UC-KLE-4 Scrap Metal Collection and Bidding Process and updated to reflect the real business systems in which the actors operate. The inclusion of business aspects, constraints

[3] http://www.drukwastecollection.com/

and opportunities are essential for designing a proper and sustainable business model. The uses case is represented by the 'swim lane' diagram shown in Figure 11.

7.6.2.1 Actors

The business model use case has 6 actors:

COMPOSITION Software Provider: This actor supplies one of more of the COMPOSITION software components to the Platform Provider. The COMPOSITION Software Provider can be a COMPOSITION partner or a venture of several COMPOSITION partners. Before the COMPOSITION software can be sold commercially, the COMPOSITION Software Provider will have to invest in commercialisation activities for the prototypes originating from the COMPOSITION project. Moreover, annual support and maintenance costs are incurred. Both investments and maintenance costs can be shared across several customers.

Platform Service Provider: This actor is a software company with existing products and services in the form of cloud solutions. The Platform Service Provider will set up, deploy and deliver the services according to the pricing models discussed in the previous chapter.

Waste Producers (market segment): A series of Waste Producers are group in a market segment because they all produce waste that needs to be handled and they are assumed to act in an equal way to price signals and offerings from the waste management companies.

Waste Management Company: The Waste Management Company is the viewport of the business model. The Waste Management Company contracts the platform from the Platform Service Provider and makes it available to all its suppliers (recyclers, etc.) as well as all existing and potential customers (Waste Producers). The Waste Management Company manages both the bidding process, the contractual process and the execution of the contract, e.g., logistics and billing. The Waste Management Company enjoys a price differential on between the price paid by the suppliers (Metal Recyclers) and the price paid to the Waste Producers. This margin covers The Waste Management Company's capacity costs, logistics costs and a profit margin.

Metal Recyclers (market segment): This actor is in fact a market segment consisting of several metal recyclers operating in the geographical area of The Waste Management Company. The Metal Recycler participates in the bidding process in order to get more metal scrap. If the capacity of the Metal Recycler is higher that the demand, the Metal Recycler will increase the price offered, and if the reverse is true, lower the price offered. Since the Waste Management Company is able to select the highest bidding Metal Recyclers, the total price obtained for scrap metal will increase thus benefitting both the Waste Producers and The Waste Management Company. The platform will thus also act as a mediator of supply and demand in the metal scrap ecosystem.

7.6.2.2 Use Case and Value Activities

The actors are engaged in a series of activities which creates value for all actors. The value activities are depicted in the 'swim lane' diagram shown in Figure 11. The activities cover three phases of the waste management marketplace: The bidding process, the validation and contract management process, and the ongoing execution of the waste management functionality via the Waste Management Marketplace.

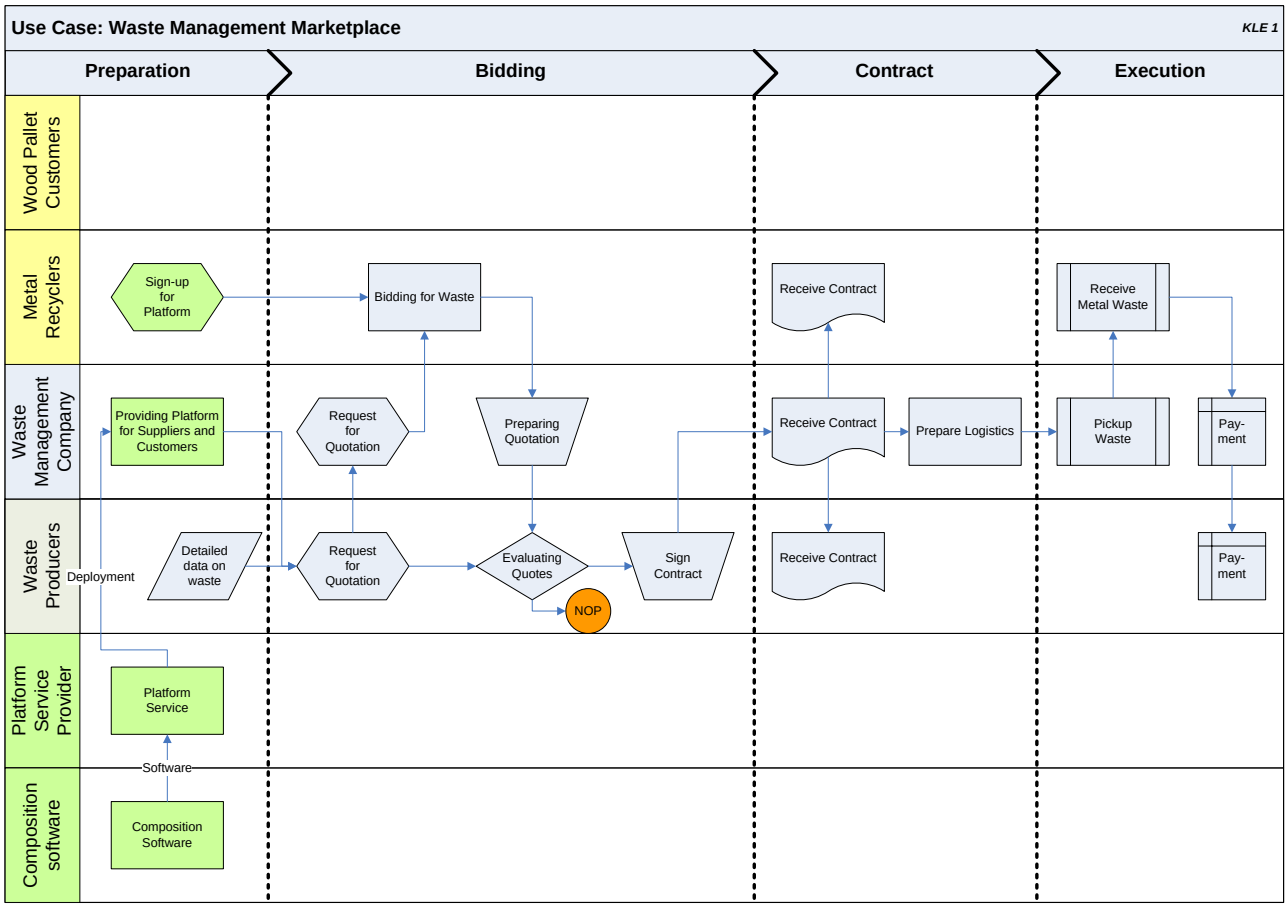

Figure 11 Use Case diagram for the Waste Management Marketplace business model

The use case has four phases.

The *first phase* “Preparation” encompasses the preparation and deployment of the platform, on which the bidding and ecosystem transactions are to be managed. Both upstream and downstream actors are invited to use the platform. No charges are foreseen for the use of the platform.

The *second phase* “Bidding” involves the Waste Producers to place an RFQ (Request for Quotation) on the platform. The RFQ is accompanied by a dossier of detailed information about the waste subject of the bidding process. The scope of the information is selected by the Waste Producer and may include: Type of waste (certificate of process and substances), the volume/weight, the pick-up point, the pick-up date/time, special requirements for the pickup (access, logistics, opening hours, etc.). The accuracy of the information will in the first instance determine the number of bids and the prices quoted. If some information is missing, no bids may be received. If information about the waste itself is inadequate, the price may be much lower than anticipated. In the second instance, the Waste Producer may be liable for compensation if some of the information given is inaccurate. This has not been considered in the business model. Also, special needs for EU bidding have not been included.

The *third phase* “Contract” is a manual phase, in which the Waste Producer considers the various bids received and awards the contract according the published criteria. This phase will also require legal assessment and interaction, which has not been included in the business model. When the contract has been received by the Waste Management Company, the process of preparing the pickup (logistics, paper work, etc.) is performed.

In the final *fourth phase* “Execution”, the Waste Management Company arranges for the pickup of the metal scrap waste at the Waste Producers site and delivers it to the Metal Recycler who won the contract. Finally, the various payments are effectuated. The process and logistics management and the associated paperwork are managed via the platform.

7.6.3 Business Modelling

The business model for the COMPOSITION Waste Management Marketplace is constructed to show how actors in this ecosystem can create sustainable business models from a mix of marketplace bidding and better

asset utilisation. This will lead to higher prices for scrap metal throughout the ecosystem which funds the cost of the market place.

The aim of the business modelling work is to provide a mathematical model of the use case interactions and their influence on the financial performance of the actors. The use case has been modelled into a value model using the e^{3}value model tool, as shown in Figure 12. The graphical components are explained in Appendix A.

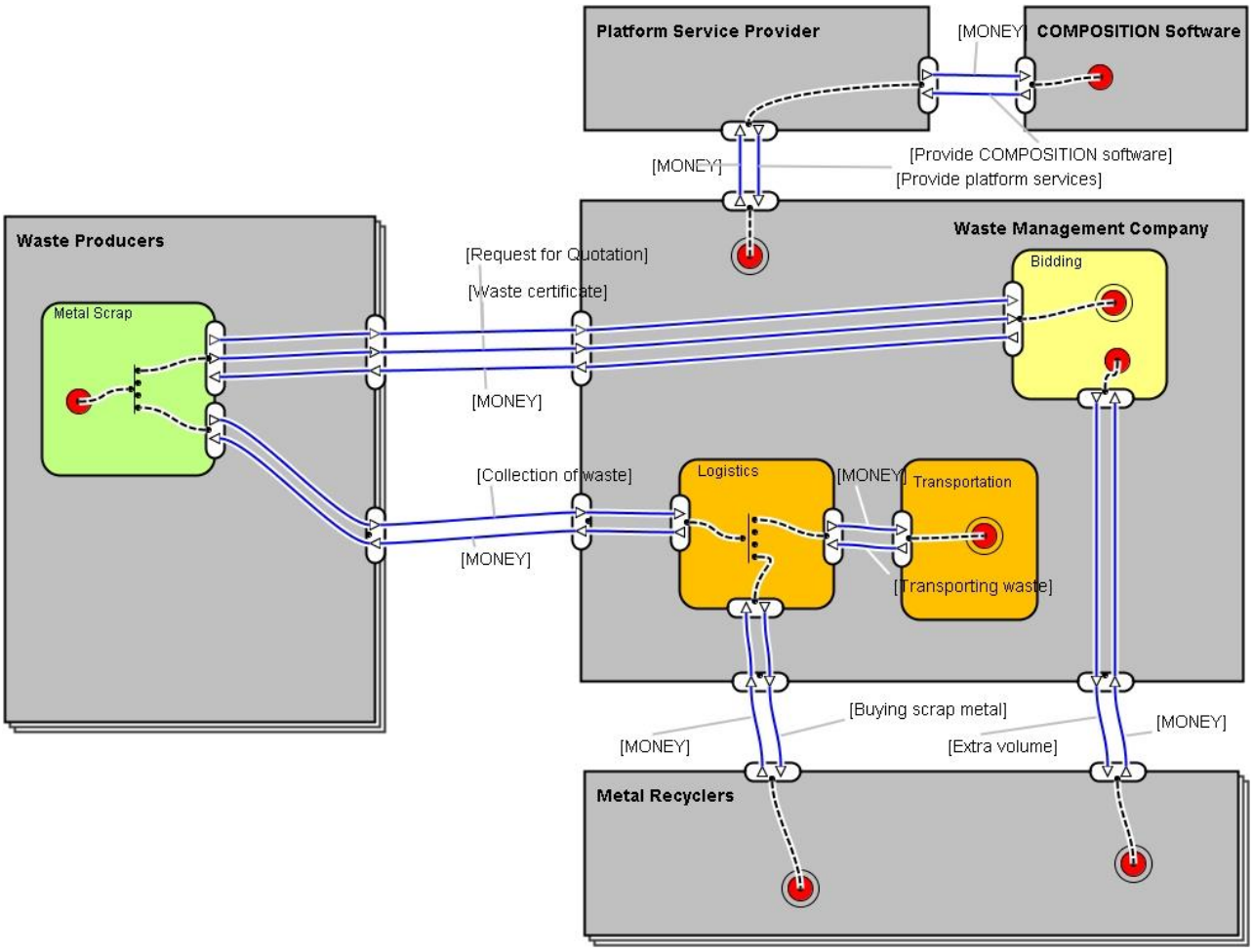

Figure 12 Graphical representation of the Waste Management Marketplace value model

The Waste Management Marketplace value model is seen from the Waste Management Company's viewport. The model implements the use cases through three scenarios represented by the scenario paths ------ in the model. The three scenarios play out as follows.

