Contract No. 004420

eu-DOMAIN - enabling **u**sers for
Distance-working & **Organisatio**nal **M**obility
using **A**mbient **I**ntelligence **N**etworks

D6.1 Proposed business models and business cases

Specific Targeted Research or Innovation Project

Project start date 1st June 2004 **Duration 36 months**

Published by the eu-DOMAIN Consortium **29 March 2006 Version 1.6**
Lead Contractor Innova

Project co-funded by the European Commission
within the Sixth Framework Programme (2002 -2006)

Dissemination Level: Confidential

Document file: D6.1 Proposed business models and cases v2.0

Work package: WP6 – Socio-economic issues

Task: T6.1 Analyse and develop realistic business model for users and service providers. The business models will be based on the concept of value-nets and specific emphasis will be made on defining and measuring value creation and identifying new business opportunities for SME's.

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Review history:

Reviewed by	Date	Validated
Internal review	18-04-2006	

Index:

1. Introduction

An estimated 12 million Europeans travel everyday across Europe working outside their normal workspace. eu-DOMAIN supports mobility among users and workers by integrating them with seamlessly accessible ubiquitous intelligent surroundings, which support self-configuring devices and use semantic agents and tools for ambient awareness. eu-DOMAIN will thus dramatically improve their ability to deliver quality services and increase the competitiveness and visibility of their host organisations.

The eu-DOMAIN platform interconnects people, devices, buildings and content in a Europe-wide interoperable network and can be used in a broad range of industrial, government, healthcare and other citizen centred applications.

An important part of the project is the development of realistic and sustainable business models for all types of users and Service Providers. The business models will be developed using the concept of value nets and dynamic value constellations to identify new business opportunities for Content Providers, Service Providers and Service Aggregators. Specific emphasis will be put on defining, identifying and measuring value creation.

1.1 Purpose, context and scope of this deliverable

The present deliverable D6.1 Proposed business models and cases for the eu-DOMAIN project is aimed at documenting the project's research into available business modelling frameworks and present the findings in terms of a proposed selection of business models for various Service Providers in the two selected user domains: Industrial Services and healthcare.

The work has been undertaken as part of WP6 Socio-economic issues, which again builds on the societal analysis performed in WP2 User requirements specifications. The user requirements specifications comprise D2.3 Functional user requirements specifications, D2.4 Trust and security user requirements specifications and D2.5 Societal requirements. The purpose of the societal analysis on user requirements is to secure that the services offered by eu-DOMAIN reflect the identified business priorities and to validate them in reference to user priorities, i.e. functionality, security and user acceptance.

The WP6 Socio-economic issues have the following objectives:

- Define and describe proper Service Provider and service aggregator roles.
- Analyse value creation in chains and networks.
- Develop realistic business models for the various stakeholders.
- Analyse and future-project the eu-DOMAIN business environment to assess potential socio-economic impact and immediate implementation effects.
- Organise a European Awareness Scenario Workshop (EASW) for each application to stimulate an external assessment through a scenario-type approach (based on the scenarios built) and a participatory method and test the functionality, market and social potential of the proposed solution.

This deliverable is concerned with the points 1 thru 3. As the technical efforts for eu-DOMAIN take-up, the European Awareness Scenario Workshops (EASW) methodology will be used to validate the business models and business cases in a real working environment.

The interrelationship between user requirements, the technical architecture specifications and the socio-economic issues is depicted in figure 1 on the following page.

