Collaborative Network for Industry, Manufacturing, Business and Logistics in Europe

D1.2
Requirements for Business Models and Collaboration Patterns in Supply Chains

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Reviewer	Wernher Behrendt
Contributors	JJ, DC, MR, MN, WB — ALL
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NIMBLE in a Nutshell

NIMBLE is the collaboration Network for Industry, Manufacturing, Business and Logistics in Europe. It will develop the infrastructure for a cloud-based, Industry 4.0, Internet-of-Things-enabled B2B platform on which European manufacturing firms can register, publish machine-readable catalogues for products and services, search for suitable supply chain partners, negotiate contracts and supply logistics. Participating companies can establish private and secure B2B and M2M information exchange channels to optimise business work flows. The infrastructure will be developed as open source software under an Apache-type, permissive license. The governance model is a federation of platforms for multi-sided trade, with mandatory interoperation functions and optional added-value business functions that can be provided by third parties. This will foster the growth of a net-centric business ecosystem for sustainable innovation and fair competition as envisaged by the Digital Agenda 2020. Prospective NIMBLE providers can take the open source infrastructure and bundle it with sectorial, regional or functional added value services and launch a new platform in the federation. The project started in October 2016 and will last for 36 months.

Executive Summary

The main goal of this deliverable D1.2 is to report on initial requirements for business models and collaboration patterns in supply chains (SC), in order to guide the development of a sustainable NIMBLE's B2B platform. One key task for the deliverable is to develop a framework for the NIMBLE collaboration and business models and thus, to contribute to their subsequent integration into a NIMBLE collaboration ecosystem. The initial collaboration model is based on four industrial use cases and their requirements, needs and wants, together with other key partners. In later stages of the NIMBLE project additional potential key partners such as platform providers and users of the platform will be identified and recruited. This deliverable is a first step to analyse the framework for the current collaboration and business models within the existing project relations for development of the platform's core business services as a first step. It also serves the purpose of initiating questions concerning the future sustainability of the platform with respect to the collaboration- and business model.

The report is a closely interlinked with D1.1, which reports on the use case requirements. It is also aimed to contribute to the D2.1 Platform Architecture Specification and Component Design and D3.1 Core Platform Infrastructure. Further, the requirements identified and described in this deliverable, will be additionally elaborated on in WP4 and WP5 where the process of evaluating, analysing, developing and implementing the NIMBLE collaboration and business models continues.

Any collaboration process starts with discovering what each partner brings to the collaboration in order to identify win-win situation, and to envision the collaboration exchange, and to then design and develop the action plan for the collaboration models. For NIMBLE, the collaboration vision goes beyond the NIMBLE project lifetime and the specific NIMBLE scenarios service offerings, into future industrial co-creation in value networks, resource sharing collaboration, social innovation ecosystem or some other, as yet unexplored, opportunity. As part of this process, the NIMBLE team has performed initial discussions with a number of different representatives within the existing use cases and collaboration partners in the project. The discussions have served to identify expectations, needs and wants in short and longer term perspectives as well as to identify collaboration gaps and lessons of relevance for the future. Furthermore key stakeholders have been invited to workshops to share their current experience and ideas for future collaborations. Workshops together with guided tours in the plants of each use case have taken place for better understanding of the needs and requirements stated by each one of the use cases and also to better understand the potential of what can be accomplished within the NIMBLE platform. For any collaboration, one challenge is the formalization of an ex-

change structure enabling long term collaborations and business model development. This includes formalizing contracts and implementation of integration mechanisms. Such formalized exchange also requires prerequisite resources supporting sustainable development as well as models for governance of the collaboration. The objectives are to further ease and speed up the use of NIMBLE (e.g. to easy registration process, step up business transactions and negotiation). We apply a user journey perspective, a methodology for capturing users' intentions and to assure for high degrees of user involvement in development and design of the NIMBLE platform and its service offerings.

From the results we can highlight the following recommendations:

- Continue to identify and develop the NIMBLE platform portfolio offerings; opportunity recognition for already identified and unrecognized offerings. What are these?
- Developing a framework for short term and long term organization and management.
- Continue to develop a common frame of reference to make sense of what customers and users actually require and what providers actually are able to provide.
- Record the experience of the initial stakeholder-group: the use-cases, their suppliers and customers in the value chain to identify potentials and challenges as well as actual value creation.
- Align the future NIMBLE service offer portfolio to trends and future requirements from different actors' perspectives to align with an Industry 4.0 strategy.

Based on this report we shall continue to benchmark the emerging platform to identify and substantiate those characteristics that will lead to a sustainable ecosystem.

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Acronyms

Table 1: Acronyms

Acronym	Meaning
ADS	Advanced Services
AM	Associated Member
B2B	Business to Business
BAS	Basic Services
BIBA	Bremer Institut für Produktion und Logistik GmbH
CPFR	Collaborative Planning, Forecasting and Replenishment
CPFR-CTM	Collaborative Planning, Forecasting and Replenishment for Collaborative Transportation Management
DBE	Digital Business Ecosystem
EOL	End Of Life
ERP	Enterprise Resource Planning
FIWARE	A middleware platform, driven by the European Union , for the development and global deployment of applications for Future Internet Future Internet
FIWARE NGSI	A harmonized API for IoT Big Data ecosystems and particularly for exposing real time context information
FF	FIWARE Foundation
FITMAN	Future Internet Technologies for MANufacturing industries - project
GM	Gold Member
ICT	Information and Communication Technologies
IM	Individual Member
IIoT/ Industrie 4.0	Industrial Internet of Things
IoT	Internet of Things
M2M	Machine to Machine
NIMBLE	Collaboration Network for Industry, Manufacturing, Business and Logistics in Europe
NGO	Non-Governmental Organizations
OSS	Open Source Software
PM	Platinum Member
SaaS	Software as a Service
SBM	Sustainable Business Models
SC	Supply Chains
SCM	Supply Chain Management
SME	Small and Medium size Enterprise

UX	User Experience
VMI	Vendor Managed Inventory

1 Introduction

The overall objective in NIMBLE is to create a B2B platform that will improve the efficiency of supply chain creation and operations for SMEs. Among the services provided by the platform are publication of digital versions of product catalogues as well as what business services a firm is offering. Through NIMBLE, companies should be able to efficiently search and find required counterparts, initiate negotiation processes, and establish supply chain relationships, including the creation of private information exchange channels.

The basic capabilities will be to register with the platform, publish products and services, making them discoverable, and participate in resulting supply chain engagements. These basic capabilities will be enhanced in a second phase with more advanced capabilities such as enabling the selective sharing of data among partners.

The objectives for WP1 are to establish an initial set of requirements covering all four NIMBLE use cases. To do this, NIMBLE partners involved in WP1have carried out the work in four steps;

I. A prepared template is used to gather information and requirements from each use case owner accompanied by a dedicated academic/technological partner from the consortium.

II. Researchers and developers in charge of D1.1 and D1.2 have visited each use case (company) to clarify all open questions collected from the templates and to get a more detailed overview of the use case environment, e.g. manufacturing processes, existing information exchange flow, and future needs, i.e. internal value creation and capturing in the use cases.

III. The filled out templates as well as information gathered at the visits and workshops are analysed and the expectations on value creation and requirements that each actor has on the platform are summed up, in order to reach an aggregated understanding of what the NIMBLE business and collaboration models should achieve (reported in D1.1).

IV. A theoretical framework that contributes to identification of requirements in relation to business models and collaboration patterns in supply chains is used for exploration and exploitation of the four use cases. In addition we also relied on experiences from previous projects, e.g. , TEFIS[1], PANLAB[2] and AmpliFIRE[3]. Analysis of the requirements and identification of key mechanisms impacting on long-term sustainability in the Internet and IoT-based business ecosystems has been carried out, building on existing knowledge about business models and collaboration pattern in Internet-based supply chains.

The deliverables D1.1 and D1.2 form the baseline requirements to be fulfilled in WP3. Requirements from WP4 will then influence value added business services in WP5. WP2 and WP3 will fulfil these requirements. WP4 will validate and revise requirements.

This document contains requirements specification for business models and collaboration patterns. It reports on the identification and design of business models and collaboration models that facilitate dynamic value creation and capturing for NIMBLE, addressing the activities of searching, finding, negotiating and execution of desired business collaboration in supply chains. As such, D1.2 is based on the project use cases and independent research, to give a perspective that goes across the use cases to further knowledge about Internet business models and supply chain collaboration patterns. Also, an additional section (Chapter 3) has been added that gives a first orientation about existing collaborative platforms. The purpose is to introduce different ways to organize and manage B2B collaboration.

[1] TEFIS: http://cordis.europa.eu/project/rcn/96812_en.html

[2] PANLAB: http://cordis.europa.eu/project/rcn/80179_en.html

[3] AmpliFIRE: http://cordis.europa.eu/project/rcn/105975_en.html

The rest of the document is structured as follows. In Chapter 2 an account is given, of Collaboration and Business Models covering supply chain, value networks and co-creation. Chapter 3 reports on existing sustainable platform ecosystems. The deliverable continues in Chapter 4 with the methodology and approach that have guided the work in WP1, Task 1.5. The methods and approach for identifying collaboration patterns are described in Chapter 5, and Chapter 6 reports on the use case requirements. Finally, Chapter 7 offers the conclusions drawn so far.

2 Collaboration and Business Model Framework

The current chapter outlines a framework for guiding NIMBLE's development of collaboration- and business models. We outline the flow of information provided through supply chain relationships that has changed over the last decades. The collaboration framework is particularly central since competition rather than taking place solely between individual businesses; nowadays involves collaboration along the entire value chains (Horvath, 2001). In such supply chains (SC), Information Technology (IT) allows various key actors to share and exchange information and also to coordinate collaboration based on competitive initiatives, as well as collaborative initiatives. We outline based on literature a framework for collaborations with intentions to support value creation in supply chains, particularly collaborations on platforms and collaborations taking place between businesses. This section will present some examples of collaboration and business models that can be of relevance for the development of the NIMBLE platform.

2.1 Supply Chain

Supply chains are critical parts of the collaborations and will therefore be outlined and conceptualised. A supply chain involves interactions between key actors in an organization's or company's networks in which each organization creates and adds value and where individual organizations must interrelate and interact (Tatikonda & Stock, 2003). Supply chain management (SCM) offers an opportunity to depict the synergy of both intra- and inter-company integration and management (Lambert et al., 1998), since SCM represents a way of managing business and relationships with others. Inter-company integration and coordination via information technology is the key for improved SC performance (Barut et al., 2002). Research shows that collaboration through intelligent e-business networks provides the competitive edge that enables all actors in a value chain to gain advantages. Intelligent e-businesses may in line with this be of interest in the development of the NIMBLE platform. However, collaboration requires individual actors to adopt simplified, standardized solutions based on common architectures and data models (Horvath, 2001). The IT-maturity and willingness by potential users of the NIMBLE platform to adopt the technology may therefore be a critical factor for NIMBLE to consider.

The literature outlines a large number of benefits through involving the whole SC into collaborations. Examples of such benefits that also NIMBLE focuses on include acceleration of product delivery and thus decreasing the times, more efficient product development efforts, and lower product manufacturing costs. Collaborations may as such enable companies and organizations to respond to rapid changes in the market and to deal with competitive environments due to an improved access to resources, higher flexibility in resource acquisitions adjusted to needs as well as leverage of resources along the SC. A strategic work with advanced supply chain management enables development of management capabilities that may further improve the potential for organizations customer responsiveness. It may also increase organizations flexibility and potential to adjust for changes in markets, customer service, and increased retention (Horvath, 2001). The literature points out the necessity to incorporate well thought through SCM into B2B collaboration models. Collaboration and information along the SC is complex and need to be well designed for enabling optimization of value along the entire supply chains. The SCM will enable information sharing and collaboration between companies and actors that are previously unknown. Different organizations have different roles and opportunities for collaboration along the value chain, which needs to be considered when designing a collaboration model framework outlined for NIMBLE.

2.1.1 Supply Chain relationships

SC relationships have strong collaborative potential and are characterized by shared resources, joint decision-making, aligned goals and risk sharing (Fawcett et al., 2008). Studies also show that better information sharing should lead to stronger supplier performance and better SC relationships, promoting the ideation and exploitation of different forms of SC collaboration (Fawcett et al., 2011). In general, three major types of collaborative relationships can be specified: manufacturing-supplier collaboration; manufacturing-customer collaboration, and collaboration with third and fourth party logistics providers (Sahay, 2003). Over the past decades, advances in IT have enabled the emergence of modern SCM. Using IT enables SC business models that deliver significant performance improvements, including lower costs, faster product development processes, shorter lead times and greater supply flexibility and SC agility (Fawcett et al., 2011). However, despite huge IT investments many companies fail to obtain stronger supplier performance and better SC relationships due to a focus on technology per se rather than how IT can be exploited to transform SC operations and relationships (Fawcett et al., 2011). Hence, SC collaboration relies on sharing constrained resources; therefore companies must focus on collaborative efforts to build productive SC relationships that create customer-oriented value (Fawcett et al., 2011).

Fawcett et al. (2011) revealed that when SC connectivity and the organizing context of an information-sharing culture are combined to build a dynamic collaboration capability, it contributes to differentiated firm performance. Fawcett et al. (2011) stated that IT's 'connecting' role remains a valued and somewhat rare capability, but also that the willingness to share sensitive, strategic information and to build better structural mechanisms for sharing opens up for innovative SC relationships. Fawcett et al. (2011) conclude that today companies are learning how to use information sharing to achieve greater collaboration and higher levels of satisfaction.

Nowadays, the concept of business ecosystem is becoming prominent, thus enterprises are becoming aware and motivated to adhere to collaborative platforms as business enablers (Graça & Camarinha-Matos, 2016). Developing collaborative processes is a way to gain agility and resilience, and leads to the emergence of new organizational structures and supporting technology, as well as enabling environments for business collaboration. In these environments, information and communications technologies (ICT) support the development of advanced collaboration platforms such as the Digital Business Ecosystem (DBE) (Nachira, 2002), with the purpose to boost competitiveness and productivity growth of small and medium size enterprises (SMEs) through ICT adoption (Nachira et al., 2007). A business ecosystem typically promotes common business processes, providing interoperable collaboration infrastructures, and facilitating trust building among its members (Graça & Camarinha-Matos, 2016).

2.2 Value network

In order to understand the NIMBLE collaboration model we add the concept of value network into the framework, which will provide insights on how values may be created through the collaboration with the aim to guide exploration and design of NIMBLE. The understanding of 'value network' departs from the value chain logic, where a chain of actors provides value, i.e. a linear model (Porter, 1985). Such value chains do not consider the nature of alliances among members (plus competitors and complementors) in a business network. Moving to a network approach implies focusing on the value creating system itself, since it is not only the companies and the industry as such that enable the creation and capturing of values in the dynamic structure of the value network. A value network is characterised by dependency between key actors, e.g. in terms of actions or resources exchanged (Peppard & Rylander, 2006). Key questions for capturing values in the collaboration model are thus "How is value created?"; "How is effective exchange created?" and "Who are the actors in the value network?" Allee (2000) proposes that mapping the exchange in a collaboration showing goods, services and revenue, knowledge flows, and creation of intangible values, is a valuable tool in understanding the value network. Alignment of a strategy for collaboration with internal partners, external partners and the surrounding environment significantly impact the collaboration's ability to identify and meet the stake-

holders' requirements and environmental threats, as well as arising opportunities. "If the strategy is out of step with the environment, no amount of changing individuals, structure, or reward systems will solve the problems of the organization" (Narayanan & Nath, 1993, p. 244).

Understanding value networks enables development of strategies for innovation in the collaboration model. For instance, there is a need to understand the complex prosumer exchange taking place in the B2B ecosystem. A prosumer based value network implies that providers of B2B services also can be users of B2B services and vice versa and this influences the exchange (e.g. information, knowledge, financial, human, social) and the values created in the network.

In sum, relationships and exchange between actors in a network are essential to understand in order to develop strategies for competitive positioning of the value network. The structure of the network plays an important role for performance in the service network and in advancement of the manufacturing and service industry toward sustainability.

2.3 Collaboration model

Collaboration is seen as a critical part of value creation in society and businesses at large and in NIMBLE in particular. Collaboration implies that more or less independent and interdependent partners interact through formal and informal negotiation, i.e. "collaborations are 'a number of autonomous organizations working together, pooling and sharing resources, information, systems and risk for mutual benefit' (Chen et al., 2014). These partners jointly create rules and structures that govern the relationships, how to act and carry out collaborations. Collaboration includes a process involving shared norms and mutually beneficial interactions (Thomson, Perry & Miller, 2009). This description emphasizes that collaboration has a multidimensional characteristic and is composed of five key dimensions. Two dimensions are structural (governance and administration), two are social capital dimensions (mutuality and norms), and the final dimension involves agency (organizational autonomy). Collaboration models aim to be used in the development of plans guiding the implementation of collaboration and exchange in collaboration (Haynes & Ghosh, 2008). So is also the case in the NIMBLE project.

We apply a system oriented approach and according to such an approach collaboration model aims to guide the collaborative value creation towards opportunity recognition and thereby enabling acting on opportunities throughout the value chain. Collaboration models may be characterised as including four action oriented phases promoting acting (Haynes & Ghosh, 2008):

- Discovery: Identify what each partner brings to the collaboration exchange that contributes to its excellence.
- Dream: Envision how identified strengths and challenges can help build collaboration exchange in an ecosystem.
- Design: Develop new initiatives to leverage strengths and address challenges identified in Dream stage.
- Delivery (output): Create and develop collaboration models action plan for the B2B-platform ecosystem.

The collaboration model is primary focusing on a perspective of long term exchange, rather than short term exchange. Nevertheless, the short term perspective outlines the path towards the long term exchange and value creation. Focus is on internal production processes, development of management and accountability as well as management of external relationships (Grönroos, 1990). Chen et al. (2014) suggest three major dimensions defining a collaboration model; 1) collaboration life-cycle involving the value creation of collaboration input, processes and output, 2) endogenous factors such as motivation – strategies of companies, component - resources involved, structure - the participants and their relationships, and management structure and function, and 3) exogenous factors such as potential partners/stakeholders, market and society. In general values created through collaborations are considered as consisting of a total product utility where both the utility of the outcome (i.e. what is produced) and the functional utility (i.e. how is it produced) are considered and directly linked to the relation-

ships and interdependencies with internal and external stakeholders. A mix of explicit outcome based theory and implicit social exchange theory is needed for understanding how and why collaboration models develop, grow or decline (cf. Korsgaard et al., 1995). Both output and relations will hence be further explored in NIMBLE.