The *first scenario* (at the top) is a traditional monetised value exchange that represents the sale of COMPOSITION software to the Platform Service Provider, who in turn delivers the platform services to the Waste Management Company. All value objects are exchanged for MONEY. The Waste Management Company gets the value object: COMPOSITION platform from the Platform Service Provider in exchange for the value object MONEY (thus creating a value transaction). Likewise, the Platform Service Provider buys the COMPOSITION software components from a COMPOSITION Software supplier (i.e., a COMPOSITION project partner.

The *second scenario* represents the values created by the bidding process (light yellow). The Waste Management Company invites all customers (Waste Producers) and suppliers (Metal Recyclers) to participate in the platform. This is taking place in a separate value activity within the Waste Management Company called Bidding. The Waste Producer issues an RFQ on the platform and provides additional information. This constitutes a value object: Extra Volume, which is demanded by the Metal Recyclers. In return, the entire market segment provides the value object MONEY (i.e., incremental higher prices), thus creating a singular value transaction.

The *third scenario* is the execution of the metal scrap collection (orange). When the Waste Producer has decided on the optimum Metal Recycler (based on price and merits), the Waste Management Company value

activity Logistics organise for the scrap to be collected and delivered to the Metal Recyclers who pays the agreed purchase price to the Waste Management Company. The Waste Management Company retains a fraction of that price to cover overhead and profit margins, and pays the agreed purchase price to the Waste Producer.

When all transactions are completed, the e^{3}value tool calculates the business values for each actor based on the baseline data entered into the model. Several iterations have been necessary, until a solution was found that benefits all actors participating in the marketplace. Only then have we arrived at a sustainable business case.

7.6.4 Business Case

7.6.4.1 Business Case Baseline Data

The following (annual) data have been used for the business case calculations:

Waste producers:

Number of actors in the Waste Producer segment: 45

Scrap Volume: 1,500 tonnes of metal scrap per year (33 tonnes per week)

Metal Recyclers:

Scrap price per tonne paid by Metal Recyclers €190

The Waste Management Company:

Retained profit margin for the Waste Producer for handling scrap metal: 25% of volume

Total capacity cost of the Waste Producer: 20% of revenues

Price increases due to tendering of scrap metal: +10%

Logistics costs for the Waste Producer: 10% of volume

Platform Service Provider

Revenues for platform services: €280,000

Cost of operating the platform 24/7: €200,000

COMPOSITION software

Revenues for licensing software components: €60,000

Cost of supporting the software component: €40,000

Initial investment in commercialising the software: €250,000

Comments to the baseline data:

The numbers presented are not directly related to any partner in the project, but are typical values for similar services (24/7 support and maintenance) and business performance (profit margin, net profit, cost structures). For the COMPOSITION software provider an investment in commercialisation of the prototype software included. This investment covers finalisation of the prototype software, development of maintenance and administrative tools, code revision and refinement, testing, etc. Also, ISO certification and documentation are included. However, no marketing or sales cost are included in the investment, but covered by the annual cost of support.

7.6.4.2 Business Case Financial Results

Baseline calculation

The baseline partial cashflow calculation, i.e., before the introduction of the COMPOSITION services and the bidding platform are shown in Figure 13.

Segment / actor (€)	Revenues	Payments	Expenses	Cashflow	Investments	Cashflow
Metal Recyclers segment		12.825.000		-12.825.000		-12.825.000
Waste Management Company	12.825.000	9.618.750	2.565.000	641.250		+641.250
Waste Producers segment (45 actors)	9.618.750			9.618.750		+9.618.750
Platform Service Provider						
COMPOSITION Software Provider						

Figure 13 Partial cashflow of actors BEFORE the service is installed

As can be seen, only three stakeholders are involved. Only the cash-out from the Metal Recyclers segment is considered.

The Waste Management Company makes a gross profit of €3,206,250 on the management of metal scrap after receiving €12,825,000 from Metal Recyclers and paying €9,618,750 to the Waste Producers segment. Direct and indirect costs (including transportation cost and fees) amount to €2,565,000 (20% of revenues), and the Waste Management Company thus achieves a positive cashflow of €641,250 for covering its other capacity cost not directly related to the management of metal scrap.

The market segment of 45 Waste Producers has a positive cashflow of €9,618,750 or an average of €213,750 each.

Business case results

After introducing the COMPOSITION services and the bidding platform, the financial equilibrium of the business ecosystem changes. The costs involved in the new services have to be paid by existing or new stakeholders in one way or another, in order for all actors to enjoy a positive impact of the new services and thus allow them to embrace its sustainability.

The Metal Recyclers (market segment) now buys metal scrap at 10% higher prices. The higher prices are justified by better utilisation of the recycling installations and more transparent competition amongst the recyclers.

The Waste Producers benefit from the higher prices obtained from the bidding process. The 10% increase amounts to a net gain of €961,875 or €21,375 per Waste Producer.

The Waste Management Company experience an increase in revenues from Metal Recyclers which is larger than the increased payments to Waste Producers. The net positive cashflow amounts to €320,625. Since the waste volume remains the same, the operational costs for the Waste Management Company remains the same. However, the cost of the platform is €280,000 so the net positive cashflow is reduced to €40,625. The Waste Producer actor may increase the net cashflow with profits from other sources, such as Wood Pellet management so that the entire cost of the platform shall not be borne only by the metal scrap business. Cashflow calculation for the Waste Management Company is presented in Figure 14 below.

Cash-in from changes in revenues	**Before**	**After**	**Change**
Revenues from Metal Recyclers segment	12.825.000	14.107.500	+1.282.500
- Payments to Waste Producers segment (45 actors)	9.618.750	10.580.625	+961.875
Net increase cash-in from in revenues			+320.625
Cash-out from changes in expenses	**Before**	**After**	**Change**
General expenses	2.565.000	2.565.000	0
Expenses for COMPOSITION	0	280.000	+280.000
Net increase cash-out from expenses			+280.000
Cashflow from investments	**Before**	**After**	**Change**
General investments	0	0	0
Investments in COMPOSITION	0	0	0
Net increase in investments			0
Total change in cashflow			**Change**
Change from before to after introduction of COMPOSITION			**40.625**

Figure 14 Cashflow of the Waste Management Company AFTER the service has been installed

The Platform Service Provider has a positive cashflow from the operation of €20,000 as presented in Figure 15 below. Whether this is a sufficiently interesting business for the Platform Service Provider depends on which other businesses the actor is engaged in and whether synergies can be derived from there.

Cash-in from changes in revenues	**Before**	**After**	**Change**
Revenues from Waste Management Company	0	280.000	+280.000
Net increase in revenues			+280.000
Cashflow from expenses	**Before**	**After**	**Change**
General expenses	0	200.000	+200.000
Expenses for COMPOSITION software	0	60.000	+60.000
Net increase in expenses			+260.000
Cashflow from investments	**Before**	**After**	**Change**
General investments	0	0	0
Investments in COMPOSITION	0	0	0
Net increase in investments			0
Total change in cashflow			**Change**
Change from before to after introduction of COMPOSITION			**20.000**

Figure 15 Cashflow of the Platform Service Provider

The COMPOSITION Software Provider is facing serious challenges in recovering the investment in commercialisation. At the present price structure, the software is unlikely to provide more that €30,000 in annual cashflow thus yielding more than 5 years return on investment on the COMPOSITION software. This is unsustainable, especially considering that the development of the prototype software has been paid by the EU funding.

7.6.5 Business Model Canvas

Business Model Canvases have been produced corresponding to the individual use cases involved in the Waste Management Marketplace.

7.6.5.1 Use Case UC-KLE-4 Scrap Metal Collection and Bidding Process

The COMPOSITION solution provides the following features:

1. COMPOSITION automatically sends notification to selected waste management companies about the scrap bins fill level (this is not possible for the waste collector to respond to using the Waste Management Marketplace)
2. Waste management companies send their offers exploiting the COMPOSITION System
3. The COMPOSITION System evaluates all the offers and selects the most suitable candidates (1 to 3)
4. The maintenance and purchasing managers (KLE) select the best candidate and approve it
5. COMPOSITION System notifies waste management companies, both selected and not selected
6. COMPOSITION System proposes selection of possible pick-up arrangements (already negotiated with waste company)
7. KLE Manager selects the most suitable one (or lets COMPOSITION do it autonomously)

The goal of all actors is to optimise the scrap metal collection process. More specifically:

1. The goal for the waste management companies is to optimise the transportation for the scrap metal collection
2. The goal for the maintenance manager and the purchasing manager is to get the best price and reduce costs to the minimum.

The business model canvas is shown in Figure 16.

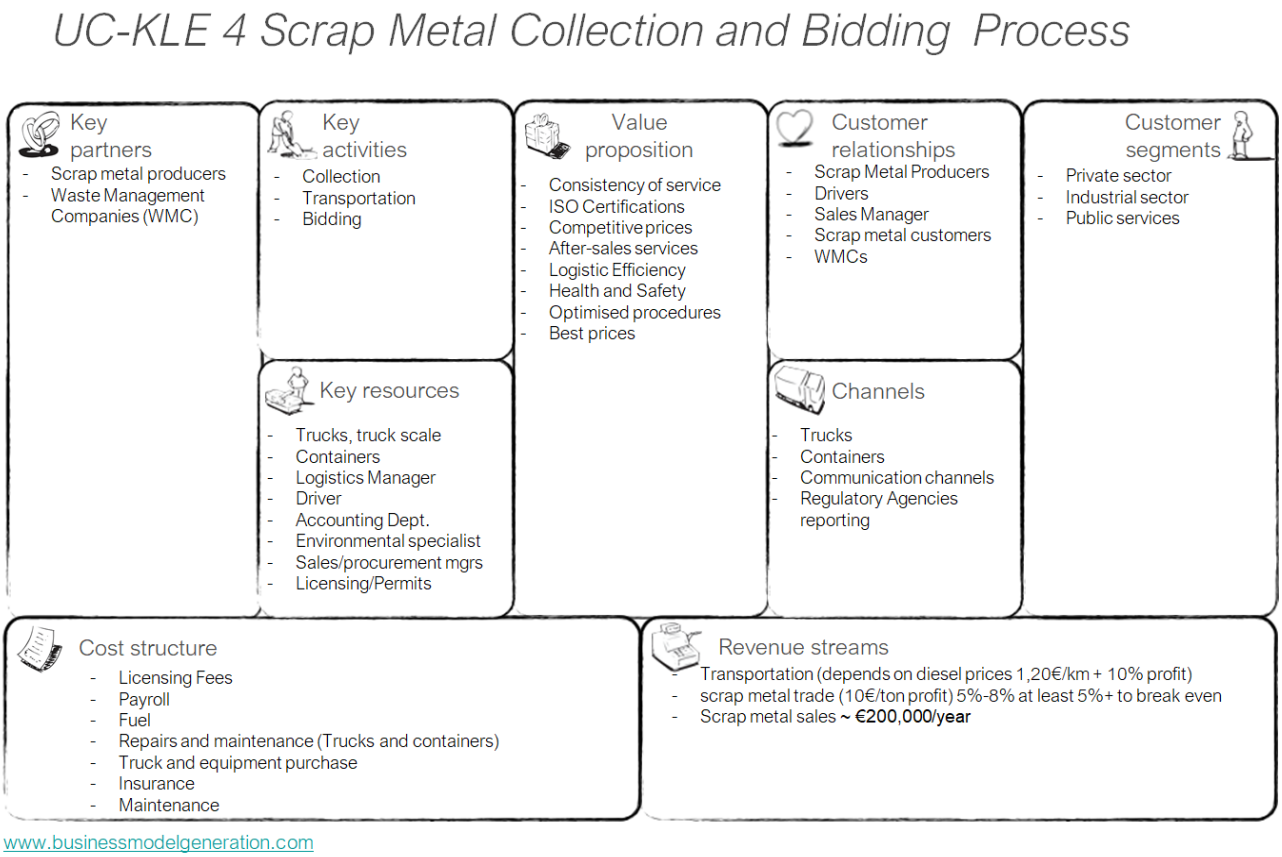

Figure 16 Business Model Canvas for UC-KLE-4 Scrap Metal Collection and Bidding Process

7.7 Software Virtual Marketplace

7.7.1 Introduction to Software Marketplaces

A Software Marketplace is a digital marketplace where software vendors can present their apps/solution to potential buyers and buyers can browse the solutions in order to find the best match with their needs.