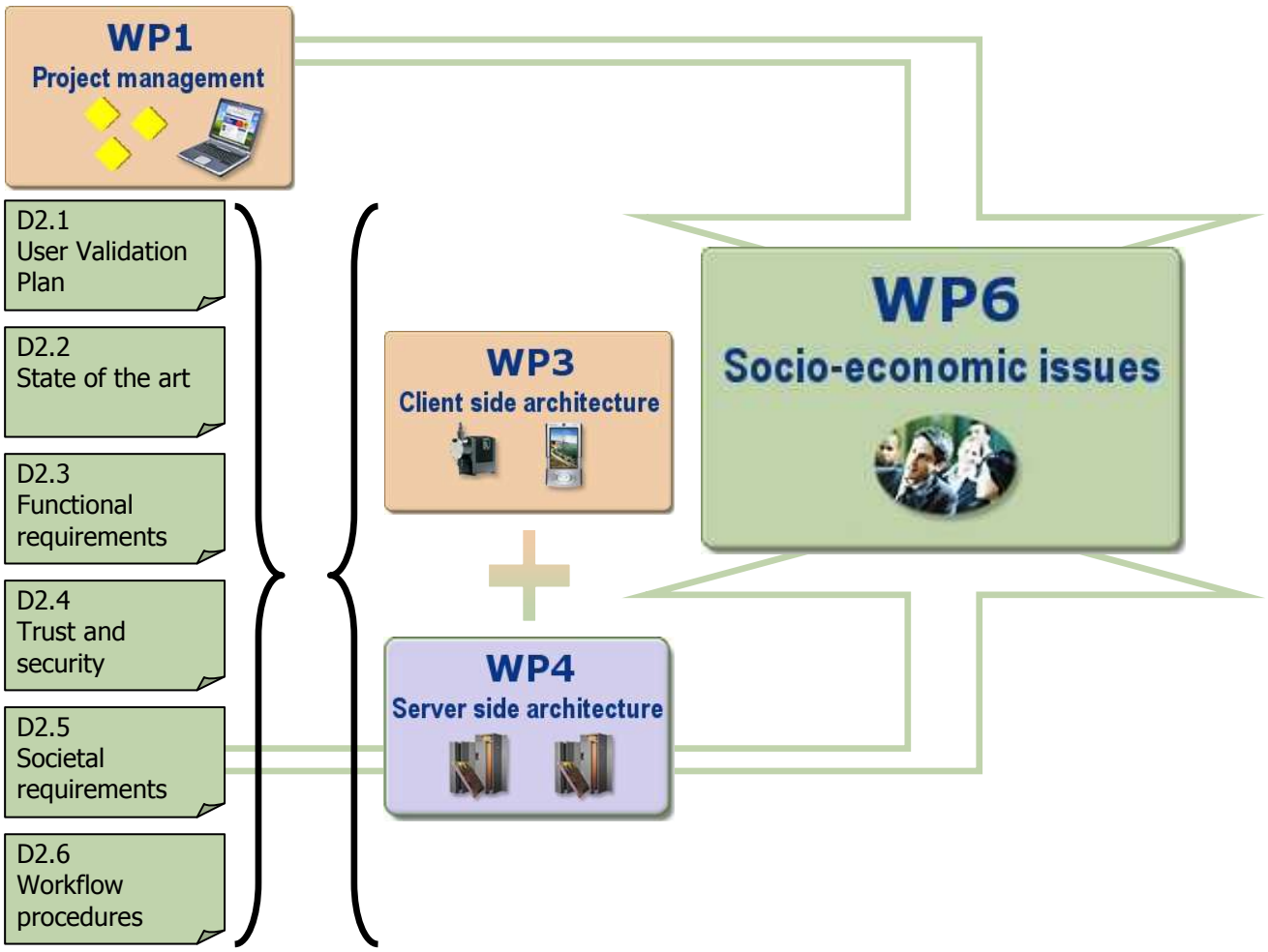

Figure 1 Workpackage interrelations

The deliverable is structured as follows: Chapter 1 includes a summary of the background for user requirements specifications and for how the scenarios have been developed in D2.1 User Validation Plan. The scenarios serve as the foundation for all requirement engineering in the project. Chapter 2 provides a condensed summary of the work reported in this deliverable.

Chapter 3 sets out a technical description of the end result of the eu-DOMAIN project. It briefly describes the service platform architecture and its embedded ambient intelligence. The purpose of this description is to provide a precise conceptual framework for understanding the new e-Business offerings, which are introduced during development of new business models in chapters 12 and 13.

In chapter 4 the roles of the various actors and stakeholders are identified and their primary business objectives are described.

Chapter 5 introduces the theoretical framework for value and value creation and chapter 6 discusses the value requirements engineering and its applicability to eu-DOMAIN. Special emphasis is put on value modelling and identification of suitable tools for the present work. The selected e^3value methodology and associated modelling tool is presented in detail in chapters 7 and 8.

Chapter 9 describes the selected user domains Industrial services and healthcare and summarises particular industry structure details, which are important for the business modelling work. This work is largely based on the description of markets, business practises and user needs described in the annex to deliverable D2.5 Societal user requirements specifications.

The chosen modelling methodology and tool has been subject to initial validation in two baseline business systems in each of the user domains: The logistics of pumps in the industrial sector and diabetes care system in the healthcare sector. The result of the validation is presented in chapter 10.

Chapter 11 proceeds to describe the new business framework made possible by the new services offered on the eu-DOMAIN platform. A description of the mechanism of the business system to new actors and services is also described.

Then in chapter 12 we describe the result of the work on identifying and defining new business models for the Industrial Service sector. It includes a gradual development of new business cases, adding new service offerings and new actors until the business system reaches a new equilibrium, where all actors are individually profitable. The resulting business case is not the only sustainable business case, but it demonstrates how the value methodology can successfully be used for identifying sustainable business models during the exploitation phase. Chapter 13 presents the exact same results from the healthcare sector.