Networking is a vital part of a collaboration model to be considered, who to network with and who to collaborate with is central, as well as who to involve for reaching efficiency and for contributing with as much value as possible into the collaboration. The collaboration context determines the types of individuals and teams who are involved in the collaborative work, and the types of tasks that need to be carried out. The context serves as a boundary and also influences the type of support to be provided for collaborative work, and can have an impact on the actual process of collaboration itself and on team effectiveness. The NIMBLE network will thus be identified and characterized in the project in order to guide the value creation processes.

Collaboration between multiple groups of stakeholders, as is the case in NIMBLE, provides multifaceted values in the collaboration model where the different partners also take different roles and serves different purposes. Suppliers may enable identification of new solutions or development of new methods, identification of technical or design problems contributing to novelty, quality and time efficiency in products assuring for new product success (cf. Takeishi, 2001). Collaboration with clients may contribute with knowledge in market trends, new ideas and solutions, improvement in design and identification of market opportunities (Langerak, et al., 2004), collaboration models involving clients are positively associated with product innovation. Collaboration with stakeholders along the value chain, for instance suppliers and customers will be targeted when exploring the NIMBLE collaboration model.

2.3.1 Framework of factors of collaborative work

To further enable exploration of value creation in the development project of the NIMBLE platform and in the actual forthcoming NIMBLE platform for collaboration, we now outline a framework of collaborative work. Research into collaboration emerges from a large number of disciplines and professional fields. The total literature for all the factors and sub-factors relevant to collaboration is huge. At the top level (see Table 1) (based on Patel et al., 2012), the factor groups are: context, support, tasks, interaction processes, teams, individuals (these groups are consistent with team performance models and other frameworks of collaboration (e.g. Salas et al., 2007). In addition Patel et al. (2012) have identified a set of overarching factors relevant across all or most of the main factor categories. Each of the main factor groups contains a number of sub-factors. In Table 2, the top level factors are found in the table heading, and their respective sub-factors below.

The table shows that there are many contingency variables (context, support, task, interaction processes, teams, individuals and overarching factors) involved for sustainable collaboration to happen. The collaboration model framework implies that in order to design a model for collaboration, it is needed to understand the complexity of collaboration, and reflect upon, manage and address these contingency variables. The sub-factors related to the contingency factors also need to be elaborated for a more detailed design of the collaboration model.

Concerning the *context* of the collaboration model, the sub-factors culture, environment, business or collaborative climate and organizational structure are vital, since they define the context of the collaboration model. Step one can be to discuss and define these.

Support is important. The collaboration model can be supported through development of tools, networks, resources, training, team-building, knowledge management and error management. These sub-factors are central for the management control of the collaboration model.

For identification of the nature of the collaboration model, central *tasks* must be identified and characterised. Here it is vital to sort out what are the types, structures and demands on the tasks that are included in the collaboration model?

The nature of the *interaction processes* must be identified, and this is done through the sub-factors of learning, coordination, communication and decision making.

Teams of partners are of course fundamental, and it is important to create awareness of the team members' different roles, their part of various relationships, how to share awareness/knowledge, and how to work towards a common ground. Also the compositions of partners in a team must be identified and carefully addressed. This can be rather tricky, since there are group processes constantly going on between partners. Even if collaboration models includes organizations, it must be remembered that organizations are fundamentally built up of individuals with personal skills and psychological factors affecting the them, hence also factors such as wellbeing among the individual team members must be considered.

There are a number of *overarching contingency factors* that are of importance when designing collaboration models. Trust between current and potential partners must be built up, as well as the identification of current and potential conflicts that might need to be dealt with. Finally, experiences, goals, incentives, constraints, management and performance, are included in what should be addressed, in order to succeed in the collaboration processes. Altogether, it is all about creating and designing for sustainable collaborations that bring values to all involved in the collaboration model.

Table 2. Collaboration Model Framework (Source: Patel et al. 2012).

Main factors:	*Context*	*Support*	*Tasks*	*Interaction processes*	*Teams*	*Individuals*	*Overarching factors*
Sub factors:	Culture	Tools	Type	Learning	Roles	Skills	Trust
	Environment	Networks	Structure	Coordination	Relationships	Psychological factors	Conflicts
	Business climate	Resources	Demands	Communication	Shared awareness/ knowledge	Wellbeing	Experience
	Organizational structure	Training		Decision-making	Common ground		Goals
		Team building			Group processes		Incentives
		Knowledge management			Composition		Constraints
		Error management					Management
							Performance

2.3.2 Co-creation

To further enable the development of a framework for the NIMBLE collaboration models, we consider the concept of co-creation. This is a concept aimed to further guide value creation in NIMBLE. 'Compelling events' appear to be one important activity to succeed with co-creation (Marcos-Cuevas et al. 2016). Such events' are of great importance for the co-creation capability development process in order to fulfil the actors' needs and expectations. Compelling events should be understood as important occurrences that either generate new or reinforce existing value co-creation activities. For instance, co-creation practices can be (Marcos-Cuevas et al., 2016): co-diagnosis (collecting and organizing information for collaborative use), co-ideation (communicating and sharing, engaging, commenting and selecting ideas), co-design (developing concepts and knowledge), co-evaluation (prototyping and improving the offering, giving feedback), co-testing (creating and managing information, and co-launching (advertising, marketing, and diffusing information). But this requires the capabilities to: communicating value (e.g. by designing and agreeing flexible contracts containing outcome-based agreements), new forms of risk and benefit sharing need to be defined, and that a servitized and co-created marketplace for sales forces are profound. People in the organization will have to adopt a proactive and collaborative approach with customers to fully understand their needs and requirements, using methods other than the established customer, and managers need to foster collective (i.e. across actors) social capital that facilitates alignment and compatible cultural meanings (social gatherings, inter-personal relationships, games, team work exercises, off-site away days etc.) (Marcos-Cuevas et al., 2016).

Necessary conditions to co-create values in B2B systems, such as the NIMBLE platform, are high levels of interaction, strong connections, collegiality and trust. However such conditions are not suffi-

cient – co-creation requires high level of engagement among network partners (Marcos-Cuevas et al., 2016). Such factors will thus be in particular focus in the NIMBLE-project in general and in the designing of collaboration models in particular. Further, internal production processes, development of management and accountability as well as management of external relationships (Grönroos, 1990) will be central in the current project. Marcos-Cuevas et al. (2016) have identified six strategic 'interaction capabilities' that makes it possible for organizations to co-create value by facilitating the mutual integration of resources. Co-creation assured through strategic interaction capabilities outlined below are part of the NIMBLE collaboration framework aimed to be used for supporting the development of a collaboration model based on reflective and aware interactions. These interaction capabilities are outlined below:

- *Individuated interaction*, concerns the identification of actors' expressed and underlying needs, processes and what value they are looking for.
- *Relational interaction*, addresses the need to cultivate social and emotional ties between the parties and empathic interaction with the actors. Fair and non-opportunistic processes and trust is important and should be established for joint value realization.
- *Ethical interaction*, ensure that actors are able to influence the nature and content of the processes.
- *Empowered interaction*, to stimulate optimal value the process should also contribute to knowledge expansion, competence building and learning necessary for resource integration among actors.
- *Developmental interaction*, resource integration for knowledge expansion, competence building and learning to engender the optimal value.
- *Concerted interaction*, finally, is the capability to co-ordinate and to involve actors in value-creating activities.

2.4 Business models

There are several socio-economic impacts and implications of applying open business models as an answer to today's societal challenges. This trend is particularly significant in the evolution of the service industry innovation (Nedimovic, 2009). In general, Europe has a need of new innovative ideas and methods that will effectively address the societal challenges such as sustainability, healthcare, transport and travel, and the aging population. Open innovation is a way to bring remarkable contribution to economic and social welfare. It is here of interest to note that manufacturing firms have increasingly adopted servitization strategies, implying offering of and competing through product-service systems rather than offering products alone (Neely, 2008; Baines & Lightfoot, 2014) This shift results in the transformation of business models to embrace the service economy – new service-oriented businesses. The proposed definition of open innovation in services grasps three important elements, notably extensive networking, user-centricity in the innovation process, and the provision of open service platforms by the service providers (Nedimovic, 2009).

2.4.1 Business model design

Developing new products and technologies in cooperation with others (i.e. firms in your own sector, suppliers, universities, and of course end-users) render added value. To have a more open view on innovation means that the company aims at shifting the way people look at the company and its environment. Here, the business model plays a crucial role. How and when external knowledge is required and used is to a large extent determined by the companies' business model which describes how value can be created from innovations and which elements have to be sourced internally or externally (Chesbrough, 2003).

A traditional view is that the purpose of business models is to develop pure cost and revenue streams (Mullins & Komisar 2009), which is the financial component in the business model. However, other components need to be integrated in the business logic for capturing the full potential of user driven innovation. The business model design can be visualized through four commonly used main components:

1) The product and services that the firm offers (the value proposition),
2) The relationship capital the firm creates and maintain with the customers (the customer relationship)
3) The infrastructure and network of partners that are necessary to create value and to maintain a good customer relationship (the infrastructure management), and finally
4) The financial aspect such as cost and revenue structures (Dubosson-Torbay et al., 2002).

The business model logic describes how values are created and captured together with different stakeholders such as customers/users and other partners in business networks. Therefore, it becomes vital for organizations to implement a flexible approach in using a diverse set of business models to facilitate the open innovation approach (Chesbrough, 2003).

Business models can briefly be defined as a description of the company's core architecture and how it deploys resources to create value in the marketplace (Chesbrough & Rosenbloom, 2002). However, there is no consensus regarding the definition, nature, structure, and evolution of business models (Morris, et al., 2005). Business models are considered dynamic and complex and emphasizes components rather than specific models or typologies (Osterwalder et al., 2005), as this provides a better method of understanding how and where value is created and captured (Chesbrough, 2006). Today, the business model literature discusses sustainable business models (SBM) incorporating a triple bottom line approach and considering a wide range of stakeholder interests (including environment and society) (Bocken et al., 2014). The SBMs are important in driving and implementing corporate innovation for sustainability, can help embed sustainability into business purpose and processes, and serve as a key driver of competitive advantage.

Morris et al. (2005) propose a framework for characterizing a business model that includes factors related to the offering, market factors, internal strategy factors, competitive strategy factors, economic factors, and personal/investor factors. According to Morris et al., their framework is not industry specific and could thus be used to design, describe, categorize, critique, and analyse a business model for any company. Osterwalder et al. (2005), propose a framework of four dimensions (pillars), which are divided into nine "building blocks": Value Proposition, Target Customer, Distribution Channel, Relationship, Value Configuration, Core Competency, Partner Network, Cost Structure, and Revenue Model (see Figure 1). Chesbrough and Rosenbloom (2002) observe that a business model essentially performs two key functions: creating and capturing value. They suggest six functions of a business model and posit that each, through innovation, could generate new value in an industry: articulate the value proposition; identify a market segment; define the structure of the value chain required by the firm to create and distribute the offering, and determine the complementary assets needed to support the firm's position in this chain; specify the revenue generation mechanism(s) for the firm, and estimate the cost structure and profit potential of producing the offering, given the value proposition and value chain structure chosen; describe the position of the firm within the value network linking suppliers and customers, including identification of potential complementors and competitors; and finally formulate the competitive strategy by which the innovating firm will gain and hold advantage over rivals.

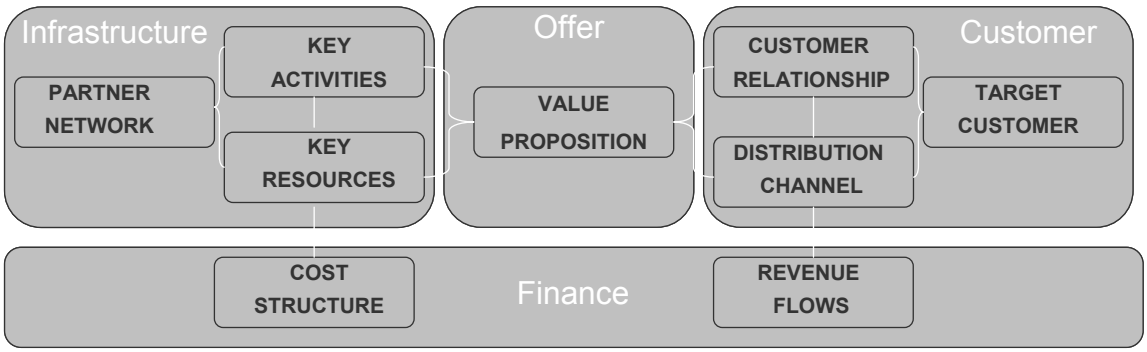

Figure 1. Business model framework (from Osterwalder et al., 2005)

The business model can be divided into internal and external factors. The internal factors focus on firm-specific factors such as competencies (Sanchez & Heene, 1996), dynamic capabilities (Teece & Pisano, 1994), and idiosyncratic bundles of resources (Barney 1991). These firm specific factors have strategic value as a result of their rarity, durability, inappropriability, imperfect imitability and imperfect substitutability (Schindehutte et al., 2008). By contrast, the external factors (environment or market forces) such as demand uncertainty, technological turbulence, and competitive intensity create industry-specific effects based on an external perspective. According to this perspective, the firm consists of a bundle of activities that interacts with components of the market such as customers, competitors, and stakeholders as it seeks a relative positional advantage (McGahan & Porter 1997). Comprehending such external factors on a cognitive level allow for appropriate design of business models and actions according to that model.

Dubosson-Torbay et al. (2002) base business model design on four principal components:

1. *Value proposition/offer*: The products and services a firm offers, represents a substantial value to a target customer (value proposition) and for which customers are willing to pay.
2. *Customer*: The relationship capital the firm creates and maintains with the customer, in order to satisfy customers and to generate sustainable revenues.
3. *Infrastructure*: the infrastructure and the network of partners that are necessary in order to create value and to maintain a good customer relationship.
4. *Finance*: the financial aspects that can be found throughout the three former components, such as cost and revenue structures.

There are causal relations between the different components. In order to serve a particular customer segment and compete with the products within that segment, the offering must have a favourable quality/price position. In order to achieve this, firms need to offer customer-perceived quality of physical product features and services, which in turn requires effective activities (e.g. large scale, competence) and organizational structure (efficient communication and division of labour and authority). This requires human, organizational and physical resources on factor markets and from suppliers of production inputs. Although not depicted graphically, external actors are potential partners or competitors in all aspects of the business: in the bundling of products (e.g. computers and software), in activities (e.g. outsourcing ICT, buying services from advertising agencies) and in the configuration of resources (e.g. banks and insurance companies share customer data bases).

3 Sustainable Platform ecosystem – an orientation

A company or a platform does not just have to use a single business model. They can mix-and-match models as they see fit or moving to a more profitable model if needed. According to Christ Meier (2016), choosing the right business model is no simple task. Knowing that NIMBLE users (actors in the SC) will consist of a heterogeneous group of actors (from different industries, with different level of IT maturity etc.) will make it challenging to choose an appropriate business model for the NIMBLE-platform. No model will be perfect from the beginning, but although small amendments and adjustments are fine, shifting to a completely different model later on will put the entire client-base at risk. Another observation is made by Matthew Aslett, from the consulting firm 'The 451 Group', who is the author of the report entitled "Open Source is not a Business Model." One of the key conclusions of the report is that 'open source' is a business strategy or tactic, not a business model.

A key question for the NIMBLE-platform is 'How to create sustainability of the NIMBLE platform'? Sustainability is not an easy question. Therefore, this section gives an overview of some of the existing business models, and collaboration models related to different types of platforms and it elaborates on what initially could be the best for the NIMBLE-platform.

The sustainability after the project, the company/-ies that takes the ownership of the platform will choose the collaboration and business model (-s). Some existing examples are presented briefly below in this section.

3.1 Objectives of the B2B-platform Projects

The NIMBLE B2B-platform aims to be a collaboration platform for the manufacturing industry in Europe. It will provide an infrastructure for a cloud-based, Industry 4.0, Internet-of-things-enabled B2B platform on which European manufacturing firms can register, publish machine-readable catalogues for products and services, search for suitable supply chain partners, negotiate contracts and supply logistics, for B2B and M2M information exchange channels to optimise business work flows.

3.2 Business models for Open Sources

There are certain details NIMBLE needs to consider before deciding on a business model and here are some highlights.

What are successful business models? Chris Meier (2016) states that any time the term 'successful' is used, a metric should follow. How is the success of the NIMBLE-platform and its business model to be measured? Comparison to other existing business model regarding some metrics (revenue, number of employees, number of paying customers etc)? The number of times the project has been forked by other companies that ended up making money off it (the number of contributors)?

For the NIMBLE-project, we defined as one success factor, to reach 2000 users spread over at least two distinct NIMBLE platforms each with different characteristics, and each having 1000+ businesses attached.

It should be noted that the open source character of NIMBLE is just a means to an end: we want companies to freely use the software in order to build further platforms. The ultimate goal is active platforms that help European SMEs to become better networked and digitalised.

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3.2.1 Examples of Open Source Business Models

Over the decades, individuals and organizations have explored the idea of how to make money out of open source software. Generating revenue from open source software is not just about providing support services. There are now a wide variety of business strategies, tactics, or business models being employed by to generate revenue from open source software. For example (Groen & Maduro, 2012):

- Many non-profit organizations obtain funding to support the development and distribution of their open source solutions from membership dues, subscription fees, donations, and/or grants.
- Many for profit organizations are paid for producing enhanced professional or enterprise versions of an open source product governed by restrictive licenses. They may also offer add-on modules or bundle the open source software within other hardware and software products they offer.
- Other for profit organizations charge for a wide range of services, e.g. consulting, installation, documentation, training, system enhancements, software maintenance & patches.

Several innovative companies are emerging and learning how to profit from the open source marketplace, e.g. news organizations, marketing firms, hosting, software-as-a-service (SAAS), open hardware, etc.