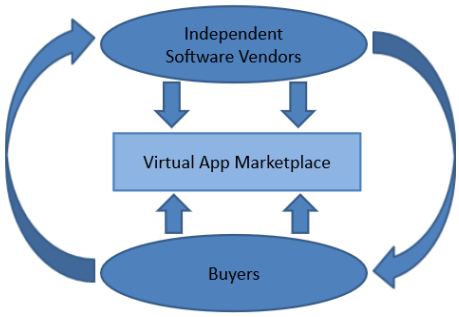

Figure 17 Software Virtual Marketplace

Software marketplaces for enterprise software are scarce. One reason is that large companies have procurement departments for their complex software needs where typical software purchases are €100,000+ and a high level of support is required. These solutions are not purchased via the web but via direct communication with potential suppliers. Smaller businesses (such as startups, online companies, publishers, consultants, freelancers, etc.) can enjoy ordinary B2B marketplaces that provide a B2C like experience such as Chekkt.com, GetApp.com, Capterra.com, Envato, etc. However, these solutions are not able to integrate software solutions after purchase, such as the COMPOSITION Virtual Software Marketplace.

A couple of recognised marketplaces offer similar services. The VMware Solution Exchange (VSX) is a socially enabled virtualisation and cloud marketplace where VMware partners and developers use a self-service portal to publish rich marketing content and downloadable software. The opportunity to publish on the VSX is available to all authorised VMware Technology Alliance Partner (TAP) members. Individual developers may

be approved to publish virtual appliances, vApps or specific content extensions to VMware management products upon request.

IBM Market Place. The Watson Virtual Agent is a new way to provide automated services to customers. It offers a cognitive, conversational self-service experience that can provide answers and take action. Software vendors can easily customise the Watson Virtual Agent to fit their specific business needs and provide custom content. Additionally, deep analytics provide insights on the buyer's engagement with the Watson Virtual Agent and help with the understanding of changing customer's needs.

7.7.2 Use Cases for the Business Model

The business model use case for Waste Management Marketplace has been derived from the following Inter-Factory uses cases described in deliverable *D2.1 Industrial Use Cases for an Integrated Information Management System* and later revisions:

- UC-ATL-1 Selling software/consultancy
- UC-ATL-2 Searching for solutions
- UC-ATL-3 Searching for recommended solutions
- UC-ATL/NXW-1 Integrate external product into own solution
- UC-NXW-2 Decision support over marketplace

These use cases have been combined and updated to reflect the real business systems in which the actors operate. The inclusion of business aspects, constraints and opportunities are essential for designing a proper and sustainable business model. The use case is represented by the 'swim lane' diagram shown in Figure 18.

7.7.2.1 Actors

The business model use case has 4 actors:

COMPOSITION Software Provider: This actor supplies one of more of the COMPOSITION software components to the Platform Provider. The COMPOSITION Software Provider can be a COMPOSITION partner or a venture of several COMPOSITION partners. Before the COMPOSITION software can be sold commercially, the COMPOSITION Software Provider will have to invest in commercialisation activities for the prototypes originating from the COMPOSITION project. Moreover, annual support and maintenance costs are incurred. Both investments and maintenance costs can be shared across several customers.

Platform Service Provider: This actor is a software company with existing products and services in the form of cloud solutions. The Platform Service Provider will set up, deploy and deliver the services according to the pricing models discussed in the previous chapter. The Platform Service Provider first delivers the basic agent-based virtual marketplace. This functionality of the marketplace allows software customers to search for solutions that align with their needs. The solutions are presented so that the Software Customer can see the benefits of the various solutions and compare them with the stated needs. The Platform Service Provider, as an independent third party, also provides a trust service, with which the Software Customer can check or trust ratings from other customers. When the customer decides on a solution and signs a licence agreement with the Software Vendor, the marketplace platform delivers the appropriate software components and IIMS interfaces online. Finally, the Platform Service Provider provides a range of Decision Support Systems (DSS) and Tools that can be added to the solution as SaaS (Software as a Service). These DSS services are delivered online.

Software Vendor: This actor is the primary vendor of software solution for IIMS. The Software Vendor signs up for the Software Virtual Marketplace and invites existing and potential customers to enter the marketplace against a membership fee. The benefit for the Software Vendor is that customers can easily search for solutions from the vendor and thus attract more sales. When the Software Customer has decided to sign up for a solution, the software and interfaces can be delivered via the platform and the Software Vendor can bill the related licence fees.

Software Customer (market segment): This actor comprises all software customers that have an interest in exploring the Software Vendor's product portfolio. The Software Customers are provided with online marketplace tools for presenting their needs, searching online for solutions and configurations, take delivery of software components and interfaces, and incorporate SaaS decision support tools into their own installation.

7.7.2.2 Use Case and Value Activities

The actors are engaged in a series of activities which creates value for all actors. The value activities are depicted in the 'swim lane' diagram shown Figure 18. The activities cover three phases of the Virtual Software Marketplace: The bidding and matchmaking process, the validation and contract management process, and the ongoing execution of the software licensing and functionality via the Software Virtual Marketplace.

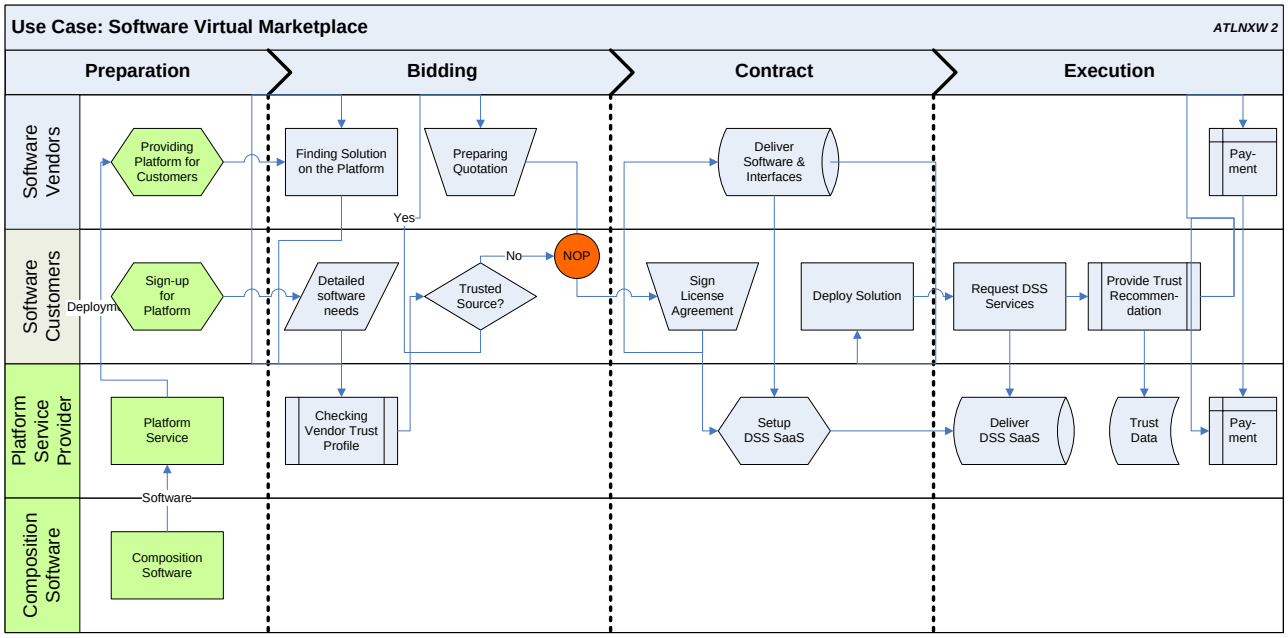

Figure 18 Use Case diagram for the Software Virtual Marketplace business model

The use case has four phases.

The *first phase* "Preparation" encompasses the preparation and deployment of the platform, on which the bidding and ecosystem transactions are to be managed. Software Customers are invited to use the platform. No charges are foreseen for the use of the platform.

The *second phase* "Bidding" involves the Software Customer firstly looking for the proper solution for their software needs. Once the solution is found, the Software Customer may check the trustworthiness of the vendor. There is a fee for this check. When the Software Customer decides that the Software Vendor is qualified, the vendor is asked to issue a quotation that completely fits the solution selected by the Software Customer.

The *third phase* "Contract" is a manual phase, in which the Software Vendor and the Software Customer sign the contract according the agreed terms. After the contract has been signed, the Software Customer has access to the purchased software for download and/or for use as SaaS.

In the final *fourth phase* "Execution", the Software Customer uses the software in conjunction with their own solution. If the software includes SaaS DSS options, these are provided by the Platform Service Provider against a fee. Also, the Software Customer is required to perform a trust rating of the vendor's software.

7.7.3 Business Modelling

The business model for the COMPOSITION Software Virtual Marketplace is constructed to show how actors in this ecosystem can create sustainable business models from a mix of trusted matchmaking and easy deployment of software. The matchmaking creates new customer demands, and more software products will be sold. Additional SaaS services, e.g., Decision Support Services, can be sold as extensions to the deployed software solutions.

The aim of the business model is to provide a mathematical model of the use case interactions and their influence on the financial performance of the actors. The use case has been modelled into a value model using the e^{3}value model tool, as shown in Figure 19. The graphical components are explained in Appendix A.