Finally, in chapter 14 we provide the validation framework to be used to validate the business models together with the overall validation of the eu-DOMAIN platform.

1.2 Background

The realization of the ambient intelligence vision is today obstructed by a huge variety of proprietary systems not being able to communicate across platforms and users struggling to make systems from different manufacturers operate together. This is especially true when services are needed outside fixed workspaces like homes, offices or factories.

eu-DOMAIN will develop a new, innovative European Ambient Intelligence service platform for automatic, context sensitive offering and contracting of mobile web services across heterogeneous networks. The eu-DOMAIN service platform will not only connect people, and content but also buildings, devices and machines in an interoperable network and so contribute to the first structured Ambient Intelligence middle-layer widely available. eu-DOMAIN will enable a mobile worker to access their 'virtual user profile' wherever they need to work, intelligently accessing the services and devices they need. It will allow content providers to offer advanced 'augmented reality' services to such users, creating new ways of collaborative working.

The eu-DOMAIN platform will be deployable in a broad range of industrial, government, healthcare and other citizen centred applications. The eu-DOMAIN project will prove the feasibility of this in a practical way by developing and evaluating demonstrators under two business scenarios:

In the field of healthcare the focus is '***Patients as customers!***':

The healthcare system is multi-faceted. A large amount of new methods, devices and medication are available from various Service Providers, each of them offering their services to an informed patient - sometimes in competition; sometimes in cooperation. The patient chooses the providers that are most suited to her/his needs.

Patients as customers!

Serving your every need!

In the field of Industrial Services the focus is '***Serving your every need!***':

In a world where customers are the primary driving force in shaping product characteristics, features and use of pumps, combined with the existence of a sophisticated communication infrastructure, i.e. the eu-DOMAIN, the basic product function of a pump will shift from simply moving water (or fluids) to be an integral, maybe even a crucial part, of the customer's solution. The value created by the "ambient intelligence" functionality of the pump becomes a major part of the customers overall value creation. The pumps are "serving you – wherever you are – whatever you do – whenever you want it".

2. Executive summary

2.1 Purpose and background

The purpose of this deliverable - D6.1 Proposed business models and cases - is to develop sustainable business models for the eu-DOMAIN platform based on research into value creation and value modelling and subsequent application of the developed tools to the two user domains: Industrial Services and healthcare. The proposed business models are based on an analysis of the existing business systems for the two user domains, drawing also on the findings in WP2 User requirements specifications, including the annex.

The business analysis and business models are focused on application of the eu-DOMAIN Ambient Intelligence (AmI) Service Platform to user domain organisations. The platform is a web based platform for service provisioning that offers interconnectivity and remote monitoring and control functionalities to users in various domains over heterogeneous networks.

2.2 Business analysis and value creation

The business analysis starts with a definition and description of the actors and stakeholders involved in delivering, buying and using eu-DOMAIN services. For the purpose of modelling the business system, the two user-partners in the eu-DOMAIN project, Grundfos and Eastern Birmingham Primary Care Trust (EBPCT), act as Content Providers. Content Providers define and are owners of the "content" and the services that the end-users ultimately are going to benefit from, including for example energy monitoring services, on-line maintenance of technical installations, home healthcare services, security or even entertainment.

The business modelling process for both Industrial Services and Healthcare is based upon the notion of value creation. Value is co-produced by actors who interface with each other. It follows from the basic human character that a sustainable business can only be built if its transactions are creating true, lasting values for all actors involved in the value exchange.

A key strategic task in using value creation to develop a business model is the reconfiguration of roles and relationships among constellation of actors, in order to mobilise the creation of value in new forms and by new players. We therefore focus on the value proposition to the customer (or to the actor providing funds for a healthcare service) and on the profitability or cost/benefit ratio of each of the actors in the value constellation. The eu-DOMAIN platform is capable of delivering a number of simultaneous services from a number of different content providers and is thus fully capable of supporting organisations' business models based on the dynamic value constellation concept.

2.3 Value modelling

For the purpose of our business modelling, we have selected the e^{3}value methodology and tool to be used with the eu-DOMAIN platform[1]. The e^{3}value methodology has proven to be very useful for the exploration of e-Business ideas, because it can be used to quickly evaluate the idea with respect to economic feasibility. It also has a graphical language, which can be used to express almost any kind of e-Business model and the semantics of the language is commonly understood by stakeholders to facilitate a common understanding of the models. The e^{3}value methodology exploits scenarios and scenario paths to develop a new business model. A scenario path can be seen as an instance of a scenario element and shows causal relations between the different actors and their value exchanges.