A reflection is that the NIMBLE-project should not be afraid to mix and match elements from the different models, but while trying to create something brand new can be problematic. NIMBLE potential clients are more likely to convert if they can clearly understand the NIMBLE-model and/or plans, and if it is somewhat similar to what other platform/companies offer. Some examples of successful business models, where success is determined by popularity, and common use, are presented below (Groen & Maduro, 2012).

Software Support Business Model: Companies sell certified distributions of open source software along with a range of after-sale professional technical support services. Some companies provide immediate access to the latest patched and certified version of the software to their paying customers only.

Software Services Business Model: A company may sell installation, maintenance, documentation, and training services for the open source software.

Software as a Service (SaaS) Model: Customers pay for the hosting, streaming, and delivery of the open source software solution on a managed set of servers offering cloud-based services.

Ad Ware Business Model: A variation on the SaaS model, in which the user does not pay anything for use of the open source solution; the advertiser pays instead, e.g. Google, ZDNet.

Consulting Services: A variety of consulting services are offered by a company. For example, a company may provide a range of management consulting, implementation, and training services related to the use of open source solutions by specific domains, e.g. healthcare, finance, and manufacturing.

Proprietary Software Model: A company offers a more closed, proprietary licensed version of a similar open source software solution. This protects them against some of the risks associated with developing products that use open source GPL licensed software. Under an open source GPL licensing, if the open source software is linked to a company's proprietary software, the proprietary software also becomes open source. Consumers buy commercial friendly open source licensed software to avoid this potential problem.

Premium Software Model: A company sells premium commercial software add-on modules or applications in conjunction with the open source software product, often packaging both together, e.g. Jaspersoft.

Dual Licensing Model: A variation of the proprietary software business models. A company may release the code they own under both a standard commercial license, as well as an Open Source License. Using this approach, customers can be attracted to a no-cost and open-source edition, and later agree to acquire a more robust, multi-user commercial enterprise edition.

Hybrid Model: A vendor forks a non-copyleft software project then adds closed-source additions to it and sells the resulting software. After a fixed time period, the company may release the patches or enhancements back upstream under the same open source license as the rest of the codebase.

Platform Integration Services: With the introduction of service-oriented architecture, many companies no longer buy software from one particular vendor. They build software using components from different vendors and integrate them to best meet their unique business needs. There are numerous risks and issues that need to be considered when mixing and matching open source with proprietary products.

Hardware Integration Model: Hardware companies may bundle open source software into their product. The software is free, and the customer just buy the box it runs in e.g. Android smartphones. This may allow the hardware company to significantly lower the cost of their products.

Indirect Services & Accessories: Companies may choose to provide indirect services and accessories for open source systems. This may include providing news and information, selling books, marketing, training materials, hardware accessories, t-shirts, e.g. O'Reilly Associates, Open Health News.

Non-Profit Business Models: Organizations may not be interested in making huge profits from their free and open source software (FOSS) solutions, but are instead interested in simply creating and distributing high quality, free software and solutions that will be of benefit to as many people as possible. They often need some level of funding to support their efforts. Many open source software projects are supported by a "sugar daddy", e.g. Firefox has Google; Eclipse has IBM; and VistA has the VA. Some establish foundations that require membership fees. Some pursue charitable grants or simply ask for donations to support their work. Sometimes the user community may come together and pool their resources to help develop a desired feature or functionality.

Independent Contractors/Developers: A growing number of programmers in the open source software community offer their services as independent contractors to develop, install, maintain, or enhance open source software for others, see e.g. on SourceForge, GitHub, or particular community web sites, e.g. Drupal, Wordpress.

Public Domain Model: Governments or other non-governmental organizations may develop software internally or hire a contractor for custom in-house modifications to software, then release that code under an open-source license.

Defensive Business Model/Strategy: Some companies may choose to pursue an open source business strategy or model to gain access to innovative new ideas, software code, or to reduce software development costs and timeframes. It also allows them to take a portion of market share for services and support for popular open source solutions. It may also allow them to join a community and beak a monopolistic hold a company may have on a particular area, e.g. web browsers, server software, etc.

As input to NIMBLE; further development should have in mind the growing list of high quality open source organizations, software products, videos, publications, services, and many others.

The most successful of the business models are summarized by Chris Meier, where success is determined by popularity, and common use (https://handsontable.com/blog/articles).

1. The Professional Services Model: the software is completely open-source, and freely available to all customers, but some services such as consulting (covering the management and implementation of the software within specific industries), installation, support (basic and/or priority), and training are only available at a fee.

2. The Software-as-a-Service (SaaS) Model: software provided as a centrally hosted service and only accessible via a paid subscription. Subscriptions are usually user, transaction volume, or time based.

3. The Open Core Model: similar to the Professional Services model, the core software remains open-source. Special features and modules that extend or enhance the core product are only available as commercial software, for a fee.

4. The Proprietary Software Model: software that is owned by an individual or a company (usually the one that developed it). There are almost always major restrictions on its use, and its source code is almost always kept secret. The terms of the GPL state that the source code of any program that uses GPL parts needs to be made available under the same license terms. A way around this is to develop a closed-source version that is similar to your OSS version (and does not use any GPL libraries or source code), which is then licensed (for a fee) to enterprise clients.

5. The Drug Pusher Model: a company creates a market by giving their product to customers for free, and once the customers are hooked, switching to charging high prices. The project starts out as open-source, with regular development, and everything else needed to build traction. Once a niche is established, the OSS project is completely abandoned, and a version similar to the OSS project is now only available commercially.

3.2.2 Permissive open source license model

The NIMBLE platform can be based on PERMISSIVE open source and this means that anybody can take the software and do what they want to do with it. The danger with permissive open source is that it can end up in many non-permissive, non-compatible niche-products. That is why NIMBLE propose a minimal set of interoperation services that all NIMBLE platforms must offer.

Here is a short introduction and orientation of permissive open source license to be aware of in the development of the NIMBLE platform. The intention in this deliverable is not to go deep into the license model, just an over view.

According to Wikipedia (https://en.wikipedia.org), a Permissive software license, sometimes also called BSD-like or BSD-style license, is a FOSS software license with minimal requirements about how the software can be redistributed. Examples include the MIT License, BSD licenses and the Apache license. As of 2016, the most popular FOSS license is the permissive MIT license.

The Open Source Initiative defines a permissive software license as a "non-copyleft license".GitHub's choose-a-license website described the MIT permissive license as, "lets people do anything they want with your code as long as they provide attribution back to you and don't hold you liable. "California Western School of Law's newmediarights.com defined them as follows: "The 'BSD-like' licenses such as the BSD, MIT, and Apache licenses are extremely permissive, requiring little more than attributing the original portions of the licensed code to the original developers in your own code and/or documentation."

3.2.3 Example of open-source business model and a marketplace

An existing open-source business model platform is ePrints platform (http://www.eprints.org/uk/). It is not a collaboration platform as NIMBLE intends to be, but they have an interesting open-source business model and a marketplace in their platform which could inspire NIMBLE. The platform also follows common conventions (standards) to handle data.

- Services that are offered (to be bought from eprints) are repositories that are configured to meet the particular requirements.
- Owners seem to be a university. EPrints Services, School of Electronics & Computer Science, University of Southampton and they work closely with clients to develop tailor-made repositories and have been doing this for 10 years.

EPrints Services exists to promote the use of repositories and to provide a sustainable funding stream to guarantee the future development and support of EPrints Open Source software. Their services provides the freedom to choose the appropriate mix of for-pay and for-free repository solutions. They are a not-for-profit commercial services organization, which are building & hosting repositories, training users and developing bespoke functionality.

3.2.4 Example of a supplier collaboration platform

In an initial overview of existing collaboration platforms, following platform "Wer liefert Was?"[4] was identified. It is the largest and leading German, Austrian, and Swiss B2B platform and marketplace to search for suppliers. This is an important aspect of NIMBLE i.e. to find suppliers to collaborate with: www.wlw.de

Another example is SUPPLYON, although they don't actually provide a platform: www.supplyon.com [5]. SupplyOn is the shared supply chain collaboration platform for the manufacturing industry used as a central online platform to manage business processes with suppliers and service providers across continents in a structured, transparent and secure manner. SupplyOn takes up where internal ERP systems leave off, and extends internal business processes seamlessly beyond company borders. The solutions are provided as Software as a Service and are aligned with the process requirements of the manufacturing industry; they encompass cross-company processes in supply chain management, supplier risk and performance management, strategic and operational procurement and in quality and transport management.

SupplyOn is often referred to as an electronic marketplace, but there is an important distinction to note: SupplyOn is not an open marketplace in which any company can register to offer its services to potential customers, such as in a business directory. Rather, SupplyOn serves as a technical infrastructure in which the processes of an existing business relationship between companies that buy and supply are electronically depicted and automated within a secure framework.

By visualizing a building, having in mind if it is a portal or a platform, one can graphically see the difference between the two: in this image, the portal is the entrance; the platform itself is the foundation of the entire building – in other words, the basis upon which all business applications are built. You are only permitted to access this platform after authentication at the portal (e.g. with your login password). Once you have access to the platform, you can take advantage of the various business applications (e.g. SupplyOn Sourcing, SupplyOn WebEDI, etc.).

The above example of an existing electronic marketplace can be used as a benchmark platform for NIMBLE since SupplyOn focuses on processes in supply chain management, supplier risk and performance management, strategic and operational procurement and in quality and transport management.

3.2.5 Example of an open sustainable ecosystem - FIWARE

Ongoing work has led to FIWARE as an interesting initiative to investigate. There is a plan for a meeting at IoT Week June 2017 in Geneva to discuss eventual collaboration potential between NIMBLE and FIWARE as a results so far. An initial reflection of the opportunity is found below.

FIWARE (www.fiware.org) is an example of an open sustainable ecosystem around a public, royalty-free and implementation-driven software platform. The FIWARE Community is an independent open community whose members are committed to materialise the FIWARE mission, that is: “to build an open sustainable ecosystem around public, royalty-free and implementation-driven software platform

[4] “Wer liefert was” is represented in the DACH region. With 540,000 companies showcased on wlw who connect with 1.3 million professional buyers every month, they are Europe’s leading marketplace for B2B products and services. Corporate customers benefit from increased visibility online and generate valuable business contacts. Buyers can save time searching for products and suppliers and get a complete overview of the market.

[5] SupplyOn has established a network of companies in the manufacturing industry – with a focus on the automotive, aerospace, railway and transport, machine engineering and plant construction, and high-tech and electronics industries – that connects some 30,000 business in 70 countries. It is this global network that represents SupplyOn’s greatest value added, because – like in social networks – the benefit of a professional web platform lies primarily in the community that it connects.

standards that will ease the development of new Smart Applications in multiple sectors". The FIWARE Community is not only formed by contributors to the technology (the FIWARE platform) but also those who contribute in building the FIWARE ecosystem and making it sustainable over time. As such, individuals and organizations committing relevant resources in FIWARE Lab activities or activities of the FIWARE Accelerator, FIWARE mundus or FIWARE iHubs programmes are also considered members of the FIWARE community. The FIWARE Foundation ("FF") is an initiative whose mission is to research in the field of information and communications technology (ICT) and to develop an open sustainable ecosystem around public, royalty-free and implementation-driven software platform standards. This ecosystem will be open to the general public. Results of the advancement in science and research are materialized in an open source platform (the FIWARE Platform) which anyone in the world can use for free. The FF has been constituted as a non-profit association. The cornerstones and founding principles of the FF are independence in decision making, openness, transparency and meritocracy. The FF is a legally independent body whose main purpose is to advance science and research in the ICT sector including the provision of shared resources to help achieving the FIWARE Mission. The purposes of FIWARE Foundation e.V. are the advancement of science and research and education in the field of Smart Applications.

Members of FF can be individuals, corporate bodies and any public legal entity. The FF shall have four levels of members: Platinum Members (PM), Gold Members (GM), Associated members (AM) and Individual members (IM). The PM and GM levels recognise Strategic End User sub levels. These are levels dedicated to non-Information Communications Technology (ICT) organizations.

FIWARE Code of Conduct (www.fiware.org/foundation/code-of-conduct):

The FIWARE Community's policy is to conduct its business affairs honestly and in an ethical manner. This Code of Conduct provides a general statement of the expectations of the FIWARE Community concerning the ethical standards that each the FIWARE Community member should adhere to while acting on behalf of the FIWARE Community under the assumption that the FIWARE Community pride itself on building a productive, happy and agile community that can welcome new ideas in a complex field, and foster collaboration between groups with very different needs, interests and goals. This Code of Conduct does not cover every issue that may arise, but it sets out basic principles to guide all the FIWARE Community members. All of the FIWARE Community members must conduct themselves accordingly and seek to avoid even the appearance of improper behaviour.

There is an on-going discussion between NIMBLE and FIWARE with the purpose to find out potential of an eventual collaboration. So far, following reflections have been made about FIWARE and NIMBLE:

1) FIWARE provides an open source IoT platform (generic enablers and commercial extensions) - similar to the NIMBLE model
2) FIWARE is based on the Open Stack license policy ("bylaws very close to Open Stack")
3) FIWARE received more than 300 Mio. € funding (and still receives a lot of funding).
4) FIWARE have 3 focus areas, one is "Smart Industry" where NIMBLE could fit in and support that area which will be elaborated. It started in the smart city area, recently spreading into the areas of smart agrifood and smart industry (Industry 4.0 - which could be a common market with NIMBLE).
5) The FIWARE ecosystem consists of three programs,
    - Mundus: globalization of FIWARE
    - Accelerator: funding calls
    - IHub: innovation, support, experience
6) Income streams: 50% membership fees, 50% public funding (goal is to decrease the latter share gradually to 0)

FIWARE have now a task to globalize the platform i.e. they want to reach out to users, customers, which opens up for collaborations with NIMBLE if a win-win scenario could be identified.

3.3 NIMBLE Platform Providers' Requirements

The NIMBLE consortium does not contain a company whose sole aim is to become a platform provider. On the one hand, this is "by design" because the output of the project is supposed to be for the benefit of external entrepreneurs who are willing to develop a commercial platform as a business proposition, but without having to first commit a large amount of resources to just create the bare-bones software infrastructure. On the other hand, this lack of an early adopter for the platform itself poses a risk to the commercial exploitation of the technical platform. The lack of a real user organization to productise the NIMBLE platform also means that we have no first-hand account of such a user's business and software requirements.

However, in the past two years, a number of researchers and authors have begun to look into the platform phenomenon and a number of useful books have started to appear, giving analyses of different Internet platforms and their characteristics, ranging from technical to economic and social media aspects. (Tiwana 2014), (Evans and Schmalensee, 2016), (Parker, Alstyne, Choudary, 2016): We found the book "Platform Revolution" the best organised in terms of what we can learn for NIMBLE, because it analyses Internet Platforms to a large extent from the perspective of the platform provider, so this chapter is based on (Parker, Alstyne, Choudary, 2016). Many of the important terms can be found in their definition of a platform.

Definition of a platform (Parker, Alstyne, Choudary, 2016, p. 5):

A platform is a business based on enabling value-creating interactions between external producers and consumers. The platform provides an open, participative infrastructure for these interactions and sets governance conditions for them. The platform's overarching purpose: to consummate matches among users and facilitate the exchange of goods, services or social currency, thereby enabling value creation for all participants.

The common understanding is that the core value of any platform is high-quality matchmaking between a large number of producers and consumers. The goods exchanged can range from physically produced to entirely virtual, as is the case with platforms like LinkedIn.

3.3.1 Internet Platform Success Factors

The two most important success factors are **two-sidedness** (at least), meaning that service or product offerings meet consumers (Parker, Alstyne, Choudary, 2016, p.21) and a **frictionless entry** meaning that it must be very easy for new participants to enter the platform and they must be able to use it with practically no extra effort. Usually, the best way of ensuring frictionless entry is to automate all procedures and use algorithms instead of people [p.25].

Therefore, the platform approach requires us to identify:

- Positive two-sided network effects
- Frictionless entry points
- Identifying how both sides of the two-sided market can grow proportionally
- Side switching opportunities: facilitate "prosumer"-behaviour of the participants

At the same time, we need to avoid negative network effects [p.26]:

- Matchmaking must be of high quality – this needs effective curation of "content".
- Data-driven network effects enhance quality of matchmaking
- Effective curation should be algorithmic (and data driven)

Two-sided networks have **4 kinds of network effects**:

- Same-side effects, which can be positive or negative

- Cross-side effects, which can be positive or negative

An example for a positive same-side (user) effect is the telephone system – the more users are taking part, the more connections and choices there are to communicate.

A positive same-side (producer) effect is the Adobe PDF platform for exchange of digital image material – it provides a much more efficient way of interoperating across otherwise incompatible digital image formats.

A negative same-side effect would be too many suppliers with competing offers – e.g. when there are too many taxi drivers, then none of them can earn a good living, and drivers may drop out of the business.

A positive cross-side effect can be seen with credit cards: when more businesses accept a credit card then the credit card is more useful to customers (this also works in the opposite direction).

A negative cross-side effect would be when there are not enough taxi drivers and therefore, customers have to wait too long for a ride – this may drive taxi customers away to alternatives (own car or public transport).

What also needs to be kept in mind is that **cross-side effects are often not symmetrical** due to the nature of the exchange (e.g. on twitter – there are more readers than writers, on Uber there are more ride-seekers than drivers, etc.).

Relevance for NIMBLE

We note that the NIMBLE platform must be able to manage all 4 types of network effects and that we need to analyse the platform in terms of possible, concrete positive or negative same-side or cross-side effects.

In principle, customers have no effort to join, the platform not controlling who joins, and large benefit expectation of the participants lead to fast growth. However, exercising no control bears the risk of negative same-side or cross-side effects. Furthermore, large benefit expectations cannot be based on a zero-sum game between the actors of the platform, because the losers will simply leave the platform. This indicates a relationship between game-theoretic considerations and successful platforms.

3.3.2 The economic role and structure of platforms

The question arises whether platforms are a completely novel phenomenon afforded by networked computing or whether there are historical examples that we can learn from.