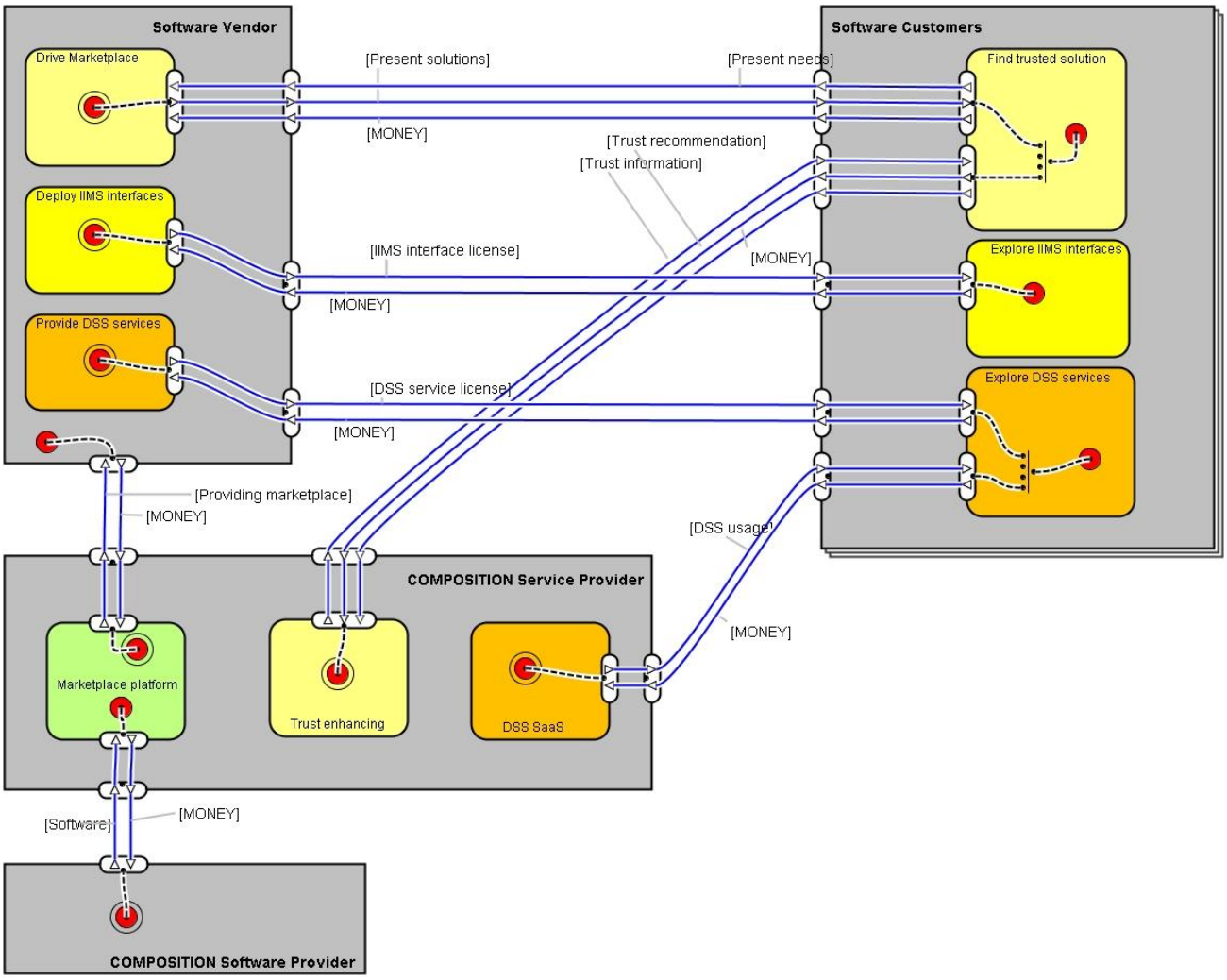

Figure 19 Graphical representation of the Software Virtual Marketplace value model

The Software Virtual Marketplace value model is seen from the Software Vendor's viewport. The model implements the use cases through four scenarios represented by the scenario paths ----- in the model. The four scenarios play out as follows:

The *first scenario* path (at the bottom) is a traditional monetised value exchange that represents the sale of COMPOSITION software to the Platform Service Provider, who in turn delivers the platform services to the Software Vendor. All value objects are exchanged for MONEY. The Software Vendor gets the value object COMPOSITION platform from the Platform Service Provider in exchange for the value object MONEY (thus creating a value transaction). Likewise, the Platform Service Provider buys the COMPOSITION software components from a COMPOSITION Software supplier (i.e., a COMPOSITION project partner).

In the *second scenario* (light yellow), the Software Vendor invites existing and potential Software Customers to enter the marketplace and search for a trusted solution. Each time the Software Customer searches the marketplace, a fee is paid for the search and for the trust recommendation. The latter is provided by the Platform Service Provider.

The *third scenario* path (bright yellow) implements the software deployment. When a proper solution is found, the Software Customer gets permanent access to the IIMS software components and interfaces that have been licensed.

The final and *fourth scenario* implements the SaaS DSS functionality. The Software Customer may buy extra DSS components that will be made are available as services from the Platform Service Provider. Each DSS service carries an annual licence to the Software Vendor and a usage fee to the Platform Service Provider.

When all transactions are completed, the e^{3}value tool calculates the business values for each actor based on the baseline data entered into the model. Several iterations have been necessary, until a solution was found

that benefits all actors participating in the marketplace. Only then have we arrived at a sustainable business case.

7.7.4 Business Case

7.7.4.1 Business Case Baseline Data

The following (annual) data have been used for the business case calculations:

Software Customers:

Number of actors in the Software Customer segment: 20

Number of match-making searchers per year: 20

Average number of licensed IIMS components and interfaces: 4

Average number of licensed DSS services: 10

Annual use of each DSS service: 150 times

Software Vendor:

Fee for one matchmaking search: €150

Annual licence for IIMS components and interfaces: €16,000

Annual licence for DSS services: €3,000

Cost associated with providing IIMS components: 60% of value

Platform Service Provider

Revenues for platform services: €280,000

Fees for using the DSS services: €10 per usage

Cost of operating the platform 24/7: €400,000

COMPOSITION software

Revenues for licensing software components: €60,000

Cost of supporting the software component: €40,000

Initial investment in commercialising the software: €250,000

Comments to the baseline data:

The numbers presented are not directly related to any partner in the project, but are typical values for similar services (24/7 support and maintenance) and business performance (profit margin, net profit, cost structures). For the COMPOSITION software provider an investment in commercialisation of the prototype software included. This investment covers finalisation of the prototype software, development of maintenance and administrative tools, code revision and refinement, testing, etc. Also, ISO certification and documentation are included. However, no marketing or sales cost are included in the investment, but covered by the annual cost of support.

7.7.4.2 Business Case Financial Results

For all actors to enjoy a positive impact of the introduction of the COMPOSITION services and the bidding platform, and thus allow them to embrace its sustainability, the costs involved in the new services have to be paid by the stakeholders in one way or another.

The Software Vendor has revenues of €1,940,000 from the Software Customer market segment and costs of €280,000 to the Platform Service Provider. Further, the Software Vendor incurs €768,000 in extra cost for providing IIMS components. As shown in Figure 20, the Software Vendor thus has a positive cashflow of €892,000.

.

Actor: Software Vendor			
Changes in cashflow after the introduction of the COMPOSITION platform:			
Cash-in from changes in revenues	**Before**	**After**	**Change**
Revenues from Software Customers (market place of 20)			
Revenues from - matchmaking	0	60.000	+60.000
Revenues from - IIMS components and interfaces	0	1.280.000	+1.280.000
Revenues from - DSS services licenses	0	600.000	+600.000
Net increase cash-in from in revenues			+1.940.000
Cash-out from changes in expenses	**Before**	**After**	**Change**
General expenses	0	768.000	+768.000
Expenses for COMPOSITION	0	280.000	+280.000
Net increase cash-out from expenses			+1.048.000
Cashflow from investments	**Before**	**After**	**Change**
General investments	0	0	0
Investments in COMPOSITION	0	0	0
Net increase cash-out from investments			0
Total change in cashflow			**Change**
Change from before to after introduction of COMPOSITION			**892.000**

Figure 20 Cashflow of the Software Vendor

The Platform Service Provider has a positive cashflow from the operation of €182,000. Revenues from the operation of the platform amounts to €280,000 with an additional €300,000 coming from the supply of SaaS decision support, which is requested 30,000 times annually by the Software Customer segment. From trust recommendations the Platform Service Provider derives €2,000. The cost of COMPOSITION software is €60,000 and internal allocated costs are estimated at €400,000. This results in a positive gross cashflow of €182,000. The computation is shown in Figure 21:

Actor: Platform Service Provider			
Changes in cashflow after the introduction of the COMPOSITION platform:			
Cash-in from changes in revenues	**Before**	**After**	**Change**
Revenues from Software Customers (market place of 20)			
Revenues from - trust recommendations	0	2.000	+2.000
Revenues from - DSS services usage	0	300.000	+300.000
Revenues from Software Vendor	0	280.000	+280.000
Net increase in revenues			+582.000
Cash-out from changes in expenses	**Before**	**After**	**Change**
General expenses	0	0	0
Expenses for COMPOSITION	0	400.000	+400.000
Net increase in expenses			+400.000
Cashflow from investments	**Before**	**After**	**Change**
General investments	0	0	0
Investments in COMPOSITION	0	0	0
Net increase in investments			0
Total change in cashflow			**Change**
Change from before to after introduction of COMPOSITION			**182.000**

Figure 21 Cashflow of the Platform Service Provider

This is a very positive outcome for the Platform Service Provider. Further, the business model is to a large extent based on recurrent income from an increasing group of customers for DSS services, which makes the business mode highly sustainable in the present configuration.

The Software Customers (market segment) buys access to matchmaking, IIMS components and DSS service licences from the Service Vendor. In addition, the Software Customer buys trust recommendations and DSS

service usage from the Platform Service Provider. The costs of these products and services are €2,242,000 for the entire segment or €112,100 on average per customer.

The COMPOSITION Software Provider is facing challenges recovering the investment in commercialisation as described above under the Waste Management Marketplace business model.

7.7.5 Business Model Canvas

Business Model Canvases have been produced corresponding to some of the ATL and NXW use cases involved in the Software Virtual Marketplace.

7.7.5.1 Use Case UC-ATL-1 Selling Software/Consultancy

The COMPOSITION solution provides the following features:

1 Potential customer has problem

2 Potential customer advertises needs to ecosystem

3 Ecosystem matches customers' needs and features regarding software product/consultancy and provides for example a top 5 list of matches

4 Ecosystem pre-negotiates Terms of Services/prices automatically on the basis of customer (and ATL) specifications

5 Seller (ATL) and buyer (KLE) approve one among the different proposed deals and agree to sign a contract.

The goal of the Software Vendor actor is to Increase product/consultancy sales.

The business model canvas is shown in Figure 22.

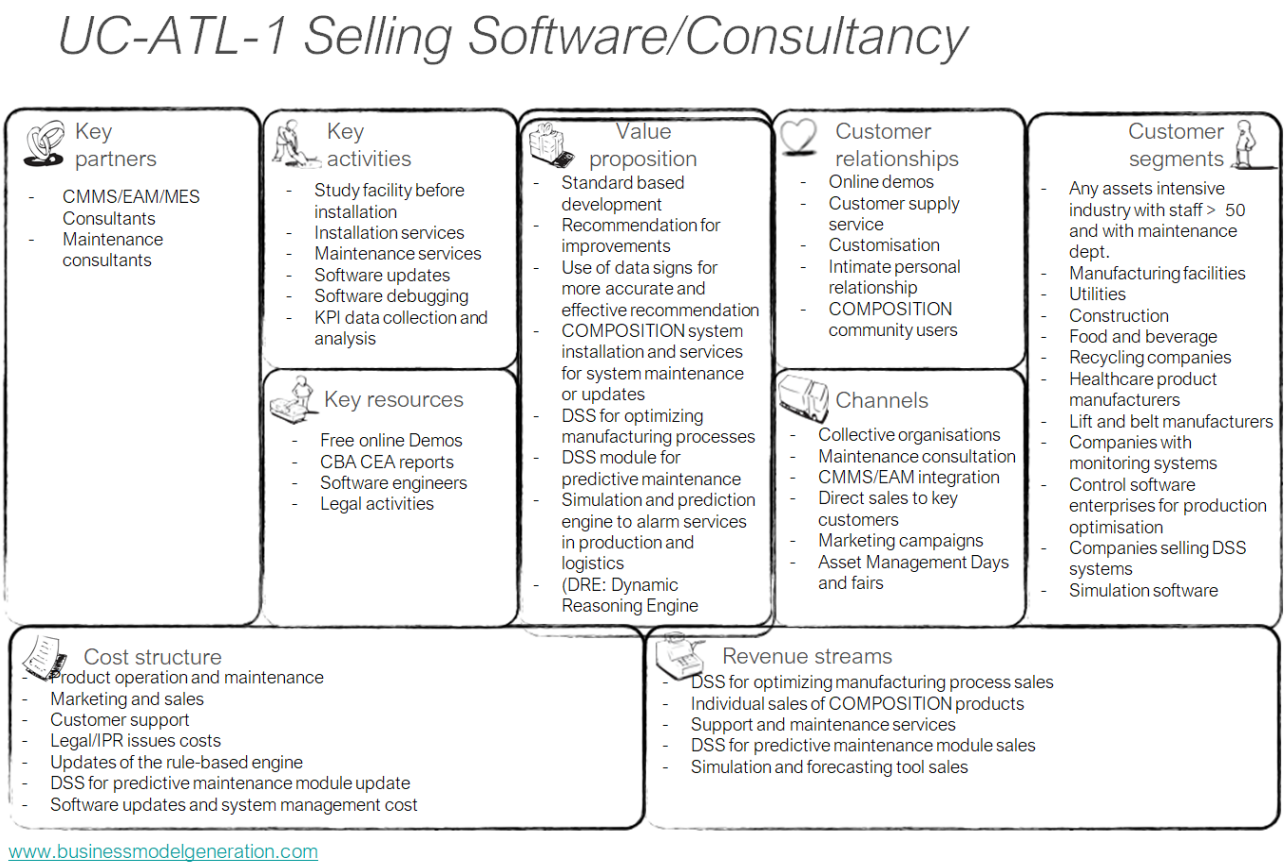

Figure 22 Business Model Canvas for UC-ATL-2 Selling Software/Consultancy

7.7.5.2 Use Case UC-ATL/NXW-1 Integrate External Product into own Solution

The COMPOSITION solution provides the following features:

1 ATL builds solution based on COMPOSITION standards that can interface with other external systems that are also COMPOSITION compatible. Then a company like NXW provides a service making use of data generated internally to the customer's premises, e.g., from sensors

2 External product can be exchanged/connected to other products that meet the COMPOSITION standards, which are provided through COMPOSITION IIMS, the interface is used to retrieve the internal data

The goal of the Software Vendor actor is to Increase product/consultancy sales

1 Integration of developed product by ATL/NXW to the COMPOSITION interface standards

2 NXW to provide a service making use of data internal to customer premises

3 NXW to provide a service that uses COMPOSITION IIMS to retrieve data

4 External application to meet COMPOSITION interface

5 External application to use the information exposed from NXW services, through COMPOSITION

The business model canvas is shown in Figure 23.

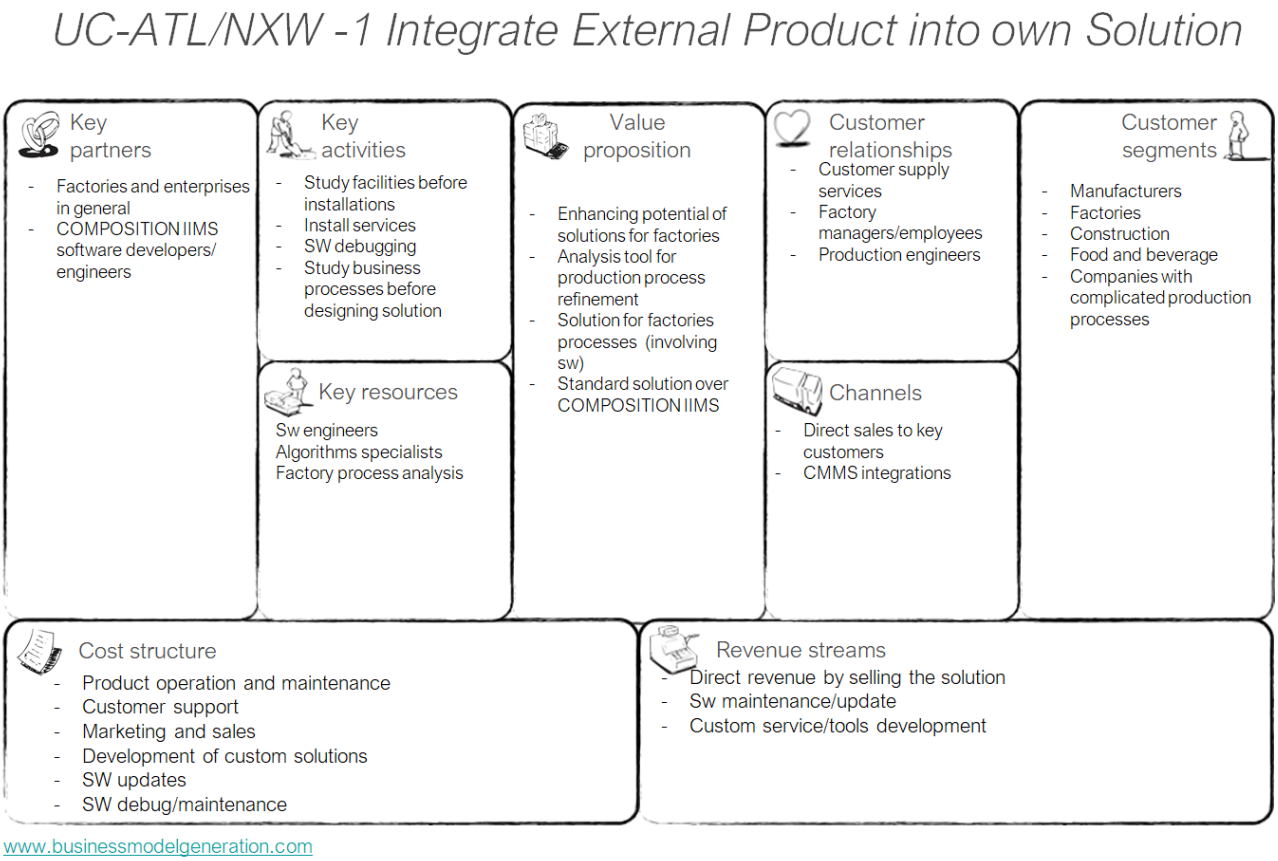

Figure 23 Business Model Canvas for UC-ATL/NXW-1 Integrate External Product into own Solution

7.8 Supply Chain Marketplace

7.8.1 Introduction to Supply Chains

The term “supply chain” denotes the network that exists between a company and its suppliers to produce, manufacture, assemble, distribute and put into operation a specific product (such as a lift or a pacemaker). The supply chain thus represents all the steps it takes to get the product to the final end user: the customer.

A simple example of a supply chain for consumer goods may be a clothing manufacturer. The manufacturer uses sub-suppliers to convert raw materials into production parts, such as fabric, zippers and other pieces that are used to make clothing. The manufacturer then runs machinery and performs other work using the parts and other raw materials to make the final clothes. Once the clothes are completed, they must be packages and stored until they are distributed to retailers that eventually sells the clothes to the customers (end users).

Figure 24 A Collection of Parts in a Passenger Car (Source: DePaula Chevrolet)

At the other end of the complexity scale, we use the auto manufacturing industry as an example. A passenger car contains 30,000 individual parts packed into 14,000-18,000 subassemblies produced by 3,000 sub-suppliers.

Some 80+ percent of the car parts are manufactured outside the auto assembly plant and sub-suppliers will have to deliver parts in JIT (Just-in-Time process) to maybe 100 locations up to 2-6 times per auto plant shift.

"Upstream" and "downstream" are business terms applicable to the production processes within several industries. The upstream stage of the production process involves searching for and extracting raw materials. The upstream stage in the production process also includes suppliers that process raw materials and produces subassemblies on behalf of the manufacturing company. The downstream stage in the production process involves processing the materials collected during the upstream stage into a finished product. The downstream stage further includes the actual sale of that product to other businesses, governments or private individuals. The downstream process typically has direct contact with customers through the finished product[4].

The COMPOSITION Inter-Factory use cases are focused on the supply chain for lifts as visualised in Figure 25. This supply chain is a typical Business-to-Business supply chain as found in most, if not all, manufacturing companies, regardless of size.

[4] http://smallbusiness.chron.com/definitions-upstream-downstream-production-process-30971.html

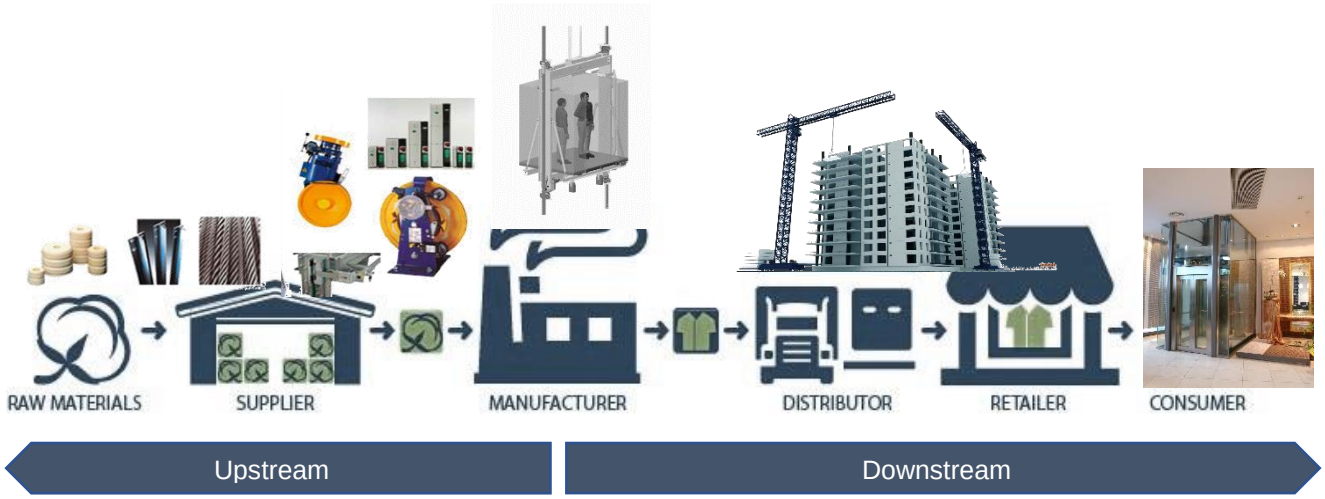

Figure 25 The Supply Chain for lift products visualised

In this example, the lift manufacturer (KLE) uses upstream suppliers for raw materials such as steel for cylinders and piston assemblies, sheet metal for cabins and doors and iron and steel rods for lift structures. It also uses upstream suppliers for assemblies such as motor and gear systems, traction and hydraulic pumping systems, and electronic controller systems.

For the downstream suppliers, the manufacturer uses specialised transportation and logistics companies to move products from the manufacturing plant to the construction sites. The manufacturer works with downstream system integrators and building developers to plan, design and install the lifts in the buildings before they are officially handed over to the final owner.