Platforms enable exchanges of

- information
- goods or services
- some form of currency

As is known from economic theory, information exchange is the basic requirement before anything else (goods, services, social currency) can be exchanged. It is a fundamental characteristic of platforms that the information exchange must take place via the platform. If one accepts that the role of Internet platforms is to provide a market place then this characteristic is included by definition. **It is indeed our hypothesis for NIMBLE that the platform provides a market place** and that the basic interaction is information exchange that leads to exchange of goods and services, between enterprises.

According to a study by Deloitte enterprises fall into four categories of economic activity [PAC, p.32]:

- asset building → the enterprise is in the business of building physical goods
- service providers → employ workers who provide services to customers
- technology creators → develop/sell forms of intellectual property (e.g. software)
- network orchestrators → platform businesses

These types of business have widely differing market multipliers (market value vs. price-to-earnings ratio) of 2.0; 2.6; 4.8 and 8.2 respectively, for asset, service, technology and network firms. In other

words, a network firm will have a four times better market multiplier than an asset builder firm. We will revisit this issue in the conclusions section of this document.

Goods or services are the **value units** for a platform. They can be exchanged directly (e.g. Youtube content) or externally (e.g. in the form of Über-drives). Payment in some form of currency is another characteristic of markets/platforms, e.g. monetizing user attention via advertisements, or taking a cut on value exchanges between users.

For each platform an important question to ask is what is the **core interaction** that leads to value exchanges? In Facebook this is the status update of the user; on Twitter it is a new tweet; on Amazon, there are several interactions: searching, comparing, buying (probably the core interaction), but also offering alternatives, and – for customers – reviewing articles which again leads to more information exchange.

For NIMBLE, our core interaction would have to be the executing of B2B transactions. In order for that to happen, the publishing of product and service catalogues and the ability to search for catalogue items is a pre-requisite.

3.3.3 Defining the Core Interaction mechanisms

In (Parker, Alstyne, Choudary, 2016, p.41) the authors claim that the following interaction model holds practically for all platforms:

Participants + Value Unit + Filter → Core Interaction

There are two fundamental types of **participants** – *producers* and *consumers*. The authors exemplify the basic structure with Google: the crawlers create web page indices, which are the **value units**. The consumers issue queries as basis for the **core interaction**. Google then uses further knowledge it has about the consumer and the web pages, to create a **filter** that ranks the web pages optimally, with respect to the user. It should be noted that Google's real customers are the companies that pay for Google's services, and this is primarily the placing of advertisements and web pages in response to user queries.

Analogously, for NIMBLE, the value unit would be a ranked set of products or services that fulfil the criteria of a search. The core interaction is the process of searching for goods and services, negotiating delivery conditions and price, and closing a deal via the platform.

Any successfully closed deal (contract) leading to a B2B transaction (delivery of goods or services) would constitute a successful core interaction.

The next question concerns the filters in NIMBLE. Our hypothesis is that strong semantic models improve the chances of good matches between buyers and suppliers and that an equally strong, but easy to use query tool will give the participants the flexibility to express their needs in efficient and effective ways.

Pull, Facilitate and Match

One of the defining features of successful platforms is that their design **pulls** the producers and consumers to the platform. To pull the participants to the platform it must provide tools to **facilitate** valuable interactions, which of course, reduces friction and transaction costs among the participants. To achieve this, the platform must **match** the needs of the consumer with the offers of the producers. In (Parker, Alstyne, Choudary, 2016, p.45) a number of challenges concerning pull, facilitate and match, are discussed:

1) pulling users onto the platform is the foremost problem, because a platform without users has no value and users will only come to the platform if it has a perceived value. Keeping users' interest is the next problem and one method of keeping their interest is building one or more *feedback loops* into the system (single-user or multi-user). A third challenge is whether the platform can leverage existing

networks (e.g. by piggybacking on them). This way, an existing base of potential participants can be utilised and activated.

2) Facilitate-related challenges relate to value creation and core interaction: for example, Instagram has won over part of the Facebook network by making it easy to share photos. Sometimes, strict governance can be a recipe for high-quality value creation: for example, SitterCity has strict rules on babysitters in order to ensure trust of parents.

3) Matching-related challenges depend on the quality of the filter(s) and these depend on the range and quality of the data that they have at their disposal.

For NIMBLE, the first challenge is of course also the foremost problem. We set ourselves the goal of obtaining 2000 business users spread over at least two instances of a NIMBLE platform. The basic calculation is that an annual fee of approximately 1000 € per business would generate 1 m € for a platform provider, which we would regard as the lower limit of a feasible platform enterprise in some niche market. At the same time, with the assumption that the platforms will be interoperable and thus, work in a federated fashion like a large platform the network effects would be beneficial to all participants alike. If we can also assume that small enterprises generate between 100 000 and 10 m € of annual turnover, then the fee would correspond to between 1% and 0,01% of an SME's turnover. Given that every credit card transaction is charged between 2% and 3% of the value transferred, our current estimation seems to be at least in a reasonable frame. However, at this stage potential customers have not yet tested the facilitation tools. Therefore, customer reaction as to whether the cost-benefit value is attractive to them is not known, either, but will be explored in the experimentation stage starting at the end of the first year.

3.3.4 Modularity

Platforms have to be stable over a long time and innovation should not disrupt operation of the platform in its daily business. If systems are built in a modular fashion, then interdependencies are kept to a minimum. For this, the boundaries between modules need to be precise, unambiguous and complete. For further development, there should be well-known design rules. Baldwin and Woodard, 2008, [in Parker, Alstyne, Choudary, 2016, p.55]) define the task as follows:

"We argue that the fundamental architecture behind all platforms is essentially the same: namely, the system is partitioned into a set of "core" components with low variety and a complementary set of "peripheral " components with high variety. The low-variety components constitute the platform. They are the long-lived elements of the system and thus implicitly or explicitly establish the system's interfaces, [and] the rules governing interactions among the different parts."

(Parker, Alstyne, Choudary, 2016) further argue that the development of PCs benefitted from modularity in the 1990s (CPU, GPU, RAM, HDD). The subsystems were connected by busses / APIs that enabled independent innovation in the subsystems.

3.3.5 Three forms of platform-driven disruption

According to (Parker, Alstyne, Choudary, 2016, p68 ff.) there are three types of disruption that platforms can initiate:

- de-linking assets from value
- re-intermediation
- market aggregation

De-linking assets from value → this is of importance in B2B scenarios, e.g. de-linking ownership of power plants from energy distribution. The idea behind it is that the asset can be used optimally and is not confined to the specific uses of its owner.

Re-intermediation → an early trend of internet economics was dis-intermediation, i.e. cutting out inefficient middle-men organizations. With platforms, more efficient middle-men have come in – e.g. quality and trust-enhancing services (e.g. TripAdvisor).

Market aggregation → platforms aggregate unorganised markets, e.g. centralising services for widely dispersed organizations or individuals. The *redBus* platform in India combines schedules and pricing information of disparate bus transportation systems / organizations across India.

The question for NIMBLE is, whether any of these aspects apply to its business model. It would seem that market aggregation is the most appropriate characteristic: NIMBLE intends to bring together European SMEs in B2B supply chains that at present, carry transaction costs that are too high.

3.3.6 Can Pipelines enter the Platform Business?

With the term "pipeline business" (Parker, Alstyne, Choudary, 2016) refer to traditional businesses that try to further optimize their existing logistics, but fail to re-assess their overall business model in the light of platform-based businesses. The authors suggest that the core initial activity is to scrutinize all transaction costs in all business processes (Parker, Alstyne, Choudary, 2016, p74):

- Which current in-house processes could be delegated to outside partners?
- Can we empower outside partners to create new value for existing customers?
- Can we network with current competitors to create new value for customers?
- Can the value of goods and services be enhanced via some platform function?

Since we observe that even within NIMBLE's four initial use cases the pipeline model is prevalent, we take as lesson from this that our potential user companies should themselves re-evaluate their business models and offer innovative ideas that could extend the functionality of the NIMBLE platform and ecosystem.

3.3.7 Launching a Platform

According to (Parker, Alstyne, Choudary, 2016, p.81), PayPal invested approximately 10m $ per month in the launch of the payment platform, by giving new users a 10$ for signing up and by giving referrers also 10$, which meant that any new customer cost 10-20$ to obtain. The authors even report a strategy of PayPal on eBay, whereby Web-Bots made purchases insisting on payment via PayPal, in order to artificially incentivise sellers to adopt PayPal as a payment method.

In general, the problem of launching a platform has two elements:

- Solving the Chicken-egg problem of networks when there are no users, yet
- Ensuring viral growth once a certain minimal user base is established

For the initialisation problem, [PAC, p89-98] offer eight distinct strategies:

a) "Follow the rabbit" – show some attractive functionality first, without the full platform being in place
b) "Piggyback" – using an existing platform or marketplace to build the new business on top of the old one
c) "Seeding" – this is when the launching party invests in creating value units first, in order to attract an initially important user group
d) "Marquee" – this means that the launching party is willing to give a particularly important group a "VIP treatment", e.g. in electronic games, EA is so important for games console makers that they give EA special incentives to adapt their games to the new console.
e) "Single-side" – this is the case when a platform is developed out of a product that originally only benefits one user group. OpenTable, a restaurant booking platform, started their business by first giving the restaurants a table booking management software and later, developed a platform out of this [PAC, p95].
f) "Producer evangelism" – here, the focus is on the seller/producer of the value unit. Crowdfunding platforms are given as example: the inventors who would like a new project funded create the content (a new campaign) and the consumers decide which of the project they wish to back.
g) "Big-Bang adoption" – the authors describe the launch of Twitter at the SXSW Festival, where the company installed large scale flat panel screens to enable users to see their tweets

appearing live at the festival, thus tripling Twitter's tweet rate within a week and make Twitter known to a large audience.

h) "Micromarket strategy" – Facebook is given as example: they started at Harvard university and gained 500 users that were very active users. The model was then extended to other university campuses where it was possible to connect across to all previously established campus networks. A similar strategy is ascribed to Stack Overflow, but this time the micromarket is not defined geographically, but in terms of topics covered.

When it comes to the viral growth of a network, four components need to be considered [PAC, p.100]: the sender, the value unit, the external network and the recipient. The core element is the value unit that must be transferred from a sender to a recipient via the external network. Since the transfer is visible to a large number of users on the network, there are some users that are interested in the new value unit and so they too, become users of the new platform.

For NIMBLE, we see micromarkets as a potential way, which could grow from regional supply chains as in the use case of Lindbäcks. This could be combined with a follow-the-rabbit strategy: one of the requested features is a generic product configuration tool that should be customisable for different businesses and products.

One potential for viral growth is that we could make the users of the platform at the same time, partial owners of the platform, thus giving a promise to fairly share the profits accrued from the efficiencies afforded by the platform.

3.3.8 Monetisation

Making money is the foremost motivation of most platforms and thus, the major question is how to monetise the value that is created through interaction on the platform. For this, [PAC, p.111] posit four sources of excess value that are exclusively provided by the platform:

(1) For consumers: access to value created on the platform
(2) For producers or third party providers: access to a community or market
(3) For consumers and producers: access to tools and services that facilitate interaction
(4) For consumers and producers: access to curation mechanisms that enhance the quality of the interaction.

The authors also offer four monetisation strategies:

(1) charging a transaction fee
(2) charging for access
(3) charging for enhanced access
(4) charging for enhanced curation

Further issues to consider are who to charge and when to charge. In some cases, one group of platform participants may be more willing or able to pay then another. If a service was first given for free and is later changed to a pay-for service then this is often detrimental because a percentage of users will drop out. The overall advice by [PAC, p.127] is to consider monetisation strategies during the design of the platform.

For NIMBLE, there are some special issues to consider and the first is in fact, the modest profit expectation from running the platform itself. We are not expecting a single platform to conquer the world and to dominate its market. Instead, we design the platform to share the expected excess value fairly between its users and those responsible for running a federated instance of the platform.

At present, the planned monetisation model is to charge an access fee, but we also envisage for the first cohort of businesses to give them an incentive, e.g. to make them shareholders in the future platform and to waive access fees until their value of transactions reaches a level where there is a clear positive margin for the participants, even when paying the access fees.

3.3.9 An initial recommendation

An early reflection of NIMBLE in relation to the different models presented in Chapter 3 is:

1) The Professional Services Model: The software is completely open-source but services (consulting, installation, support, training) and adaption to specific industries are available at a fee.

Successful example platform: https://www.redhat.com/en[6]

Motivation: This can apply to NIMBLE to some extent by means of development of value added services by third parties and platform support by technical service providers.

Enterprise Linux®. Today, Red Hat delivers a comprehensive portfolio of products and services using the same open, collaborative business model and an affordable, predictable subscription.

2) The SaaS Model; Apart from free on-site deployments the software is available as a "ready to go" centrally hosted service accessible via paid subscription.

Successful example platform: https://www.sugarcrm.com [7]

Motivation: This can apply to NIMBLE in case a cloud infrastructure provider (e.g. IBM or other suitable partner) commits to long-term hosting of the NIMBLE platform.

Today, digital disruption is driving a tectonic shift in how companies deliver an extraordinary customer experience, inventing new ways to connect with and deliver value to customers. The companies that win in this era of empowered customers do so because they create better relationships with their customers. Sugar is deployed by more than 2 million individuals in over 120 countries and 26 languages. Companies large and small are turning from yesterday's CRM solutions to rely on Sugar to manage customer relationships.

3) The Open Core Model: The core software is open-source while extension is available as commercial software.

Successful example platform: https://www.talend.com[8]

Motivation: In NIMBLE this is exactly what the value added service marketplace could be exploited for.

Below follows some examples of more general approaches used for web based platforms that can be of inspiration to NIMBLE.

1) Ad Ware: Like for any other web page advertisements can serve as a basis for income as soon as a large user base is established. Those advertisements can be disabled at a fee.

2) Rate limiting: The overall idea is the same as for the SaaS model but paid subscriptions are only needed when exceeding a defined limit of requests, data storage or the like. Multiple "license stages"

[6] Red Hat mission is to be the catalyst in communities of customers, contributors, and partners creating better technology the open source way. Red Hat, the world's leading provider of open source, enterprise IT solutions. More than 2 decades ago, Red Hat had a spark of an idea—a vision for developing software differently. We believed that collaboration with an ecosystem of IT leaders, open source advocates, developers, and partners could create a better foundation for the future of IT—Red Hat®

[7] SugarCRM enables businesses to create extraordinary customer relationships with the most empowering, adaptable and affordable customer relationship management (CRM) solution on the market. SugarCRM are the industry's leading company focused exclusively on customer relationship management. Helping clients build a unique customer experience through great customer relationships is their focus.

[8] Talend is the leading open source integration software provider to data-driven enterprises and the first data integration platform with native Apache Spark support. Customers connect anywhere at any speed, at a predictable price.

or pay-by-call approaches can be established. This benefits SMEs while making big enterprises pay up for the dropped income.

Approaches NIMBLE should definitely avoid:

1) The Proprietary Software Model: Proprietary closed-source versions are developed and licensed to enterprise clients.

Motivation: This can be a dangerous approach since it contradicts the general open-source idea and can lead to multiple "islands" while the open-source solution goes extinct.

2) The Drug Pusher Model: The software starts as open-source and is transformed to a closed-source spin-off after attracting a large user base.

Motivation: This completely contradicts the open-source idea and would possibly exclude the SMEs that are the main "target" of the NIMBLE platform.

One should not underestimate the open-source community. If NIMBLE are able to create a useful platform - which is a general requirement for the success of the project and any kind of exploitation - there will definitely be a number of contributors when it comes to maintaining and improving the core functionality.

As soon as the NIMBLE-platform reaches a somewhat stable beta stage with 100+ users NIMBLE can discuss whether to transform the core functionality to some kind of "managed" open-source community, such as Apache, or stick to the "simple" open-source approach using GitHub, issue tracking and patches for contributions.

Popular Apache projects: http://tomcat.apache.org/, http://maven.apache.org/, http://hadoop.apache.org/

Furthermore, Apache Marmotta (http://marmotta.apache.org/) - the people responsible for the Apache administration has moved to a spin-off though.

4 Methodology and approach

Business and collaboration models are highly influential on end-users activities, tasks and ways of working together hence, when designing business and collaboration models end-users play a critical role. It is for them the B2B platform should be usable and valuable, since it will become a vital part of their future situation. User involvement thus relates to social, ethical, and economic reasons, and is ultimately about user's rights to influence their own context (Simonsen & Robertson 2013). User involvement also contributes to design processes by generation of, often more creative, ideas and increased possibilities for innovation. For the NIMBLE B2B platform user involvement is critical and will contribute to:

1) an understanding of those who will buy and/or use the NIMBLE B2B platform,

2) insights in varying objectives, goals, needs and ways of thinking, that people have

3) good foundations for decisions,

4) an increase of the probability of taking right design decisions,

5) speeding up the decision process for identification of initial requirements, and

6) preparing for better acceptance of the platform with its collaboration and business models. In short, user involvement increases the probability of success while it simultaneously decreases the risk of failure. Therefore, our approach is coloured by theories from participatory design, interaction design, and user experience (UX), and the importance of user involvement have guided when selecting methods.

Below the methods used for identifying and gathering requirements for the business and collaboration models to be developed in NIMBLE are described.

4.1 User Journey Method

Methodologically, the user journey method will be used as inspiration for the design of the NIMBLE B2B platform business and collaboration models. In service design the user-centred approach manifests in user journeys, where focus is on actual user behaviour. Thus, user journey mapping is a commonly used tool for understanding user behaviour (Marquez, Downey & Clement 2015). User journeys build on the user's experience, which implies a focus on a customer's cognitive, emotional, behavioural, sensorial and social responses to a service. As such user experience constitutes a multidimensional construct, and user journey mapping is used in order to empirically examine customers' experiences over time, from pre- to post purchase (Lemon & Verhoef 2016), or in other words, taking into account the entire service ecology, since user journey mapping creates an understanding of all the steps required to perform a task (Marquez et al. 2015). The insights are then used as basis for (re)design the platform, from touch points, i.e. the instances where the customer actually interacts with the firm/company to all aspects involved. Ultimately, the designed user journey should be "the end result of the implementation of a coherent strategic plan" (Norton & Pine II 2013, p. 12).