An efficient supply chain process requires suppliers that are reliable. This means that they produce a quality product that meets the manufacturer's needs, and that the product is delivered on time. Assume, for example, that a furniture producer manufactures high-end furniture, and that a supplier provides metal handles and other attachments. The metal components need to be durable so that they can be used on the furniture for years, and the metal parts shipped to the manufacturer should work as intended. The supplier must be able to fill the manufacturer's orders and ship metal parts to meet the manufacturer's production needs. These steps are necessary to produce a quality product that is shipped to a customer in a timely manner. In the physical world, these aspects are handled through contractual instructions, material and quality system certificates, substance declarations, JIT logistics plans, etc. All the paperwork is part of every supply chain process and must be meticulously followed, whenever changes in the supply chain are made.

It is clear that a complex – sometimes mission-critical – supply chain will not be able to work without a comprehensive and reliable Supply Chain Management (SCM) system. Moreover, an SCM system can reduce the cost and complexity of the supply chain process, particularly for a manufacturer that uses many parts such as the auto industry.

Supply chain management has evolved from business necessity to one of the primary focus areas for enhancing competitive advantage. In the last decade we have seen a new driving force in corporate strategy: optimising the value proposition to customers. Customers have become increasingly demanding, expecting ever-higher levels of product and service performance. In industry after industry, customers are expecting greater customisation of products and services to their individual needs. At the same time, they are also used to a constant stream of innovations in the goods and services they use that either reduces the cost or improves the benefits they receive (Laan, 2010).

Through *intra-company* optimisation, companies have engineered and reengineered their business practices to enhance overall performance. By implementing internal system solutions such as ERP and supply chain planning and execution systems, company management can make informed business decisions. Intra-company optimisation extends real-time information throughout the organisation, ensuring synergy among operations, finance, sales, purchasing and customer service. This allows all departments to work as a cohesive unit reducing operating costs and maximising customer satisfaction. Unfortunately, intra-company optimisation often pushes costs out to the disadvantage of trading partners upstream or downstream.

However, *inter-company* integration can provide precisely the flexibility and dynamism required to satisfy customers' demands. Imagine a virtual organisation that encompasses a group of producing companies, all working together to maximise customer service, slash costs and share the profits. By optimising not only their

internal processes but also their interactions with each other, they realise benefits of a truly integrated supply chain which can better satisfy the customers' demands for dynamic value propositions. This concept is basis for the revolution in development of supply chain integration and synchronisation, to create "excellent service organisations".

It is clear that a Digital Marketplace is a primary type of integrating platform that can facilitate the streamlining of manufacturing processes. By building on paradigms based on marketplace theories, the COMPOSITION platform will extend the intra-company IMS into a collaborative Digital Marketplace incorporating the entire Supply Chain.

A Business-to-Business Supply Chain Marketplace must be able to handle all the aspects of supply chain management with the added complexity that the marketplace actors are not all proven or approved suppliers, the products offered are not according to agreed standards and the production logistics and capabilities of the supplier are unknown. This makes the Supply Chain Marketplace a very dangerous forum for manufacturers to operate in, unless the marketplace is able to address all of the above uncertainties and mitigate all.

Considering also that the selection, validation and approval of subcontractors can take months or even years, a digital online marketplace for contracting deliveries from sub-suppliers is not realistic. However, the marketplace can provide a cost-effective way to explore the potential for cost savings from a multitude of suppliers (e.g., a bidding platform for Expression of Interest). It can also greatly reduce the cost of contract management and execution with existing sub-suppliers through standardised exchange of supply chain information and integration with the various IMSs in operation at the sub-suppliers.

The COMPOSITION business model for the Supply Chain Marketplace takes into consideration all of the above opportunities and concerns adapted to the COMPOSITION use cases.

7.8.2 Use Cases for the Business Model

The business model use case for Supply Chain Marketplace has been derived from the following Inter-Factory uses case described in deliverable *D2.1 Industrial Use Cases for an Integrated Information Management System* and later revisions:

- UC-KLE-7 Ordering raw materials

This use case has been updated to reflect the real business systems in which the actors operate. The inclusion of business aspects, constraints and opportunities are essential for designing a proper and sustainable business model. The uses case is represented by the 'swim lane' diagram shown in Figure 18.

7.8.2.1 Actors

The business model use case has 4 actors:

The Manufacturer: This actor is the main manufacturer in the supply chain and thus provides the viewport of the business model. The Manufacturer is engaged in Business-to-Business networks of upstream and downstream suppliers. The Manufacturer signs up for the Supply Chain Marketplace and invites existing and potential sub-suppliers to join the marketplace in order to realise the benefits of integrated supply chain management. The Manufacturer uses the marketplace both for engaging new sub-suppliers or replacing existing ones and for streamlining day-to-day execution of supply chain management tasks. In the bidding case, the Manufacturer can request preliminary price and technical information from relevant market actors. This information is used to short-list potential candidates, which will undergo a comprehensive validation before contracts can be signed and the supply chain integration can be performed.

The Suppliers (Market Segment): This is a collection of potential suppliers of a specific part or component of the Manufacturer's product. The market segment is interested in becoming a validated supplier to the Manufacturer and uses the Supply Chain Marketplace to submit preliminary bids.

Supplier: Once the supplier has been short-listed, the supplier becomes an individual actor in the business model. The supplier then enters the validation phase and, if successful, becomes a fully validated supplier to the Manufacturer

Upstream Supply Chain (Market Segment): This is the collection of upstream suppliers. Some supply raw materials, others supply semi-manufactured parts. All the upstream suppliers participate in the contract management phase because they may (or may not) be depending on the new supplier's products. For example, a new supplier of ball bearings may cause some of the suppliers to change the dimensions on the pistons that they supply.

Downstream Supply Chain (Market Segment): This is the collection of downstream suppliers. Some supply logistic services, others are installers or construction companies. All the downstream suppliers participate in the contract management phase because they may (or may not) be depending on the new supplier's products. For example, a new supplier of lift systems may require the building constructor to renew construction permits.

Platform Service Provider: This actor is a software company with existing products and services in the form of cloud solutions. The Platform Service Provider will set up, deploy and deliver the services according to the pricing models discussed in the previous chapter. The Platform Service Provider first delivers the basic agent-based virtual marketplace. This functionality of the marketplace allows sub-suppliers to exchange product data, production data, logistics plan, quality certificates and a wealth of other manufacturing information between the suppliers and the manufacturers, and also between themselves. The marketplace thus provides the integration of SCM systems

COMPOSITION Software Provider: This actor supplies one of more of the COMPOSITION software components to the Platform Provider. The COMPOSITION Software Provider can be a COMPOSITION partner or a venture of several COMPOSITION partners. Before the COMPOSITION software can be sold commercially, the COMPOSITION Software Provider will have to invest in commercialisation activities for the prototypes originating from the COMPOSITION project. Moreover, annual support and maintenance costs are incurred. Both investments and maintenance costs can be shared across several customers.

7.8.2.2 Use Case and Value Activities

The actors are engaged in a series of activities which creates value for all actors. The value activities of the multiple actors are depicted in the 'swim lane' diagram shown Figure 26.

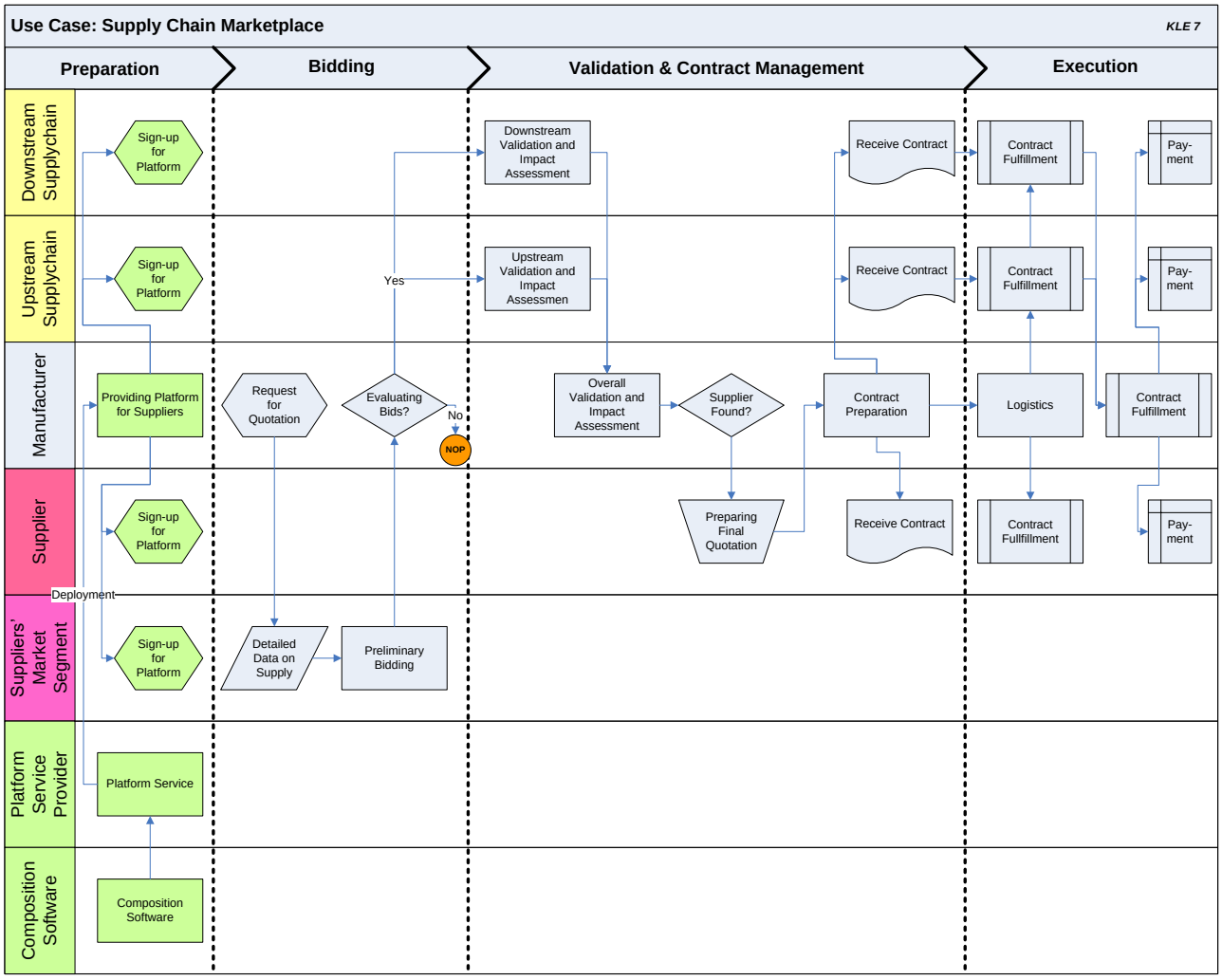

Figure 26 Use Case diagram for the Supply Chain Marketplace business model

The activities cover three phases of the Supply Chain Marketplace:

The first phase “Bidding” involves inviting suppliers to submit bids for one or more components entering the final product.

The second phase “Validation and Contract” involves the validation of potential suppliers with the succeeding contract management process.

Finally, the third phase encompasses the ongoing execution of the supply chain information integration via the Supply Chain Marketplace.

7.8.3 Business Modelling

The main rationale of this business model is to explore persistent cost savings internally in the organisation of the Manufacturer. Using the marketplace integration tools, data and documents can easily be exchanged, and the processes of validating new suppliers and managing contracts for all suppliers become much more effective. The realised savings should more than outweigh the added cost of operating the marketplace. Secondary benefits can be found in cost savings among suppliers and, occasionally, lower prices from bidding processes among suppliers for specific products. However, the discussion will mainly be seen from the side of the Manufacturer.