In the NIMBLE project the user journey will be used as a method and guiding framework for the design of the business and collaboration models. More specifically this implies that the focus will be on the users';

- *Context* – Where are the users? What are the conditions under which they work? What does their business processes look like?
- *Progression* – What are their key activities? What phases can be discerned? What are their businesses logics of flow?
- *Information system* – Problem formulation? How can information system support information exchange and collaboration in the supply chain?

- *Functionality* – What type of functionality are they expecting from the NIMBLE B2B platform? Which functions are desirable and which are less important?
- *Incentive/Motivation* – What are their incentives in each step? What future situation do they want to reach? "What's in it for me?"

Altogether, the approach and the questions described above have been "always present" when participating in project meetings, or conducting workshops in the NIMBLE project.

4.1.1 The Use Cases

In NIMBLE there are four use cases; White Goods; Eco Houses; Textile Manufacturing; and Childcare Furniture. Each use case consists of the problem owner, one research partner as mentor, one software company as service provider, and one or more supply chain partners.

Involved in the NIMBLE project are also the core platform developer group which consists of different IT-system partners and institutes, and the platform adoption group with partners in charge of standardisation, and regional industrial sector representatives acting as multipliers for adoption. The partners have different expertise competences: Architectural Development, Data Management, Expertise in Optimization Methods and Algorithms in operational Supply Chains, Trust, Privacy, Security, Business Models and Business Processes Valorisation of Research Results and Outreach, Project Management.

The use cases were asked to establish an initial set of requirements. The formal descriptions of the stories were to be the base for the requirements and specifications later on. A form was used with three sections that should be filled out by all use cases, and which covered the following areas;

1. Application: the use case description and workflows with AS-IS work flow (what are the current processes in the use case?), and TO-BE workflow (how/where does the platform support the use case activities?)
2. System requirements: IT-perspective on the use case
3. Challenges and Risks: expected problems and barriers

During this work the contact was mostly not face-to-face – physical, instead the process was arranged through the project web portal, and via e-mail (for full description of the initial set of requirements from each use case, see D1.1).

4.2 The business and collaboration model requirements collection process

Overall, our aim is to understand each use case current situation, expectations, wants and needs with regards to the collaboration and business models. This has been carried out in four steps, namely;

- A review of written materials, including each case written requirements forms on an aggregated level related to collaboration models (Who, What, How). Data has also been collected at NIMBLE project meetings, in which we mainly observed however with the opportunity to ask questions and ask for clarifications.
- To advance an in-depth understanding of each use case, we have visited each use case site. During these meetings we carried out workshops with a focus on their scenarios (for a detailed account of the use case scenarios, see D1.1) and their initial expectations on the platform. The purpose of these workshops was to initiate a sense-making process between the technical and business partners. Hence each use case was asked to involve some partners from their business as well as their technical side (their IT department) for to make possible elaboration on both business and technical requirements. The use case meetings lasted between 1 and 2 days.

- Concurrently an overview of earlier success cases took place, where we identified and analysed existing sustainable platforms, gathering insights and recommendations that were of interest for the NIMBLE B2B platform.
- Finally we have conducted workshops with the four use cases in connection to a project meeting with the aim of identifying challenges and risk management, visibility etc. This time each use case identified and discussed what, strengths, weaknesses, opportunities and threats they could recognize in relation to the platform.

5 Use case collaboration and business model

The following chapter outlines the use cases and their role in the development of a new collaboration and business models for NIMBLE. The platform aims to offer a number of services supporting B2B supply chain collaboration between companies and their stakeholders, e.g. suppliers and customers. The use cases contribute with concrete challenges that may provide value for further use cases from a variety of potential customers of the platform.

This chapter gives a view of the service offerings through the eyes of the use cases as potential customers. We identify each use case's current problems and challenges concerning information exchange and collaboration in their supply chain. We then elaborate on the service solutions; the embedded supply chains and organizational needs and wants related to each of the four use-cases, in relation to services and collaboration. What can NIMBLE offer in the use cases in relation to this, in order to provide frictionless information exchange and collaboration in the supply chain and hence provide value for the use cases? More specifically, what are the different value offerings; the services needed and the values asked for in order to support frictionless and smooth collaboration (speed, quality, trust, reliability etc.). We also summarize the co-creators; external key actors of relevance for the use case in order to develop service offerings based on the companies' and the key actors' needs and wants in different parts of the supply chain. Finally, we identify the different needs of information exchange and collaboration that will decrease friction in collaboration in the different phases of the supply chain.

In understanding the use cases and their need of a B2B platform, below is a description of the supply chain process of WHO needs to collaborate about WHAT, WHERE, WHEN, and WHY. More specifically, what are the expectations on the platform service offerings for supporting and resolving collaborative challenges and enhancing each organization's efficiency in stakeholder management in the B2B collaboration?

We make an aggregated analysis of the above by discussing the following areas:

- Requirements and specification for collaboration patterns
- Information flow and needs
- Expectations of the platform users concerning value creation, and demands on the platform
- Key mechanisms impacting on long-term sustainability of a B2B-platform

5.1 Childcare Furniture Use Case – Micuna

5.1.1 Overall purpose

The Childcare Furniture Use Case comes from an international company operating on markets around the world. They need a rich and reliable matchmaking database including international members in the value chain representing different native markets for enabling a faster and high quality adoption of knowledge into products offered to the specific national markets. The platform aims to be a link to a new market as a facilitator to identify collaborative "native" partners for the product development, production and logistics. The collaborative partners identified through the platform will facilitate the company's adoption of the e.g. cultures, norms and legislation in the specific and unique national markets. The company also needs access to a database with updated legal requirements attached to different parts of the value chain. This database needs to include critical information from national and international legislation enabling fast and quality assured knowledge transfer from authorities and certification bodies to the company, and as such provide easier acquisition of relevant and reliable information on norms and regulative requirement in specific geographical areas. In addition, the platform also needs to include product catalogues for enabling identification of collaboration potentials along the value chain. Further, the platform needs to include mechanisms for enabling negotiation opportunities with different partners on the platform, i.e. mechanisms enabling reaching of collaboration agree-

ments. Expanding the business to new international markets is difficult and requires fast adoption of new knowledge where the development of an international ecosystem facilitates the potential of successfully exporting products to new markets where the business and products is adjusted to wants, needs and requirements in the specific market. In line with this, the use case vision is to facilitate collaborative supply partnerships and increase innovation capabilities by finding providers of required materials and operations which contribute to improvement at different levels (i.e. operational costs, ultimate quality).

Figure 2. Workshop at Micuna.

5.1.2 Collaboration model framework

Problem statement: The context of the collaborative business environment

The environment is characterized as international. This use case describes a situation where the company e.g. expands to new markets and is in need of new collaboration partners in the supply chain, for instance in need of "native" suppliers, sub-contractors and logistic partners. Companies expanding to new markets do not have established partners of their own and finding established partners is a time consuming process, particularly for a SME. The furniture sector, as many other sectors, is characterized by its high percentage of SMEs and one of the limiting factors of SMEs is their weakness in moving from being local or national suppliers to becoming export companies. The different rules and regulations in other countries often make it too hard to work out new supply chains and logistics for export. When it comes to exports, a manufacturer like MICUNA has to manage different manufacturing processes for essentially the same product, because country-specific regulations demand different production steps, different use of materials and subsequently, different logistics chains.

Support for collaboration

To illustrate the value provided by NIMBLE we outline the problem to be solved for the use case company. NIMBLE may support SMEs in breaking barriers when entering into new markets. Many SMEs currently operating on international markets or aiming at new markets have limited networks and resources to identify "native" collaboration partners. NIMBLE should support match-making, and enable companies to identify high qualitative and relevant collaborative partners such as suppliers, sub-contractors and logistics partners. Thereby NIMBLE will enable companies to navigate more

smoothly in new markets. The platform itself should act as a "marketplace" for collaboration partners in different countries, for instance as in this case within the ecosystem of the furniture industry. The platform retrieves a list of companies that matches the search parameters provided. Then, the company is able to filter the results and compare different providers. The NIMBLE platform will also make the negotiation with partners in different countries smoother through supporting the process of reaching agreements. Also, manufacturer and selected provider negotiate the order conditions through the platform. This includes the exchange of needed documentation via file sharing and provision of a messaging system or platform inbox to discuss further details. Further, NIMBLE will enable adaptation of product specifications and manufacturing processes according to regulations and norms for each market.

In sum, NIMBLE expects to contribute to more efficient processes in production, for instance in prototyping new products adjusted to particular markets and hence result in cost reductions.

The use case seeks to facilitate SMEs' entry into international markets. Decision-making takes place in environments with high uncertainties in terms of unknown cultures and limited knowledge about national regulations. Decision-making is also related to high complexities in how to deal with contingency factors in the new markets, i.e. factors unique for the markets. Culturally and legally anchored information critical for the company's business in specific counties is acquired through external collaboration partners. An efficient exchange of information and knowledge would improve the decisions-making for the company operating in global markets. Information and knowledge exchanged will be integrated in the product development processes and may as such provide faster innovation but also assure the offering of high quality products adjusted to the specific market needs. NIMBLE is required to assist SME management in their decision-making through enabling match-making for knowledge transfer between native collaborative partners and the companies. NIMBLE is also required to support decision-making regarding negotiation and reaching of agreements between partners. Finally, NIMBLE is required to provide updated information on legal issues critical for the SMEs when operating in different countries.

NIMBLE enables development of global networks that assure knowledge transfer; i.e. exchange of proprietary information and knowledge critical for the SME. This increases efficiency in transactions of relevant and reliable information. It also assures for exchange of service and products between key actors. NIMBLE facilitates for SMEs to gain access to e.g. manufacturers, providers of required materials and operations, which it cannot cover by its own resources or which it aims at improving along different dimensions (i.e., operational costs, ultimate quality). NIMBLE is as such used as a resource in the bridging of knowledge and information, as a channel for collaboration and as a customer channel. NIMBLE is used as a resource for acquisition of human capital (stock of knowledge and absorptive capacity by the company), social capital/ relational capital (exchange and knowledge transfer) but also structural capital through the provision of negotiation mechanisms and documentation as well as updated information on regulations and legislations. Managing and using human capital knowledge well will enable a better understanding of activities and their outcomes and improve future performance e.g. in terms of increased product quality as well as for attracting resources and customers. Knowledge about cultures and legal conditions for products offered and insights in potential design improvements enables the product development function to improve future exploitation of high qualitative products. The social capital may include both loose ties e.g. distant relationship for less complex exchange and close ties e.g. based on close relationships for complex exchange. The platform enables SMEs moving towards a decentralized information management adjusted to needs and wants in the specific country. NIMBLE reduces the amount of resources needed for acquisition of resources (human capital and social capital) and for exploitation of offerings. The structural capital provided through NIMBLE enables knowledge to for instance captured, structured, transferred, stored and made available for work in the product development function, in the production and in the marketing department.

Collaboration tool/ offerings

NIMBLE should be used as a tool to facilitate B2B collaboration between companies operating on a global market. Information introduced in the platform should have a public and a private side, offering

the potential of sharing the information of the private side only with selected potential collaborators or publicly.

From this use case we identify the following;

- Match-making between companies operating in global markets, enabling identification of relevant and reliable collaboration partners. NIMBLE includes an ecosystem of key actors in the particular sector and also includes information about certifications of their members. The platform would retrieve a list of companies that matches the introduced parameters. Then, the company would be able to filter the results and compare different providers. Offering relevant matching-partners decreases uncertainties for the non-native company to operate in the market. Once technical characteristics of required material or component are defined, the company enters NIMBLE and searches the ecosystem. NIMBLE retrieves a list of companies that matches the introduced parameters. Then, the company is able to filter the results and compare different providers. To have a first contact with selected candidates, a remote session with voice, video, chat and sharing documents capabilities is arranged through NIMBLE. The company performs another internal evaluation of the provider before making a final selection for the specific needs of supply, this to find adequate supplying partners to reach production objectives or to improve current supply chain.

- NIMBLE should develop mechanisms to negotiate with known and new production partners through the platform achieving collaboration agreements with different collaboration partners. The manufacturer should be able to include the provider in the ERP system if missing. Manufacturer and selected provider should be able to negotiate the order conditions through the NIMBLE platform. This allows the exchange of needed documentation via file sharing and provision of a messaging system or platform inbox to discuss further details. Manufacturer and supplier negotiate all aspects of business conditions. First, financial and delivery terms are agreed. Then, technical aspects are reviewed to ensure the needs are properly fulfilled. Other areas of agreements may also be included. NIMBLE must be based on mechanisms assuring for trust, offline activities with permission to get access to companies such as Micuna's information regarding, contract, prices etc.

- The compliance of destination to native norms may lead to significant changes in product design, selection of materials or manufacturing processes for the manufacturing company. NIMBLE should include and assure for exchange of information and knowledge in the area of norms and regulations in order to facilitate and accelerate the information acquisitions for manufacturing companies by using systems for surveillance and knowledge management, this to provide faster adaptation of processes through an agile and effective awareness about normative and legal issues in new markets. This should be assured in two ways:

    1. Through collaborating with new and established partners with high competence, found through matchmaking where negotiation also has taken place. The environmental complexity involving new norms, cultures, legislations and regulations should decrease through the collaboration where the native provider offers native knowledge and ensures quality requirements and legislative issues in the specific country. These partners are also well acquainted with customers' needs and preferences in their country. Collaboration with different critical native providers decreases both uncertainties and complexity in the company throughout the whole supply change, and thus facilitates decision-making and brings forth efficient and high quality operations.

    2. NIMBLE needs to include all critical information on the norms and regulations needed in the destination country regarding the goods the company wants to export and/or bring to a new market. Agile mechanisms should be developed that pay attention to critical normative aspects related to specific products in destination countries. In the case of Spanish furniture producers, such a service is provided by AIDIMME. Companies can access the AIDIMME "Technology Surveillance and Knowledge Management System" to consult

about normative and legislation related to specific products they want to produce or request. This system maintains a structured repository of information related to normative and legislation in the furniture industry in Europe.

- Publication of product catalogues in NIMBLE enables identification of potential partners in the value chain while it simultaneously renders visibility and provision of updated information. NIMBLE should offer agile and user friendly mechanisms to publish and retrieve products from the catalogue published in the platform. NIMBLE should also offer mechanisms to keep the product information in the catalogues updated. A user-friendly template should be used. More detailed product information should also be available depending on the nature of the product, this to allow for a detailed search enabling easy identification of the well categorized products displayed in the platform. Necessary data allowing for product categorization should be introduced and checked before being published in NIMBLE.

- NIMBLE should offer a market channel for both new and used products aimed for recycling. Such an offering would make corporate social responsibility visible, as well as requesting accountability for such matters. When the customer no longer uses the product, they can contact the retailer and proceed in two alternative ways. The platform enables facilitation in managing the product End-Of-Life (EOL) for instance through:
    1. Managing recycling of products used by customer, enabling the option for the manufacturer to re-use some product components.
    2. Offering a market channel for renovation of the used product (e.g. replace the cot by a child's bed), at a discount in the new product and support in the furnishing of the room. More specifically the retailer informs the manufacturer about the product EOL, so this opens up the option of offering a renovation to the user, receiving the used product and offering a new one at a discount, arranging this contact through NIMBLE.
    3. Offering a service for mediating of products , in this case used furniture from the retailer or manufacturer to be donated to NGOs and charitable organizations, to give products a second life.

Collaboration through interaction processes

A central part of the collaboration is the aspect of visibility for the different collaborating partners involved and what different partners may provide into the interaction, e.g. in terms of information, knowledge, product and services. Collaborative interactions with manufacturing may involve visibility and interactions connected to different functions and departments: Production departments, Sales departments and Product development department. Potential manufacturers may receive higher visibility among providers through NIMBLE, benefiting the manufacturing company. Moreover, external key stakeholders involved in the value chain who will also benefit from the service offerings at NIMBLE are for instance:

- Suppliers and logistic partners get the opportunity to be part of an ecosystem and to present their product and service offerings on the platform, thus gaining access to new customer segments and new markets. NIMBLE becomes a new market channel for such companies.
- Retailers can gain access to showcases of manufacturers and products to fill their stores for customers. Retailers may gain access to a larger number of manufacturing companies and also to gain more information on the products and service offerings.
- Authorities and certification bodies receive improved visibility among the manufacturing companies in need of updated knowledge about relevant and reliable information on norms and regulative requirement in specific geographical areas. This makes it easier for such authorities to assure that regulation and legislation is followed.
- Particularly standards setting organizations will be required by manufacturers, providers and logistics operators to obtain required certifications. Specification bodies receive more custom-

ers and the platform provides opportunities for new business models and market expansion for such bodies.

- Non-Governmental Organizations (NGOs) and charity organizations gain access to new types of charity offerings. The donations of used products also get more visibility on the platform. New types of organizations get involved in the expanding supply chain assuring for corporate social responsibility and sustainability. This type of organizations manages the distribution of donated products and becomes as such stakeholders and users of NIMBLE. The platform enables development of capabilities to manage the EOL of their products, thereby saving time (easy to contact parties to take charge of these products) and more easily finds the adequate "evolved" product they need. Customers contact the retailer for both, getting rid of the not-used product for a second life, or negotiate a product renovation with the manufacturer. Retailers may also find adequate supplying partners and the EOL management, which enables retailers to add services to customers such as reparation and re-collecting and assuring re-use of products.

5.2 Textile Manufacturing Use Case – Piacenza

5.2.1 Overall purpose

The Use Case Textile Manufacturing wants to build close relationships between fabric designers and clothing stylists, since they are aiming for more customized production of their exclusive fabrics. The adoption of virtual prototyping tools would make possible this tight collaboration, and lead to a fully virtual clothing design, which would greatly increase the speed of both design and production processes. In sum, design proposal quality, flexibility in production and delivery, and also service and quick responses to customers' needs are critical to build added-value and overcome cost pressure. NIMBLE should be a platform for a fast and reliable data exchange service, based on IoT, M2M and B2B data transfer. Piacenza want the platform to act as a place where textile industries can monitor and exchange data of several types. They reason that the main value of the platform is found in its standardization, which would allow companies to interact with new customers/suppliers (mainly B2B), without having to set up a new channel (and format) of communication or to use their legacy systems. They would find all the data needed through the platform.