The aim of the business model is to provide a mathematical model of the use case interactions and their influence on the financial performance of the actors. The use case has been modelled into a value model using the e^{3}value model tool, as shown in Figure 27:

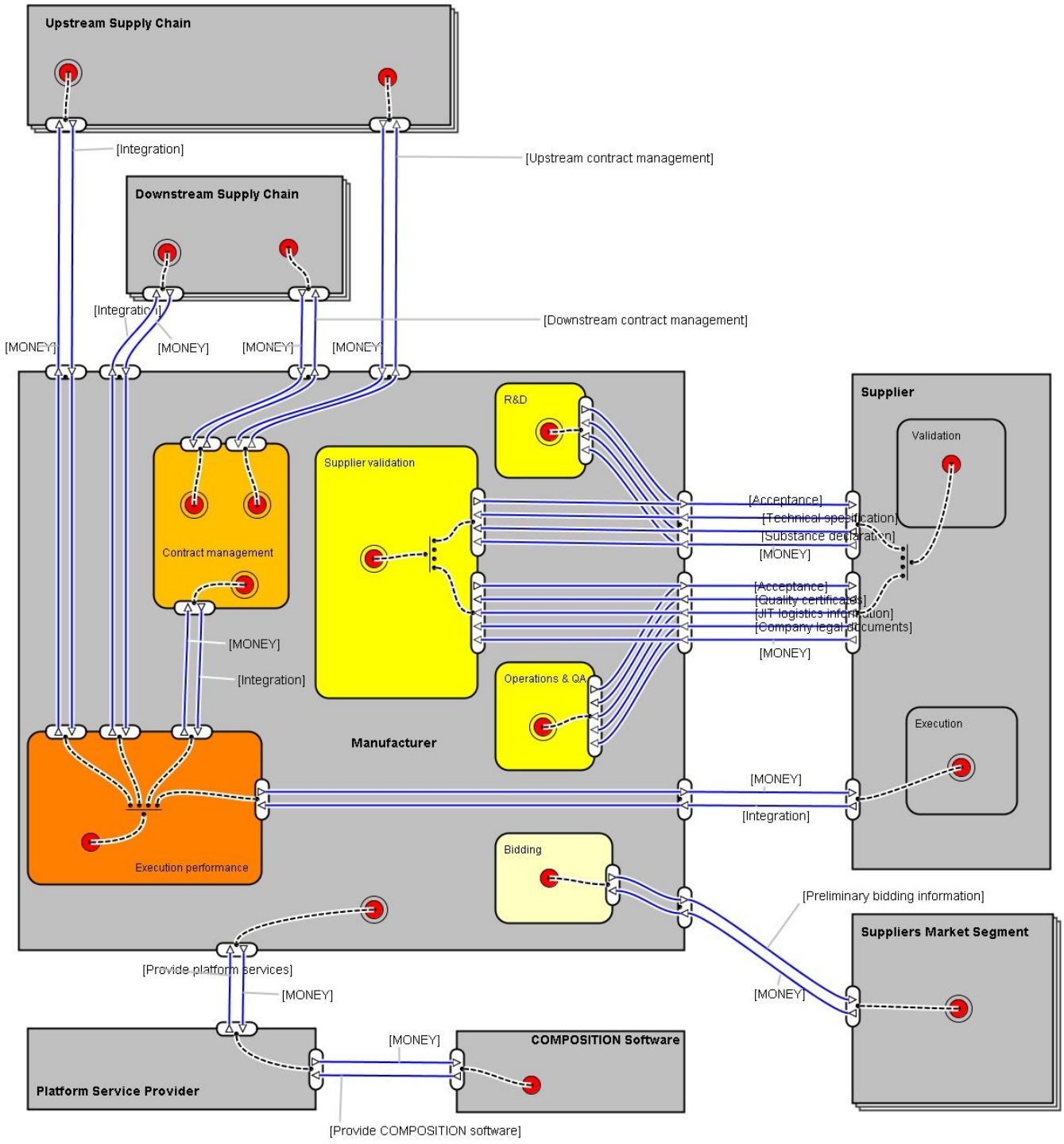

Figure 27 Graphical representation of the Supply Chain Marketplace value model.

The Supply Chain Marketplace value model implements the use cases through five scenarios represented by the scenario paths ----- in the model. The five scenarios play out as follows:

The *first scenario* (at the bottom) is a traditional monetised value exchange that represents the sale of COMPOSITION software to the Platform Service Provider, who in turn delivers the platform services to the Manufacturer. All value objects are exchanged for MONEY.

The *second scenario* represents the values created by the bidding process (light yellow). The Suppliers Market Segment values having the potential for becoming a supplier to the Manufacturer. In return, the Manufacturer expects lower prices for the component that is subject to the bidding process. The value to the Manufacturer is thus represented by an incoming cashflow stemming from the lower prices to be paid after the bidding. The

scenario is terminating inside the Manufacturer's value activity "Bidding", which allows us to separate the calculated cashflow for this activity separated from the Manufacturer's other activities.

The *third scenario* is the validation of the short-listed supplier (bright yellow). This activity is the most complex and involves a number of interrelated activities. Firstly, the short-listed supplier delivers various technical information (in electronic form via the Marketplace): Technical dossiers (drawings, specifications, parts lists, etc.) together with substance declarations and statements of conformity (chemical content, hazardous materials, etc.). The information is validated by the Manufacturer's R&D organisation. Secondly, the short-listed supplier delivers various operational information (also in electronic form via the Marketplace): Logistics and JIT information, ISO Quality certificates, material certificates and CE conformity statements, and other legal documents. The information is validated by the Manufacturer's Operations and QA organisation.

The value objects for the Manufacturer consist of the provided information that allows for validation of the supplier (and hence the realisation of the savings from the bidding process). The value object for the Supplier is the successful validation (and hence the acceptance as an official supplier to the Manufacturer). Both of these value objects are non-monetary in the context of the model. However, we have a monetary element representing the savings for the Manufacturer in performing the validation process using the Supply Chain Marketplace platform. The savings are distributed on the involved value activities R&D, Operations & QA and Supplier Validation. The value activities allow us to separate the calculated cashflow for this activity separated from the Manufacturer's other activities.

Very importantly, the information provided must also be validated in the Upstream and Downstream Supply Chains, who are depending on the successful integration of the new supplier's product into the final product. These interactions are not shown in the model for the sake of simplicity, but the corresponding monetary impact is included in the next scenario Contract Management.

The *fourth scenario* is representing the overall contract management procedures (orange). The activity is related both to formalisation of the validation and making the short-listed supplier an approved supplier as well as the ongoing cost of maintaining the contracts. The cost of this activity is based on the total business volume of the Manufacturer. The value object is the savings involved in handling the contracts via the Supply Chain Marketplace rather than in manual form. These savings are estimated as fixed savings with each of the Upstream and Downstream Supply Chain members as well as savings from the ongoing execution of the contracts as presented in the last scenario. The value object for the Supply Chain members is the integration with the Supply Chain Marketplace which allows them to realise further savings in their own organisation (not included in the model).

The *fifth scenario* implements the anticipated savings in supply chain management costs that result from the use of the Supply Chain Marketplace represented by the value object Integration. Total costs are a function of the total business volume of the Manufacturer, and the savings are foreseen in the KPI section to be in the order of 25%. The savings are generated in the Execution performance value activity of the Manufacturer and distributed to the other beneficiaries in a predetermined ratio. A major beneficiary is the Manufacturer himself, represented by the Contract management value activity. Upstream and Downstream Supply Chain members as well as the Supplier also shares different parts of the total savings from using the Supply Chain Marketplace for interaction.

When all transactions are completed, the e^{3}value tool calculates the business values for each actor based on the baseline data entered into the model. Several iterations have been necessary, until a solution was found that benefits all actors participating in the marketplace. Only then have we arrived at a sustainable business case.

7.8.4 Business Case

7.8.4.1 Business Case Baseline Data

The following (annual) data have been used for the business case calculations:

<u>Manufacturer</u>

Total business volume for all suppliers: €50,000,000

Overall expenses for one supplier validation without using the Supply Chain Marketplace: €60,000

Savings on supplier validation resulting from the Supply Chain Marketplace: 30% (~KPI)

Overall contract management cost in percentage of total business volume: 0,1%

Overall cost of execution the Supply Chain in percentage of total business volume: 1%

Savings on the execution costs resulting from the Supply Chain Marketplace: 35% (~KPI)

Sharing ratios of savings in execution process Manufacturer, Upstream, Downstream, Supplier: 10:4:4:2.

Supplier Segment

Number of suppliers for a single component in the segment: 20

Business volume of the single component subjected to bidding: €5,000,000

Price-reduction for a single component caused by competitive bidding: 15% on the value of that component

Upstream Supply Chain

Number of upstream suppliers: 200

Contract management cost savings per supplier: €50

Downstream Supply Chain

Number of downstream suppliers: 500

Contract management cost savings per supplier: €100

Platform Service Provider

Revenues for platform services: €280,000

Cost of operating the platform 24/7: €200,000

COMPOSITION software

Revenues for licensing software components: €60,000

Cost of supporting the software component: €30,000

Initial investment in commercialising the software: €150,000

Comments to the baseline data:

The baseline numbers are not directly related to any partner in the project, but are typical values for similar services (e.g., business volume, admin costs for contract management, etc.) and business performance (profit margin, net profit, cost structures).

For the COMPOSITION software provider an investment in commercialisation of the prototype software included. This investment covers finalisation of the prototype software, development of maintenance and administrative tools, code revision and refinement, testing, etc. Also, ISO certification and documentation are included. However, neither marketing nor sales cost are included in the investment but covered by the annual cost of support.

7.8.4.2 Business Case Financial Results

Because only financial performance influenced by the introduction of the Supply Chain Marketplace, the baseline data included in the model are only partially describing the financial operation of the Manufacturer. Hence, a full profit/loss account cannot be established from the available data. However, we are only concerned with the changes in cashflow and profitability, so the baseline data are sufficient.

Business case before the introduction of the Supply Chain Marketplace.

Only the expenses of the Manufacturer related to supplier validation, contract management and execution of the supply chain management are relevant for the business case before the introduction of the Supply Chain Marketplace. The numbers appear in Figure 28 below:

Segment / actor (€)	Revenues	Payments	Expenses	Cashflow	Investments	Cashflow
Manufacturer			*824.000*	*-824.000*		*-824.000*
- Bidding						
- Supplier validation						
- R&D			19.500	*-19.500*		-19.500
- Operations & QA			19.500	*-19.500*		-19.500
- Contract management			110.000	*-110.000*		-110.000
- Execution performance			675.000	*-675.000*		-675.000
Supplier segment (20 actors)						
Supplier						
Upstream Supply Chain (200 actors)						
Downstream Supply Chain (500 actors)						
Platform Service Provider						
COMPOSITION Software Provider						

Figure 28 Cashflow of actors BEFORE the service is installed

Business case results AFTER the introduction of the Supply Chain Marketplace

After introducing the COMPOSITION Supply Chain Marketplace, a number of financial performance changes. Firstly, the bidding process leads to realisation of cost price reductions. The validation of new suppliers on the digital marketplace allows the Manufacturer to realise cost savings in several areas including R&D and Operations. Savings in the overall contract management are also possible. Finally, all actors benefit from the digital marketplace in terms of cost savings in execution of all the tasks in supply chain Management.

The Manufacturer has a total positive cashflow of €714,000 mainly coming from reduction of cost prices from the supplier segment. The Supply Chain Marketplace has made it so much easier to carry out bidding process that the Manufacturer can seriously plan for competitive pricing. In addition, savings in organisational cost structures for the validation of suppliers, management of the supply chain and the overall contract management are realised due to efficient exchange of documents and integrated IMS systems. The savings are €244,000; just short of the added costs of the COMPOSITION platform, which is €280,000.

The computations appear in Figure 29:

Cash-in from changes in revenues	**Before**	**After**	**Change**
Revenues increase from bidding	0	750.000	+750.000
Net increase cash-in from in revenues			+750.000
Cash-out from changes in expenses	**Before**	**After**	**Change**
Expenses for - Bidding	0	0	+0
Expenses for - Supplier validation - R&D	19.500	15.000	-4.500
Expenses for - Supplier validation - Operations & QA	19.500	15.000	-4.500
Expenses for - Contract management	110.000	50.000	-60.000
Expenses for - Execution performance	675.000	500.000	-175.000
Expenses for COMPOSITION	0	280.000	+280.000
Net increase cash-out from expenses			+36.000
Cashflow from investments	**Before**	**After**	**Change**
General investments	0	0	0
Investments in COMPOSITION	0	0	0
Net increase cash-out from investments			0
Total change in cashflow			**Change**
Change from before to after introduction of COMPOSITION			**714.000**

Figure 29 Cashflow of the Manufacturer in the FIRST year AFTER the service has been installed

The Platform Service Provider has revenues from the operation of the platform of €280,000. The cost of COMPOSITION software is €60,000 and internal allocated costs are estimated at €200,000. This results in a positive gross cashflow of €20,000.

The COMPOSITION Software Provider is facing challenges in recovering the investment in commercialisation as described above under the Waste Management Marketplace business model.

8 Conclusion and Next Steps

8.1 Methodology

We have looked at different modelling frameworks which are suitable for describing the COMPOSITION value creation capabilities and how the resulting business models can be used to forecast the stakeholders' economic performance under different assumptions. The work has focused on three different business aspects.

The Intra-Factory use cases largely involve only two actors and the proper business model aspect is a cost-benefit analysis followed by a Business Model Canvas visualisation.

Software components and solutions are sold to software companies. The main issue here is to find the proper pricing models and revenue streams.

IIMS in Manufacturing Industry Marketplaces are multi-stakeholder ecosystems, where several value propositions are combined into an end-to-end solution for industrial actors. The Value Based Business Models methodology is used for this ecosystem.

For the complex task of defining new business models for IIMS for Manufacturing Industry Marketplaces, an ontological perspective on the exploration of innovative service concepts based on value creation has been selected. The use cases have been modelled into a value model using the e^{3}value model tool, which also calculates the net cashflow for each actor in the value network.

8.2 Results of Analysed Business Models

In the ***Waste Management Marketplace***, the business model shows positive cashflow for all actors. The Metal Recyclers (market segment) buys metal scrap at 10% higher prices from the bidding process. The Metal Recycler participates in the bidding process in order to get more metal scrap. If the capacity of the Metal Recycler is higher that the demand, the Metal Recycler will increase the price offered, and if the reverse is true, reduce the price offered. Since the Waste Management Company is able to select the highest bidding Metal Recyclers, the total price obtained for scrap metal will increase thus benefitting both the Waste Producers and The Waste Management Company. The platform will thus also act as a mediator of supply and demand in the metal scrap ecosystem. The net positive cashflow for the Waste Management Company amounts to €320,625. However, the cost of the platform is €280,000, so the net positive cashflow is reduced to €40,625.

In the ***Software Virtual Marketplace***, the business model also shows positive cashflow for all actors. The business model for the COMPOSITION Software Virtual Marketplace is constructed to show how actors in this ecosystem can create sustainable business models from a mix of trusted matchmaking and easy deployment of software. The matchmaking creates new customer demands and more software products will be sold. Additional SaaS services, e.g., Decision Support Services, can be sold as extension to the deployed software solutions. The Software Vendor has revenues of €1,940,000 from the Software Customer market segment and costs of €1,048,000. The Software Vendor thus has a positive cashflow of €892,000. The Platform Service Provider has a positive cashflow from the operation of €182,000. Revenues from the operation of the platform amount to €280,000 with an additional €300,000 coming from the supply of SaaS decision support, which is requested 30,000 times annually by the Software Customer segment.

In the ***Supply Chain Marketplace***, the business model likewise shows positive cashflow for all actors. The main rationale of this business model is to explore persistent cost savings internally in the organisation of the Manufacturer. Using the marketplace integration tools, data and documents can easily be exchanged and the processes of validating new suppliers and managing contracts for all suppliers become much more effective. The realised savings should more than outweigh the added cost of operating the marketplace. The Manufacturer has a total positive cashflow of €714,000 mainly coming from reduction of cost prices from the supplier segment. In addition, savings in organisational cost structures for the validation of suppliers, management of the supply chain and the overall contract management are realised due to efficient exchange of documents and integrated IMS systems. The savings are €244,000; just short of the added costs of the COMPOSITION platform, which is €280,000.

8.3 Next Steps

The work on cost-benefit analysis of the Intra-Factory scenarios will be reported in deliverable *D9.7 Cost, Benefit, and Risk Evaluation*. Scientifically sound methods such as the Constructive Cost Model and the BeneFIT method will be introduced and analysed.

It is the intention to update and reissue *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry*, when the results of the pilots are available.

When the software components are stable, the proper pricing models and revenue streams will be selected and presented in *D9.11 Final Exploitation Strategy and Business Plans*.

9 List of Figures and Tables

9.1 Figures

9.2 Tables

10 References

(Betsch, 2001) Betsch O.: Preismodelle in Kreditinstituten. In: Diller, H. (Hrsg.): Vahlens Großes Marketing Lexikon, 2. Auflage, München: Beck; München: Vahlen, 2001, S. 1332-1333.

(Blumberg et al, 2012) Sven Blumberg, Xiao Chen, Julia Heidemann1, Martina Beer, Gilbert Fridgen, Hanna-Vera Müller: IT-Projektsteuerung – eine Methodik zum Benefits-Management mit integrierter Risikobetrachtung in Wirtschaftsinformatik und Management 4 (2012)

(Boehm, 1981) Boehm, Barry (1981). *Software Engineering Economics*. Prentice-Hall. ISBN 0-13-822122-7

(Laan, 2010) Joost W. van der Laan: Supply Chain Integration. Retaileconomics 2010 (First published in "Executive Outlook" of March 2001 and updated in 2010. https://retaileconomics.com/supply-chain-integration/ Accessed on 30 Dec 2017)

(Meffert, 2000) Meffert H.: Marketing: Grundlagen marktorientierter Unternehmungsführung. Gabler-Verlag, Wiesbaden, 2000

(Meffert, 2003) Meffert H., Bruhn M.: Dienstleistungsmarketing: Grundlagen-Konzepte-Methoden. Gabler-Verlag, Wiesbaden, 2003

(Nagle&Hogan, 2007) Nagle T. T., Hogan J. E.: Strategie und Taktik in der Preispolitik. Pearson-Verlag, 4. Aufl., 2007

(Osterwalder, 2010) Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, John Wiley And Sons Ltd, 2010

(Pigneur, 2005) Pigneur, Y.: *e-Business model ontology for improving business/IT alignment*, Interop, CAISE-EMOI'05, 2005

(Skiera, 2006) Skiera B., Lambrecht A.: Ursachen eines Flatrate-Bias-Systematisierung und Messung der Einflussfaktoren. Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung, Jg. 58, 2006, S. 588-617, 2006

(Thestrup, 2008) Thestrup, J., Guarise, A., Gräfe, G (2008): Business Modelling of Emerging Service Opportunities in the IoTS Ecosystem, The Internet of Things and Services - 1st International Research Workshop, Sophia-Antipolis, France, September 2008

(Zerdick, 1999) Zerdick A., Picot A., Schrape K., Artopé A., Goldhammer U., Vierkant U., López-Escobar E., Silverstone R.: Die Internet-Ökonomie. Springer-Verlag, Berlin Heidelberg, 1999

Appendix A

Graphical components of the e³value tool

Figure 30 shows the collection of visual elements in the e³value tool. Most of the concepts in the e³value ontology are found in this figure. The grey areas represent actors, market segments and value activities. The value interfaces are oval white areas on the edge of actors and market segments and the tiny triangles in these value interfaces represent value ports. Some ports are directed outward from a value source; others are directed inward to distinguish in-ports and out-ports. On the outward side, ports are connected to other value sources. These connections represent value exchanges.

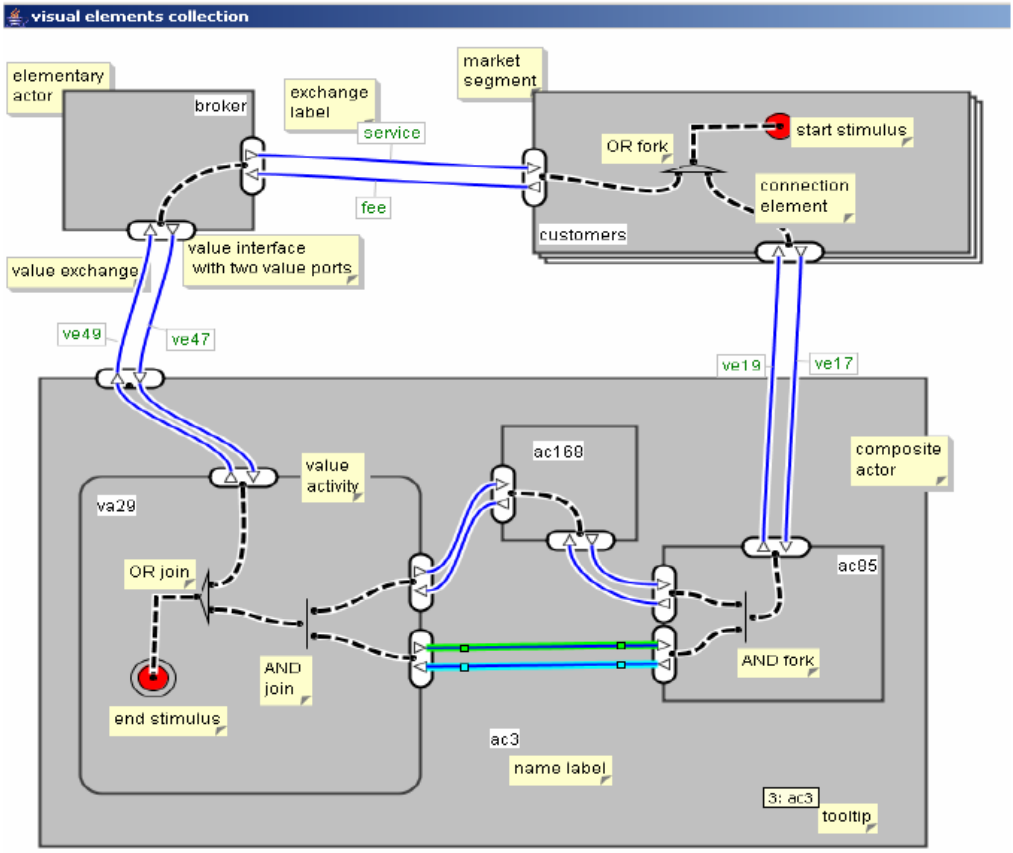

Figure 30 Graphical presentation of the e³value model

The dotted lines on the value sources represent connection elements; they connect scenario elements. All types of scenario elements are displayed in the figure: The start stimulus, the end stimulus, the OR fork, the OR join, the AND fork, the AND join and the value interface. The editor also includes scenario ports (black dots on the scenario elements), the exchange label, the name label and the comment. These are visual constructs and not part of the ontology.