Figure 3. Workshop at Piacenza

5.2.2 Collaboration model framework

Problem statement - The context of the collaborative business environment

The use case is situated in an innovative working environment with a focus on product development, or more specifically on textile design. Today, it is vital for the company to be able to react better and faster to market changes in the supply chain (SC), to exploit the flexibility of the production for fashion. It requires a close relationship between fabric designers and clothing stylists, since they are aiming for more customized production of their exclusive fabrics. There are over 400 suppliers involved in the supply chain process. Many of these are SMEs with limited ICT-resources. In the textile sector, the origin of the supplies and ethical issues are of importance. Customers are demanding for instance proof of water recycling, hence the company needs to demonstrate that the production is environmentally "safe".

Collaboration between the actors (both suppliers and customers) in the SC is mostly based on close relationships that build on trust and an information-sharing culture. The customers (designers) have a great impact on the company's products (customer-made products) so there is a need of a collaborative tool that supports collaborative processes that promote agility and value-creation, enabling environments for business collaboration.

Support for collaboration

To illustrate the values provided we outline the problem to be solved for the use case company. Many SMEs in the SC have limited software to maintain an exclusive environment; the use of NIMBLE would be a tool that facilitates collaboration between the internal production and the external designers. NIMBLE should be a platform for a fast and reliable data exchange service, based on IoT, M2M and B2B data transfer. The platform itself should act as a place where textile businesses can monitor/exchange/give data of several types. Since there are many suppliers, NIMBLE should support an integrative environment for many software products. The suppliers themselves must not be required to change their software.

The use case seeks to facilitate and make efficient, the decision-making regarding product development processes, for faster innovation. NIMBLE is required to assist and ensure the accuracy of rich information and communication between actors, facilitate exchange of ideas in virtual designs, and decrease the workload associated with its use. Of value is the traceability of all production actions in the SC and to provide, easily and quickly, those data to the customers, with real time granular monitoring of production flow; to provide real time, accurate forecasts of machinery and product availability.

In collaboration, building networks are important. In this use case, networks are based on relationship exchange, close relationship between designers and the company, intended for fast design development. Networks are already established prior to the use of NIMBLE, trust is already established between the SC actors. NIMBLE is used as a resource in the design development process by sharing documents such as CAD documents and catalogues. A dynamic, real-time access to information is crucial in order to decrease the time for information exchange and collaborative design work.

Collaboration tool/ offerings

At present, in the fast evolving textile and clothing market, actions to answer unpredictable demand must be taken very quickly and this requires a high level of diffused collaboration. This is only possible with data sharing, standardization, trust, and privacy and confidentiality preservation. The main value of the NIMBLE platform is seen in its standardization, that would allow companies to interact with customers and suppliers (B2B), without having to set up a new channel (and format) of communication themselves, each using their own legacy systems. They would be able to find all the data needed through NIMBLE. Collaborative tasks in this use case concern both standard and non-standard, routine and non-routine, production data and design information; data transferred non-real-time and real-time access. The following requirements are central:

Collaborative design and production: Virtual catalogues and services, a dynamic, real-time access to supplier virtual catalogues and services is intended for fast design development. The company shares its catalogue online with potential customers

IoT machine connection and data elaboration: The user shall be able to access real time data at machine and product level, exploiting IoT and M2M-data.

Automatic origin certificate declaration: Using NIMBLE, a company can re-collect real time machine data at the end of the production run and produce automatically the preferential origin certificate declaration.

In this collaboration model the tasks are relatively structured with stable goals (e.g. in terms of the order in which tasks are completed, or how). It is important thus to ensure clear, measurable boundaries for the tasks which the team members are individually and collectively responsible for, and avoid redundancy.

Collaboration through interaction processes

One view on collaborative working is that individuals and teams are part of a collaborative working environment within which they engage in interaction processes: learning, coordination, communication, and decision making.

The platform enables development of a learning organization by rapid exchange of information leading to valid decisions in the design and production process this making innovation cycles faster. NIMBLE should support a fast and reliable data exchange service, based on IoT, M2M and B2B data transfer. The platform itself should act as a place where textile industries can monitor/exchange/provide data of several types.

NIMBLE supports communication with selected value chain actors e.g. designers and customers. The more the right information is conveyed to the right people at the right time in the most appropriate way, the more effective collaboration will be. Distributed collaboration technology may better support actors with various communication skills, giving an overall broader range of views and knowledge. Some decision-making in the SC is about design proposals. Decision making in collaborative work is more likely to be naturalistic, relying on a blend of intuitive and analytical processes.

We can conclude that the collaboration model in this use case is based on an already existing network of value chain actors (suppliers and customers). Relationships are built and *overarching factors* such as values and trust are already established prior to the use of NIMBLE. Trust is both personal/informal and impersonal/institutionalized; a climate of trust enables people to engage in business with each other, and is of high value to an organization or a business. Distributed working may make it difficult to develop trust among actors, but there is evidence that exchanging social information via interactive chats can make a start at establishing trust, indicating the importance of personal contacts. The challenge in collaborative working is to encourage computer-assisted collaboration at reasonable levels of security. The quality of shared physical and/or virtual spaces may motivate people to collaborate with each other.

NIMBLE will make it easier to create more dynamic, real-time access to suppliers' virtual catalogues and will be an incentive for fast design, manufacturing, product traceability and real time monitoring of production and provide customers with information about their orders and deliveries, automatic origin certificate declaration, including ethical and environmental fulfillments.

In sum, the collaboration requires a close relationship with designers and suppliers, quick responses to customers' need are critical to build added-value and overcome pressure of prices. This can be achieved by a shift to virtual design that brings fabric and cloth producers closer together. Also, virtual design will provide the possibility to exchange specifications and preview of the order without physical sample.

5.3 Eco Houses Use Case – Lindbäcks

5.3.1 Overall purpose

The use case of Eco Houses wants to establish new logistics chains, and improve monitoring of transport and on-site construction, in order to ensure that reliable quality information of supplier's products from the construction sites get transferred back to the organization. A major benefit will be the simplification of data handling. This is currently dominantly operated manually, involving many parts of the value chain and also many different tasks. Today the company handles many different types of documents that are in different formats (e.g. spreadsheet tables and documents), and in different systems. There is a need for making information more transparent and structured, and better to analyze. Also, along the value chain it is important to be able to keep track of changes that may affect the end product. The supply chain of the use case would be improved by seamless connection between the manufacturing company and their supply chain actors. All suppliers and logistics partners should be able to publish ordering information (e.g. invoices) and specification documents for direct B2B information exchange. This use case also needs sensor data (IoT) in modules that cover the processes / stages of production, construction and after sales. The data should be enriched by an "Analysis Supplier" with expertise in eco houses to transform plain data for knowledge transfer (e.g. usage conditions based on relative humidity and temperature, or leakage to a distinct alarm in a specific area).

5.3.2 Collaboration model framework

Problem statement - The context of the collaborative business environment

The environment is characterized as national, and the use case is expanding its business rapidly with a new production site. The new plant will have three times the capacity of the current one and hence will increase the amount of data and information that must be handled by the production, suppliers and third party transport actors. This expansion calls for new information management in the supply chain and a need for transforming manual work into a digitally automated flow. It is no longer possible for the organization to keep track of all the information manually. There is a need for new information structures to keep track of the right information in the right place and to provide it at the right time to reduce redundancies in the product and information flow.

Support for collaboration

NIMBLE is expected to support the simplification of information management in the supply chain. It will particularly support seamless connection between the manufacturing company and their stakeholders in the exchange of information and knowledge for manufacturing modules in the industrialized construction of apartment buildings. NIMBLE will also support tractability throughout the value chain related to PLM approaches. NIMBLE will support a more private relationship and knowledge transfer between the company and their stakeholders.

Collaboration tool/ offerings

NIMBLE should be used as a tool to facilitate B2B collaboration for quality assurance and long-term traceability of the parts in a product (in this case a bathroom module). A specific characteristic for this market is that the product, i.e. the building, has a long expected lifetime. Information introduced in the platform should have a private side, offering the potential of sharing private information only with selected potential collaborators. Stakeholders with an interest in the data need to be verified to get access.

NIMBLE aims to offer effective and supportive tools for:

- Enabling consolidation of information from different sources in order to make information more analyzable and traceable.
- Keeping track of changes in the supply chain occurring from suppliers, customers and the internal organization. For example, deviations that occur are registered and connected to specific

parts to make possible analysis and finding a root cause of perceived problems (parts and processes).
- Offer potential for reactive changes in the manufacturing process through relevant feedback, e.g. based on critical incidents that may receive sever consequences.
- IoT-sensors for collecting information that can affect the product, e.g. measurements of temperature, humidity, leakage and energy consumption.

Collaboration through interaction processes

A central part of the collaboration is the aspect of traceability and accountability for the different collaborating partners involved and what different partners may provide into the interaction, e.g. in terms of information, knowledge, product and services. Collaborative interactions may involve different functions and departments: internal actors are from Sales, Project managers (responsible for building project), and Factory management. Moreover, external key stakeholders involved in the value chain should also benefit from the use of the service offerings from NIMBLE , in this case for instance suppliers such as Podcomp. Third party stakeholders may need information/data from NIMBLE, e.g. insurance companies. Use of IoT-solutions can be used for decreasing risks for insurance companies and hence offer lower insurance fees for customers of houses.

Figure 4. Workshops at Lindbäcks Bygg.

5.4 White Goods Use Case - Whirlpool

5.4.1 Overall purpose

The main objective of the White Goods use case is to improve the flow of information from their customer service and field service back to the internal supply chain organizations. The adoption of structured feed-back mechanisms aims to deal with quality problems identified by the field service in order to improve product design. A B2B platform would in this case improve the flow of knowledge in both directions of the value chain, and hence lead to increased efficiency, higher quality, decreased costs and faster innovation. They wish that NIMBLE should be a place for fast and reliable exchange of different types of critical data. The use case focuses on the collaboration between a company and the external third-party SMEs offering field services to end customers. The use case exemplifies services that may be provided involving a complex relationship between larger and smaller companies collaborating on a multi-sided platform. The platform provides value through enabling the company to standardize the information flow and knowledge transfer between external and internal actors.

Figure 5. Workshop at Whirlpool.

5.4.2 Collaboration model framework

Problem statement - The context of the collaborative business environment

The White goods use case focuses on improving the collaboration potential in the aftermarket, particularly the collaboration with service-technicians. The case company is in need of a service that enables them to receive feedback from the many service technicians in many different countries for product development and to solve the problems identified, for future products. Service technicians are the ear to the service market, operating close to the customers in all possible locations. This helps to increase the quality of the products. Access to aggregated data and hence analysis of relevant data for product development aims to improve the design knowledge about the product and enhance the internal diagnostic and prognostic capabilities. The vision of the use case is to achieve a collaborative environment where it is possible to share, in a correlated way, product quality data coming from different sources. This would allow actors involved in the Product Lifecycle to improve their capability to take decisions that have impact on product quality. Currently there are many data sources and data in different format. The organization has a fragmentation in heterogeneous systems and information islands. They have a wish that all information will be accessible from one single user interface, e.g. that the user will access the system inserting the serial number of the product and thereby retrieve, in real time, all the information associated to it.

Currently, the collaboration between the external and internal actors is fragmented, with loosely coupled islands of information attached to the specific products. The organizational structure for collecting information from the many service-technicians involved is highly complex due to the large number of technicians, operating in different countries, in different markets and where the companies offering the service in many cases are SMEs. There are currently no solid feedback mechanisms that can deal with the issue of bringing together all relevant information for further analyses and correction in the value chain. There is for instance a loosely coupled information flow on quality failures into the product development department. Knowledge gained by the field technicians are not efficiently fed back to product development and manufacturing so that they can take countermeasures when a recurrent defect is reported. Manufacturing experience and quality findings are not effectively fed back to product development to recognize potential weaknesses of the product, nor is it fed forward to customer service in order to recognize potential failure causes and prepare in advance for their resolution. Further, design knowledge about the product is not effectively transferred to customer service in order for field technicians to enhance their diagnostic and prognostic capabilities. This causes higher warranty cost (e.g. substituting the whole machine instead of a single component).

The exchange between the external service technicians and internal departments will primarily be of a transactional character rather than a relational character. Focus is on the transactions of data and information without face-to-face interactions.

Support for collaboration

Many SMEs in the SC have only limited access to software for data and information management to report quality failures into the design, production etc. of new products. The use case exemplifies the complex relationship between larger and smaller companies collaborating on a multi-sided platform. NIMBLE will improve the flow of knowledge in both directions of the value chain, leading to faster innovation. The use of NIMBLE will provide a tool to facilitate collaboration between the internal functions and the external function of service technicians with the ear to the market failures. There is a large number of actors to be involved, a large number of potential errors to be captured and the decision-making in organizations are hereby characterized by high complexity with high problems of information overload. This requires a tool for enabling systematic adoption and analyses and sorting of information. Such an approach would facilitate and make efficient quality in decisions-making in product development processes, production and in other parts of the value chain and by this assure for faster and quality assured innovation. NIMBLE will enable the manufacturing company's information management to become more structured and centralized, helping key actors in decentralized units of the internal organization to make more efficient decisions.

Information communicated by the service technicians to the product development outlines a routine task. Unpredictable tasks by the product development functions become predictable through the analyses of actual product deficiencies and improve the ability to prognosticate and improve products in the early design phase. The task is devoted to low complexity in information exchange with highly specified information for exchange. The diagnostic work is made more automatic and this will decrease the diagnostic work by the developers. A higher focus may thus be towards the product development and finding of solutions.

NIMBLE should offer a resource for acquisition of quality information collected in the aftermarket to be used for the development of new products with increased quality features. The platform will thus provide resources for product development and decrease the time needed for information gathering. Knowledge about current errors in products offered and potential design improvements enables the product development function to improve the company's future exploitation of high qualitative products. NIMBLE supports the manufacturing company in that knowledge is captured, structured, transferred, stored and made available for work in the product development function. Moreover, NIMBLE enables the collaborative partners to establish a culture of knowledge sharing. NIMBLE supports the development of clear guidelines, policy, information and documentation processes through organizing the communication between the partners. Highly structured mechanisms for exchange of information and knowledge assure that the service technicians are aware of the information they should communicate / exchange with the manufacturing company.

Collaboration tool/ offerings

NIMBLE will facilitate B2B collaboration between companies operating in different parts of the value chain since NIMBLE offers coordination of information flow from, in this case, the external service technicians to the internal platform.

The information structure in the exchange with external service technicians will be relatively fixed with clear instructions on information needs. The task structure will be simple, involving highly structured and fixed information that can be easily be uploaded and communicated by each service technicians in the field. Exchange through a single point of contact will avoid duplication of work, with the help of a user-friendly product-avatar. The NIMBLE platform will provide the front office (single point/Avatar) and connect it with the back office (e.g. for regression analysis). This will be further elaborated on below.

The NIMBLE platform aims to offer effective and supportive tools for:

- Offering quality assured analyses of errors in products and different parts in the supply chain in order to bring such information into companies' decision making. Regression analyses based on data from the field technicians should be correlated with production-recorded data (e.g. on-line test, functional tests, statistical quality check etc.). Correlation of issue(s) from fields to manufacturing process shall be realized using customer-driven input and quality data inside the processes.
- Offering a product Avatar for easy access to data, information and analyses from a single point, i.e. the NIMBLE platform, assuring for smooth exchange of information and knowledge sharing. The avatar should cover all critical product quality related information from one single user interface: the user will access the system inserting the serial number of the product and will retrieve in real time all the information associated to it.

Collaboration through interaction processes

The vision is to achieve a collaborative environment to share in a correlated way product quality data coming from different sources, allowing actors working with the Product Lifecycle to improve their capability to take decisions impacting on product quality and leading to reduced failure rates in the marketplace, increased effectiveness in product field failure resolution, and, in the long run, an improved overall quality perception from the market with a consequent increase of the market share.

The collaboration in this case through NIMBLE is characterized by distance relationships between key functions and actors in the value chain. The collaboration is primarily based on transactions while there is a limited focus on relationship exchange. The information exchange is characterized as formal, synchronic and non-verbal/ written or based on figures/numbers. The collaborative interaction processes improve structured processes of learning in-between the partners through knowledge transfer. Learning is here an iterative process for both partners and the feedback mechanisms also assure for double loop learning. NIMBLE enables development of a learning organization by limiting deficiencies in product and by enabling increased quality. The product development department learns from the external field technicians and the external field technicians learn from the product developers. NIMBLE enables improvement of the decision-making capability both among internal and external partners. The collaboration through the platform improves the flow of communication; the right information is conveyed in the SC to the right people at the right time in the most appropriate way. NIMBLE enables developing and coordinating a communication channel that currently does not exist. The collaborative interactions on NIMBLE assure as such for increased absorptive capacity by actors involved in the collaboration interactions.

NIMBLE enables decreasing the workload for the internal product development through automatic information collection and analyses. This while increasing efficiency in transactions of information between a large number of service technicians representing a large number of SMEs and the big company.

The internal organization that is involved in the process of collaboration is:

- ***Marketing***: transforming the needs of the consumer into product concepts
- ***Global Product Organization***: research, product development and procurement
- ***Manufacturing***: transforming raw materials and components into products
- ***Supply Chain***: distribution of the products to retailers and customers
- ***Customer Service***: managing post sales operations including field service and spare parts.

In particular, data and knowledge sharing from customer and "field service" are not fully integrated yet. In many countries a third party carries out the "field service".

We can finally conclude that NIMBLE aims to offer a potential for commitment and accuracy in decision-making by actors in the product development function. Regression analyses provides analyses based on a complex information base (much information, on different product errors, reported by many different service technicians in different geographical areas etc.) that is communicated in a user friendly way through the avatar.

5.5 Relevance to NIMBLE initial micro-services

This section summarizes the use case information from D1.1 and D2.1. The summary describes the services looked for by the use cases and how the services relate to the initial NIMBLE micro-services.

The micro-service offerings are all outlines offerings in the NIMBLE business model. All micro-services related to each one of the use cases are presented in Table 3. The purpose is to identify current NIMBLE offerings and potential future offerings asked for by the use cases (analyses will be made). These micro-services were discussed in a meeting in Valencia.

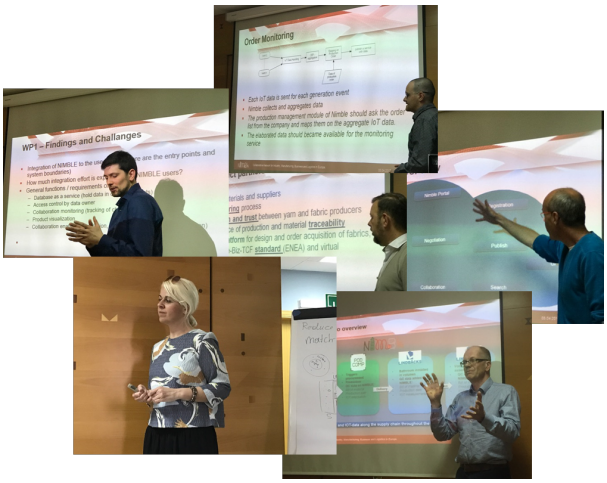

Figure 6. Sense-making in Valencia.

5.5.1 Childcare Furniture Use Case – Micuna

The main capabilities required from this use case revolve around **publishing** catalogues and being able to search through existing information in a helpful manner. The expectation for companies is to be able to publish their catalogue dynamically through NIMBLE, and have other entities being able **to search and browse** through published catalogues in a guided manner. The guided manner should support for example relevant taxonomies and ontologies, potentially presented as multiple facets through which a user can interactively narrow his search space. There should be various characteristics by which to filter or narrow the search scope, such as reputation of the counter-party.

Provider search: The manufacturer aims at finding providers of required materials and operations, which it cannot cover by its own resources or which it aims at improving along different dimensions (i.e., operational costs, ultimate quality).

Negotiation: Manufacturer and supplier negotiate all aspects of business conditions. Firstly, financial and delivery terms are agreed. Then, technical aspects are reviewed to ensure the needs are properly fulfilled. The manufacturer includes the provider in the ERP system if missing.

Awareness of normative and legislation to enter new markets: A company is interested in entering a new market to export products. To that end, it needs to know all the regulations needed in the destination country regarding the goods the company wants to export. The compliance of destination normative may lead to significant changes in product design, selection of materials or manufacturing processes.

Publication of product catalogue: A company publishes part of their product catalogue in the platform, in order to be visible to other supplier and manufacturing companies for doing business or estab-

lish collaboration relationships. Information introduced in the platform may have a public and a private side, sharing the in-formation of the private side only with selected potential collaborators.

Product End-Of-Life: A company is interested in managing the product End-Of-Life (EOL) and this can be done with two approaches. On the one hand, the manufacturer aims at offering a renovation of a used product (e.g. replace the cot by a child's bed), at a discount in the new product and support in the furnishing of the room, while on the other hand, some products can be donated to NGOs and charitable organizations to give them a second life.

5.5.2 Textile Manufacturing Use Case - Piacenza

NIMBLE suggests the publisher/subscriber pattern for a B2B **communication**, which is an appropriate solution for most software infrastructure in which a component should communicate with others. The other communication service that the use case needs to adopt for the **Monitoring Scenario** is the IoT functionality of NIMBLE. In the FITMAN project Piacenza implemented a monitoring system for some departments and machines integrating the FITMAN component respect the FIWARE NGSI Context Management specifications.

Collaborative design and production: Company A (e.g. a fabric supplier) can share design or production data with company B (e.g. its customer, a clothing producer). The latter can modify and exchange again the data. Data changes must be tracked and available for all eligible users.

Virtual catalogues and services: A dynamic, real-time access to supplier virtual catalogues and services is intended for fast design development. The company shares its catalogue online with potential customers. On the other side, the company logs into the portal and gets access to the supplier virtual catalogue with just a few clicks. Publication of catalogues must be managed very carefully, because usually the fabric catalogues are not available to everyone, for copyright reasons.

IoT machine connection and data elaboration: The user shall be able to get access to real time data at machine and product level, exploiting IoT and M2M scenarios. The data are expected to come from plug and work sensors integrated into the machineries and processed at factory level to produce information about, for example, the order status and forecast a shipment date.

Automatic origin certificate declaration: Using NIMBLE, a company can re-collect real time machine data at the end of the production run and produce automatically the preferential origin certificate declaration. To the latter, the platform will be able also to add information about the ethical and environmental fulfilments of the company.

5.5.3 Eco Houses Use Case - Lindbäcks

The main motivation for this use case is to improve the supply chain by connecting stakeholders and data from throughout the process. Lindbäcks need to keep track of the original design of all produced units, along with the individual changes applied to each individual unit. The main purpose is to add quality and **IoT-data** along the supply chain throughout the lifecycle, from design to maintenance. All data and changes should be **traceable**, and proper notifications should be sent when changes occur. All access to data should be governed by proper authentication and authorization.

Product configurator: The customer of bathrooms is able to make changes on the features and properties of a bathroom that will be part of the flat in a future eco house. This will be realized by a bathroom product configurator.

IoT Measurements in bathrooms: Measurements of temperature, relative humidity (RH), leakage and energy consumption, as well as measurements of the conditions of the modules in the end-product (finalized building) and product lifecycle management.

Tracing components and adding QC (Quality Control): With the traceability of single parts up to modules the supply chain should gain substantial increase of quality in the end-product (finalized building). As well closed-loop product lifecycle management shall be realized via information about production processes inside of the product (e.g. NFC/RFID chips as a carrier of data).

5.5.4 White Goods Use Case - Whirlpool

NIMBLE is expected to provide unified access to information about a specific product combining data coming from different and separated data sources. Search and data analytics services are expected to accompany this capability.

Collect and correlate data coming from different sources, to enrich relevant information, and ensure proper dispersal of that information. Lifecycle Management of data and the Product Avatar services will mainly be exercised by this use case.

Regression Study: Issues from field are currently not correlated with production-recorded data (e.g. on-line test, functional tests, Statistical Quality check etc.). Correlation of issue(s) from field to manufacturing process shall be realized using customer-driven input and quality data inside the processes.

Product Avatar: Recover of all product quality related information from a single point.

Below follows a summary of the use cases and their contribution to micro-services. For detailed information about the micro-service content, see section 5.5.5.

Table 3. A summary of the use cases and their contribution to micro-services.

Micro-services	Childcare Furniture	Textile Manufacturing	Eco Houses	White Goods
Identity	X	X	X	X
Search	X			
Publish	X			
Catalogue	X	X		
Communication		X	X	
Negotiation	X			
Matchmaking		X		
Business Process		X	X	X
Product Lifecycle	X	X	X	X
Data Sharing Service			X	X
IoT Data Processing		X	X	
IoT Analytics				X

5.5.5 The NIMBLE Concept and Micro services

The NIMBLE main initial concepts consist of services focusing on collaborative and functional aspects that embraces suppliers manufacturers, service providers, retailers, logistics providers, software providers and cloud service providers, with the aim to cover phases such as: subscribe, publish/search (e.g. publish products or services, or search for potential partners, products, and/or services), negotiate

and execute collaborative tasks while monitoring and controlling the execution of agreed collaborations. More details are given in D3.1.

The Digital Collaboration Marketplace is composed of a stack of business collaboration applications. The application hierarchy has three levels: business-, operational-, and object-level applications. Users access the collaboration platform via the business level applications. The Digital Collaboration Marketplace will offer a set of analytics applications and will be driven by the project use cases. The Big Data Toolset will develop analytics applications for batch (e.g. for anomaly detection on home appliances based on the production data) and real-time data (e.g. monitoring of humidity in the container shipping modular houses).

Communication with IoT devices and platforms is performed by micro-services in this group. In which the IoT Analytics and IoT Data Processing Micro-service deal with analytics on collected IoT data and reception of IoT data that will be pre-processed and stored persistently. These micro services will be elaborated at later development stages of the platform.

The main goal of the **Collaborative Process Modelling Tool** is to realize a Business Process as a Service model. The application will provide ready-to-run business process constructs for supply chain operations, such as Ordering, Fulfilment, Freight Management, Shipment, Payment, etc. eventually leading to standards-based collaboration processes, such as Collaborative Planning, Forecasting and Replenishment (CPFR), CPFR-CTM (an extension of CPFR for Collaborative Transportation Management), Vendor Managed Inventory (VMI), etc. Small enterprises will be able to tailor the predefined templates to their specific needs. Collaboration between users or companies is handled by micro-services in this group. These micro-services are initially:

NIMBLE Portal Component

Frontend Micro-Service: This micro-service provides the graphical user interface. Each request from the user is delegated to the target micro-services (e.g. registration requests are delegated to the Identity Micro-service).

Identity component

Identity Micro-service: This micro-service administers identities on the platform.

Catalogue component

Search Micro-service: provides search functionalities. It communicates with the Catalogue Micro-service to get information about products and user services. It also communicates with the data stores under the hood to access to the data concerning product/service directly and to the semantic schemas for semantic search purposes.

Publish Micro-service: provides administration of product and services as well as categories used for their semantic annotation. The publishing component interacts with the data stores to get details about product categories maintained as taxonomies.

Catalogue Micro-service: stores products and services persistently by utilising Apache Marmotta (for storing semantic representations of the published items as a whole in a triple store as well as for selective storage of desired fields of the items in a free text-engine). For the time being, it also uses a relational database (i.e. PostgreSQL) for structured representation of items.

Collaboration Component

Communication Micro-service: handles communication with or between entities on the platform.

Negotiation Micro-service: negotiation between companies is augmented by functionalities of this micro-service. The Negotiation Tool will give information about company size, legal form, liquidity, experience, etc., and will use negotiation models defining what business actor to choose first, what are the side deals, is it one time or an on-going negotiation process, etc. In case of negotiation failure, the

Match-making Tool will provide continuation of the negotiation process, recommending alternative business actors.

Matchmaking Micro-Service: provides functionalities for matching companies, which are likely to fulfil each other's requirements. The Matchmaking Tool will help businesses to find suitable partners based on various criteria. NIMBLE will support horizontal B2B collaboration for particular supply chain segments (raw material provider, inbound logistics, distributor, etc.); supply chain needs (speed, reliability or flexibility), geo-graphic alignment, shared benefits along financial, operational, consumer-based dimensions; expected capability of partners (volume, skill, market access, financing, influence).

Business Process Micro-service: provides the definition of communication workflows among multiple supply chain partners and the execution of the designed process.

Product Lifecycle Micro-service: manages and analyses product lifecycle data. According to the use cases, the lifecycle data could be stored on the NIMBLE platform or provided by third party services that must be called when a set of data is required. The data and services must be accurately described with metadata to quickly find, retrieve and update them. The lifecycle data management could store or provide data in various steps and the users could retrieve them upon need.

Data Sharing Service: manages policies and rights-management for data sharing. This micro-service does not store any actual data that is being shared. This micro-service will be elaborated at later development stages of the platform.

IoT Component

IoT Data Processing Micro-service: receives IoT data, pre-processes it and stores it persistently. This micro-service will be elaborated at later development stages of the platform.

IoT Analytics Micro-service: performs analytics on collected IoT data. This micro-service will be elaborated at later development stages of the platform.

6 Opportunity Recognitions and Challenges

The following chapter identifies and explores collaboration and business model challenges and some mechanisms in opportunity recognitions and risk management for developing the NIMBLE B2B eco-system. More specifically, this chapter addresses what collaboration challenges key partners face in the development of B2B digital platform in an open innovation context in early phases. What are the core mechanisms' fostering value creations and what are the opportunities and risks in the development of a sustainable digital platform collaboration model?

Figure 7. Workshop in Valencia discussing opportunities and risks.

6.1 Opportunities

This section gives a brief summary of the value-creating interactions, i.e. benefits recognized by the use cases. What the platform does is intermediation between actors in the supply chain, at much higher volume and with much lower transaction cost, thereby generating opportunities and benefits for both vendors and buyers.

NIMBLE makes it possible to:

- Directly visualize choices of business services for communication and collaboration
- Open doors for manufacturing companies to find collaboration partners
- Reducing time for search for micro-services and collaboration partners
- Reducing delivery time (to the customer)
- Reducing information redundancy through aggregation of all the data in one place, in one format, one archive
- Reducing time to market
- Improving analytical capabilities while reducing resources for it
- Improving resource acquisition for purchasing activities (better price, quality, delivery time)
- Improving efficiency in information flows in the supply chain

- Improved communication
- Improved traceability of the communications
- Improving customer satisfaction with choice of communication channels
- Improving access to rules /legislation enabling faster adoption to targeted market
- Improving customer relationships (discounts, repairs, and recycling)
- Improving use and adoption of standards in different sectors, countries etc.
- Improving development of close customer relationships and exchange through such relationships
- Improving development of transactional exchange

In sum, the platform must provide tools to facilitate valuable interactions, and support different types of communications and collaboration activities, i.e. make collaboration frictionless.

6.2 Challenges

In a workshop, the use case partners were asked to discuss potential risks with NIMBLE. The identified risks are summarised below.

Case Lindbäcks:

- Privacy, who owns the data?
- Interface company - NIMBLE
- Trust
- Attractiveness to stay on the platform
- Standardization of 3D-models
- Combination of 3D Models into one visualization

Case Micuna:

- New Property (common understanding)
- Frontend: information about how to fill in template
- Security and privacy
- Reliability of data
- Who supports NIMBLE?
- Complex use of NIMBLE
- Logistics in EOL-management
- User involvement in EOL

Case Whirlpool:

- Unstructured message bodies not interpretable by platform users without further interaction
- Investment in services that will not be sustainable
- Data volume kills the platform (much larger than usual business objects)
- Securing the data access service
- Closed circle of participants
- Analytics intrusion
- How will the platform grow based on this use case?

Case Piacenza risks:

- Privacy: May I know information about the login of my customer? –How often he logs on, -Which articles he sees, -For how long he stays on the page
- Security: The platform may be an open door for hackers?
- The communication does not arrive or arrives late or corrupted?

The use case actors in the development of the NIMBLE-platform put forward needs for a multi-sided platform that will support different types of collaboration activities valued in their own business. These needs must be evaluated in relation to the overall aim of the platform to support standardized business services suitable for different types of companies within different industries and in various countries. Here is a summary of the initial key challenges of the development of the NIMBLE-platform:

1. The customization of services versus standardization.
2. Development of services that support collaboration and not just exchange of information. Therefore it is vital to discuss and identify what collaboration is about in the different use cases, and to plan for collaboration tools even though this type of tools was not planned for initially, they need to be further elaborated upon.
3. The type of data that will be handled by the NIMBLE-platform. There is a variation of data volumes that need to be handled, from single exchange of files to aggregated data analysis. Also, different format of data that will be exchanged must be designed for.
4. Easy to use and to adopt by the target group of users. For example if the target group is SMEs, they should not be required to have specific systems for adoption of the B2B-digital platform. The benefit of the platform will be a facilitator of interaction with actors without having to set up new channels (and format) of communication, i.e. there need to be value created for all parties.
5. The governance and sustainability of the B2B-digital platform. It is important to have external use case actors part of the development of the platform, to have access to real users, in the same time work for how the platform will survive after the project ends. Therefore, developing and evaluating different business models must work in parallel with the platform development. This to ensure viability of the platform and support the case use actors' engagement in the project.
6. It is essential to address cost and timing for new tool adoption (critical for SMEs) and different adoption barriers. Therefore, continuous test of the functions are vital during the development, and hence to develop a plan for this.

6.3 Collaboration model categories

We identify, based on the use case workshops, four initial core collaboration model categories for sorting among the initial NIMBLE service-offerings and a prototype of a checklist for further identification of critical collaboration model requirements impacting on the business model design, i.e. a map for navigation in the business model development. Indeed, managing business models relies significantly on the tacit knowledge of key actors where the business model is developed and constructed in high uncertainty (Aram & Noble, 1999). The success of business models depends on the ability to adjust the business model in accordance to critical contextual factors (Chung et al. 2004). Studies show that high-profit business models are based on clearer and more sorted structures than the low profit business models. Well-structured business models leads to more nuanced, focused, and fine-tuned actions. (Malmström, Johansson & Wincent, 2015).

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We outline four contextual factors based on analyses of the NIMBLE-project that will enable further design, development and organization of the NIMBLE's collaboration and business models. The contextual and the attached core dimensions are described below:

1. Openness in business transactions (open vs. closed). Open transactions are publicly available for a large number of actors while closed transactions are more private and selective in inclusion of actors.

2. Mode of transactions (transactional based vs. relationship based). Transactional based exchange does not involve human interactions (i.e. involving transaction of money, goods, information etc.), while the relationship based exchange primary focus on exchange based on close relationship, see Figure 8.

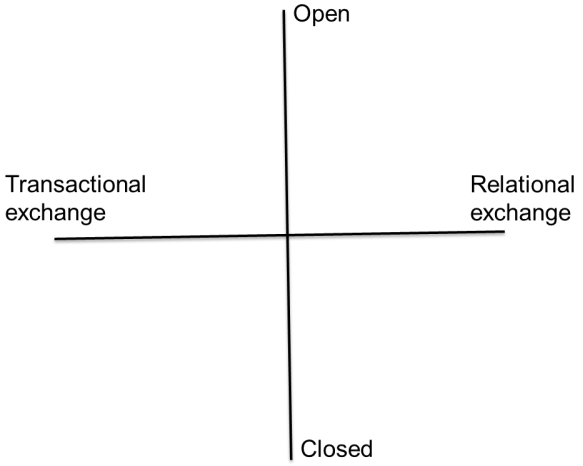

Figure 8. Core contextual factors affecting collaboration.

The model of the initial core contextual factors aims to enable recognizing consistencies and trade-offs in NIMBLE decisions, e.g. on what to offer or not. Successful navigation among potential offerings may provide opportunities for navigation in the business model management. Further, sorting in the business model enables improving the potentials of communicating business model offerings in front of potential stakeholders such as providers and customers of NIMBLE. It may as such improve the potential of gaining access to resources needed.

We further provide an initial checklist to visualize some of the core contextual factors to take into consideration when developing NIMBLE business models and attached service-offerings. The checklist may afford well-organized and precise procedures to describe tacit or explicit structures underlying the core logic for business model generation (e.g. Shafer et al., 2005). Therefore, this section highlights some of the contextual factors that should be managed depending on type of business model (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). The table shows 16 different categories describing collaboration and their dimensions. For instance, the category of uncertainty collaboration describes whether the collaboration has the characteristics of high degree of uncertainty or if it is low. The collaboration mode describe whether the collaboration has a more passive character focusing on information exchange and feedback, or more active focusing on active collaboration in which actors want to co-create together, learn and transfer knowledge.

Table 4. Contextual factors affecting collaboration and type of business model.

Contextual factors	**Dimensions**	
Mode of transactions	Transactional	Relational
Degree of openess	Public (open)	Private (close)
Risks	Low	High
Uncertainy collaboration	Low	High
Planning	Easy	Difficult
Complexity	Low	High

Frequency in contacts	Low	High
Communication process	Oneway	Twoways
Information transformation	Automated	Manual
Information type	Static	Dynamic
Timeframe	Lagged	Real time
Type of relations	Distance	Close
Type of channels	One	Multi
Collaboration mode	Passive	Active
Type of exchange	Reactive	Proactive
Digitalization maturity	Low	High

6.3.1 The development of NIMBLE

In the development of NIMBLE's Business Services, there is a need to distinguish the differences between basic services (BAS) and advanced services (ADS) (Sousa, Sousa, da Silveira, & da Silveira, 2017). It is identified by the use cases that both categories need to be considered in the development work of NIMBLE. Briefly, BAS aim to install and maintain basic product functionality in an efficient and effective manner for the customer (e.g. product installation, provision of spare parts, maintenance and repair). Working with BAS does not require much customer interaction and hence it requires limited association with how customers create value. ADS on the contrary relates to working closely with customers to co-create value that goes beyond basic product functionality. ADS broadly correspond to customer support services. The different type of services also requires different type of business models: Product-centred (value co-creation focuses on assisting the customer in realizing value potential embedded in product), or 2) Service-centred (co-creation of value in the customer's specific context, beyond potential embedded in product).

7 Conclusion

The following chapter gives a summary of the initial collaboration and business model requirements for the NIMBLE B2B ecosystem. It reports on the identification and design of collaboration models and the business models and models aimed to facilitate dynamic value creation and capturing for NIMBLE and its current and future potential collaboration partners. The initial analyses of the use cases visualize the complexity in the NIMBLE collaboration model, i.e. in the basic and advanced business services and their offerings. Furthermore, the conclusion addresses benchmarking of existing Platform ecosystems; opportunity recognition and risks; socio-economical values; and the next steps for NIMBLE. We close with recommendations for future development and implementation of sustainable NIMBLE collaboration and business models.

7.1 Collaboration and business model

Just as there are many different industries and types of organizations there are many different kinds of collaboration and business models and also ways to manage these. While some are multifaceted and complex others are simple. Even within the same industry or organization there may be collaboration and business models that are different from one another and thus also in need of management strategies, which is in line with those selected in the specific cases. General collaboration and business model strategies do not necessarily map out strategies fitted for the specific situation. The collaboration and business models in NIMBLE are therefore adjusted and developed in accordance with the specific needs in NIMBLE. It is therefore essential to explore both the business models as well as the business model management strategies, which need to be adjusted to the specific situations and also adjusted to fit different industries and companies. Also, it is essential to understand the determinants of the situation and the specific business model management typology. Knowledge of underlying factors may enable a continuous and proactive work with business model development (See e.g. Teece, 2010).

In general, the collaborative work in NIMBLE implies that individuals and teams from different organizations and companies are part of a collaborative working environment within which they engage in interaction processes and through which they co-create value. The work with development of the platform involves high complexity where new and old technologies are combined in new ways for certifying the need of the platform stakeholders and where the external interface; i.e. the business platform as a market channel aims to be user friendly, provide attractive offerings and also reach out to users, providers and other potential stakeholders. This requires co-creation by different groups of experts, people with different roles, different countries, organizations and also a though through orchestration of the work with designing and developing business models including activities like; true decision making, learning, coordination, and communication. Therefore, NIMBLE needs to consider and deal with 16 initial identified contextual factors that should be managed in relation to each business model offered. These contextual factors frame the initial design of the NIMBLE business model components, specifically the value offerings (basic and advanced services), type of collaboration relationships, and communication channels.

Figure 9 illustrates the four identified business model management typologies[9], i.e. 1) Routine business model typology, 2) Analytical business model typology, 3) Engineering business model typology and 4) Research business model typology. The typologies are in the case of the NIMBLE users of based on the two dimensions and the two polar ends of the following dimensions; 1) Openness in business transactions (open vs. closed), and 2) Mode of transactions (transactional based vs. relationship based).

[9] Inspired by Perrow (1970) technology typology and that technology is an important factor in contingency theory.
Perrow, C. (1970). Organizational Analysis: A Sociological View, Wadsworth Pub. Co.

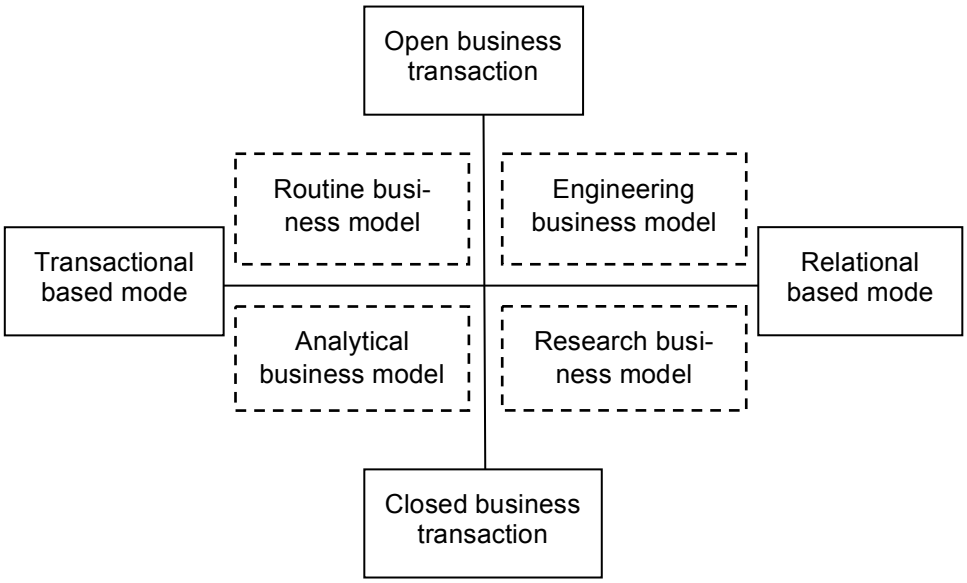

Figure 9. The four identified business model management typologies.

The NIMBLE market window implies a single-access point to multiple micro-services based on communication and collaboration tools. The analysis of the uses cases indicates that NIMBLE will be a platform that considers a range of different contextual factors and different types of business models.

1. Routine business model: A business model focusing on transactional exchange, public, automated oneway-directed mass-communication with activities 'for' customers or suppliers. The collaboration is basic, distance with low frequency. For example services like catalogues and web-shops.
2. Research business model: A business model focusing on relational exchange, private, manual twoways-directed communciation with activities 'with and by' customers or suppliers. The collaboration is complax, close with high frequency. For example services supporting co-creation activities.
3. Engineering business model: A business model focusing on more open transactions and relationships-building collaboration. The communciation process is twoway with manual actitivities 'for-with' customers or suppliers. The collaborationcan be characterized by high frequency with active acting. For example with services for communication.
   relation based mode, navigation – new markets, absorbative capacity,
4. Analytical business model: A business model focusing on transactional mode and more closed transactions. Value-creation together with customer and suppliers are important. For example services handling big data analytics.

We can base on the findings from the initial analyses of the collaboration and business model requirements summarize the view of the business model definition in terms of "Two sides of the business model definition coin".

A variety of micro-service offerings attached to all four types of business model management typologies imply from the NIMBLE provider point of view a portfolio of service offerings that may be used for reaching the potential of the NIMBLE business model and for spreading risk among the different

service offerings with different potentials. The single market-place makes the development of such portfolio possible. Elaborating further on the "Two sides of the business model definition coin", the business model management typologies are as seen above labeled similar for both sides of the coins but the meaning of the typologies however varies between the two sides. The value offerings in the NIMBLE business models must ease the collaborative friction between the collaborative partners in the supply chain. This means that the offerings must attract at least two parties regarding WHO needs to collaborate about WHAT, WHERE, WHEN, and WHY. The collaborative interaction processes enables companies to acquire absorptive capacity, acquire critical information and knowledge critical for adjusting the business to different international contexts. It also enables the companies to adjust products to needs and requirements e.g. through outsourcing of parts of the business to external native collaborative partners. NIMBLE also supports interactions through enabling communication with selected value chain actors as potential providers (manufacturers, suppliers, retailers and logistics operators).

In the development of NIMBLE, services facilitating and supporting value-creation are essential. Micro-services reinforce existing value co-creation activities: co-diagnosis (collecting and organizing information for collaborative use), co-ideation (communicating and sharing, engaging, commenting and selecting ideas), co-design (developing concepts and knowledge), co-evaluation (prototyping and improving the offering, giving feedback), co-testing (creating and managing information, and co-launching (advertising, marketing, and diffusing information).

7.2 Benchmarking of existing Platform ecosystems

Once the goals are set for the NIMBLE-platform and following Meier's (2016) advice before compiling a list of possible business models for the NIMBLE-platform, there are some steps to consider:

1. The NIMBLE customers must be defined, as detailed as possible and addressing:
    - what type of collaborations are in focus for them that NIMBLE can support,
    - what they would be willing to pay, put in efforts in using NIMBLE, and
    - what type of business model is most likely to appeal to them?
2. Define NIMBLE competitors if any. This means not only knowing what other platforms that exist, but also what business model they follow (governance, organization), how much do they charge, and what terms and conditions they apply on their platforms.

When all above is stated, NIMBLE can compile a list of most suited business models, which is then compared and discussed in detail in team, community or advisors. NIMBLE has to keep the entire process familiar and easy, for NIMBLE users/customers. There must be some business models behind NIMBLE, but NIMBLE users/customers may only see it as a simple solution to their collaboration challenges.

As Meier (2012) concludes, choosing the right business model is no simple task, and no model will be perfect from the beginning.

7.3 Opportunity recognition and risks

In general, three major types of collaborative relationships can be specified in a SC: manufacturing-supplier collaboration; manufacturing-customer collaboration, and collaboration with third and fourth party logistics providers. In these collaborative relationships, collaboration requires individual actors to adopt simplified, standardized solutions based on common architectures and data models. Different companies have different roles and opportunities for collaboration along the value chain, For instance

IT-maturity and willingness by potential users of the NIMBLE platform to adopt the technology can play a matter and may therefore be a critical factor for NIMBLE to consider.

It is essential in the development of NIMBLE to continue to involve the use cases in the development process and support a sense-making process for mutual understanding, see Figure 10. The concept of co-creation must be considered and guide value creation in NIMBLE, both regarding the development of the NIMBLE platform and in the collaboration processes taking place at the NIMBLE. Therefore, in the development process of NIMBLE, actors need to understand that co-creation assured through strategic interaction capabilities that consider identification of actors' expressed and underlying needs, processes and what value they are looking for; addresses the need to cultivate social and emotional ties between the parties and empathic interaction with the actors; stimulate optimal value the process should also contribute to knowledge expansion, competence building and learning necessary for resource integration among actors, and the capability to co-ordinate and to involve actors in value-creating activities. Finally, in the development of NIMBLE it is essential to explore how the customers' of NIMBLE can use NIMBLE in the supply chains and how NIMBLE will attract users and keep them staying.

Figure 10. The NIMBLE development process.

7.4 Socio-economic business landscape

The term "platform economy," or "digital platform economy," encompasses a growing number of digitally enabled activities in business, politics, and social interaction (Kenney & Zysman, 2016). Platforms today mobilize organizations and key SC actors to contribute to mutual global businesses. A platform economy as NIMBLE comprises a distinctly new set of economic relations in the SC that depend on the Internet, computation, and data. The NIMBLE ecosystem is a source of value and sets the terms by which users can participate.

NIMBLE aims to contribute to access to global markets and collaboration models and through this change the economic landscape of doing business across borders, by decreasing cost of international transactions and interactions in the supply chains. NIMBLE opens the door for small companies to become "micro-multinationals", by accessing to customers and suppliers both national as well as in other countries.

Expanding businesses to global markets may be complex and challenging, especially for SMEs. Platforms, like NIMBLE, facilitates through reducing complexity in collaboration and business models by creating 'leaner models for going global' (McKinsey, 2016). It offers organizations an opportunity to

navigate their collaboration and business model development (including organizational structures, products, assets, and competitors) into new directions. Value chains are shifting and digital platforms are as such key facilitators in the new era of globalization. Digital platforms offer new ways to share knowledge, learn, collaborate, and acquire new skills and resources.

NIMBLE's digital footprint allow companies to globalize in a leaner way. Digital tools for business services facilitate and support remote collaboration and instant communication where SMEs can enter new international markets without establishing a physical presence at all. We state in accordance with McKinsey (2016) that platforms may broadening participation, boosting productivity, and changing the way companies go global.

7.5 Next steps

The NIMBLE business models and services to be offered are at this point in time to a high degree close to satisfying the needs of the current use case companies, their suppliers and customers. The development of the platform navigates towards offerings beneficial for up-scaling to additional potential customers; offerings that provide value to the customers and relief their "pain". A pull strategy has primarily been used for identifying and anchoring potential service offerings and commercial interests. The collaboration model for value creation and the business model is continuously and interactively identified and explored on in connection to the collaborative partners.

A crucial factor for NIMBLE development of service offerings is a need for enabling the continuous development of each individual use case to enable high qualitative service offering for attracting potential users of the basic and advanced business services. The development of the service offerings are still in an early innovation phase and in need of further refinements and development for being able to provide value to end users. Hence, understanding the difference of activities in the pre-commercialization stage and the commercialization stage in NIMBLE is vital and works with these actors are forthcoming and planned for. As a first step in this work, customers and suppliers related to the use cases will be involved in the development work of NIMBLE. Moreover, reaching and attracting new customers outside the collaboration partners and the partners' current networks is also a challenge and will be part of the forthcoming work.

Finally we list some first recommendations for the further identification, design and implementation of NIMBLE future collaboration- and business models based on the findings from the current state and future visions:

Continue to identify and develop the NIMBLE platform portfolio offerings; opportunity recognition for already identified and unrecognized offerings. What are these?

The NIMBLE platform portfolio of service offerings aim to provide an outlet for complementary service offerings that together bring businesses to new levels. Each service offering needs to be well thought through to fit into the portfolio for optimizing risk management and to contribute to value creation. Social, technical and economic values need to be well balanced for sustainability in the comprehensive portfolio service offerings. This implies a need to understand each service offering through the contextual dimensions offered in the current initial document of the NIMBLE collaboration and business models. If NIMBLE wants to establish collaboration with a wider user-base it will require services of different types. A diversity of collaboration is crucial, based on a balanced mix of strong ties and loose ties for opportunity recognition in the collaboration. In development of collaboration model, loose ties are needed to a much higher extent. NIMBLE should turn to potential stakeholders outside the current NIMBLE community. We suggest the project to continue the development and implementation of the NIMBLE portfolio offerings to include both basic service offerings and advanced service offerings in relation to the four initially identified business model management typologies. The business model management strategies need to be further explored; i.e. sorted out and clari-

fied. The strategies need to be made transparent for attracting potential future stakeholders such as users and providers.

Developing a framework for short term and long term organization and management:

The NIMBLE platform ecosystem needs to be continuously developed through further identification and design of organizing and management of collaboration- and business model. There is a need to design a well thought through portfolio of service offerings possible adjust and to organize for a short time perspective and for a long term perspective in accordance with the short term (e.g. 2000 users) and long term goals (internationally widespread and competitive sustainable collaboration and business models). This work involves continuous reflections on opportunities and challenges/ risks to enable a successful navigation throughout the project but also after the end of the project. The NIMBLE business-service offerings need to be developed in order to take different contexts into consideration.

Continue to develop a common frame of reference to make sense of what customers and users actually require and what providers actually are able to provide.

The NIMBLE platform ecosystem needs to provide a framework of organizational learning and sense-making for reaching the short term and long term goals. Professionals from different paradigms get together with different frameworks in mind, with their perspective based on their particular roles. These different frameworks need to be synchronized and orchestrated for reaching the short term and long term goals. There needs to be a continuous discourse defining and redefining the framework, as well as the actual operational and strategic activities to take place in order to reach goals. The NIMBLE service offerings need to be developed in order to support interaction processes and exchange in collaborations; e.g. learning, communication, coordination, and decision-making.

Investigate experience from the initial use-cases, their suppliers and customers in the value chain to identify potentials and challenges as well as actual value creation.

The current collaboration in the NIMBLE platform ecosystem throughout the value chain, specifically the collaboration with external suppliers and customer companies in the use-cases value chain needs to be further explored. Through insights from them we could support the evolution of the NIMBLE platform to better serve wider stakeholder interests– beyond the current main interests. The NIMBLE service offerings need to consider development of relations, group processes and skills both regarding organizations, teams and individuals as well as their requirements.

Aligning the future NIMBLE service offer portfolio to trends and future requirements from different actors' perspectives into the strategy Industry 4.0.

The NIMBLE platform ecosystem needs to continue to explore and understand the gap between SMEs' everyday reality, for instance the IT-maturity in the company, lack of competence and resources in the company for implementation of solutions and new demands on employees in accordance with industry 4.0. For instance; work processes change and so do the roles of the shop floor workers who now move towards roles as coordinators and problem-solvers. The platform ecosystem needs to consider the collaboration model in accordance with current trends but still balance the offerings to the companies' requirements, needs and wants and ability to actually implement and use the service. Services need to be user friendly.

Continue to benchmark existing platform ecosystem initiative for identification of and implementing a sustainable ecosystem.

The NIMBLE platform ecosystem needs to continue with the initiated work with benchmarking of current on-going initiatives and continue the work with analyses. These analyses aim to guide decision-making regarding the choice of ownership and governance for accomplishing sustainable collaboration- and business models. This implies assuring use-cases and potential external stakeholders that the platform will be sustainable in the long run.

By taking these next steps to enhance B2B collaboration NIMBLE can become the Future B2B collaboration platform for the creation of both substantial business and contribute positively to societal impact and to resolving some societal challenges..

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