In the modelling, we are therefore using the already developed scenarios for the two user domains: "Serving your every need" for Industrial Services and "Patients as Customers" for healthcare as our starting points for modelling new sustainable business models using the e^{3}value tool. From a content

[1] Developed by Jaap Gordijn at the Vrije Universiteit Amsterdam

point of view, the scenarios put the end-users' needs into operation thus enforcing the stakeholders to take an outside-in perspective of the business model.

2.4 Baseline business models

In order to develop new sustainable business models for Industrial Service and Healthcare, we draw on the findings in WP2 User requirements specification. First we set out to validate the choice of model by creating baseline value models, which represent the existing business systems for each domain and illustrate the value exchanges that take place between different actors. Based on our global assessment of the two user domains, we conclude that the baseline models represent a fair and accurate picture of the real-world business system and that our value model methodology provides an accurate and useful tool for the further modelling work.

The baseline business systems are assumed to be in a more or less perfect economic equilibrium. Actors undertake profitable operations or perform activities with a positive cost/benefit ratio and behave according to economic laws of maximising the benefit of a particular transaction relative to the associated costs of performing such transaction. Since all actors are profitable, the system is in a long-term *steady-state* or *equilibrium*.

An important aspect of the steady-state economic system is that it is often a closed system. Only a fixed amount of money (profitability) is available. If new services are introduced, the profitability from these services must come either from the end-users being so convinced about the attractiveness of the value proposition that they are willing to direct additional money into the system (paying more for the improved or new services) or from one or more of the present actors being able to reduce costs elsewhere due to the new service, so that the net result is an increased overall profitability in the system. A key approach in our work has thus been to iteratively compose and decompose value activities in order to find new value constellations or new value actors that make the business models sustainable.

2.5 Extended business models

From the baseline models, we move on to developing extended business models that include a new actor: The eu-DOMAIN Service Provider. The Service Provider is a firm that establishes the eu-DOMAIN platform and offers the functionality of the eu-DOMAIN infrastructure in an ASP-type (Application Service Provider) arrangement to its customers. The customers are Content Providers, which could be an industrial product company (i.e. Grundfos) or a healthcare authority (i.e. EBPCT). In both cases, the eu-DOMAIN end-users are employees, business partners, patients, etc. of the Service Provider's customers.

2.5.1 Remote asset monitoring in the industrial service sector

For Industrial Services, the extended business model was developed based on the industrial market segment comprising customers, owners and users of Grundfos circulation pumps for cooling and HVAC applications.

Internet-enabling of industrial products are bringing huge business opportunities. Everything from a pump, a building, an industrial machine, and an office's thermostat will have the potential to be networked thus creating a huge network of interconnected devices. Product companies can use their devices to enter into a customer service relationship that increases both revenue and customer management. In many ways, the product companies can use the networking technology to reduce the burden of Asset Management and reduce the total cost of ownership for the end-user. Product companies can use device networking technologies to reduce costs, reduce installation time, improve effectiveness, neutralise learning differences, bridge knowledge gaps, gain more customers, and pursue new opportunity areas.

Grundfos Manufacturing is the main actor in the extended business scenario. They provide high quality service to their customers, as is part of the company's overall strategy. In addition to providing the basic service and maintenance, Grundfos Manufacturing has introduced network communication components allowing users as well as Service Partners and Grundfos' own staff to

remotely access the installations. Grundfos is basing the remote services on the eu-DOMAIN platform and has outsourced the operation to a eu-DOMAIN Service Provider. As a by-product of the communication network, Grundfos Manufacturing is now able to enter into new partnerships with third parties such as utility companies, offering them automatic meter reading (AMR) of energy consumption at the customer's installation. This partnership adds enough economic volume to the system to make all actors profitable and thus creating a sustainable business model.

In the model, Grundfos Manufacturing undertakes three value activities: Contract service, installation and service support, and remote metering. Most value objects are being exchanged via the Grundfos Manufacturing actor. We have chosen this approach because it conforms with the desire of Grundfos Manufacturing to be intimately linked with their customers and to provide world class services to them. This also implies that Grundfos will not allow other service providers to get in direct contact with their customers. By being engaged in all exchanges of value objects, Grundfos retains total customer control and supports customer satisfaction, brand recognition and a high level of customer retention. A graphical representation of the full business model is shown in Figure 28.

An overall profitability analysis has been carried out based on the value model and using the e^{3}value tool. The profitability sheet below shows the result of the analysis.

Market segment / actor (k€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	6,240	-6,240
Service Partner	2,400	0	2,400
eu-DOMAIN service provider	564	543	21
Utility company	0	36	-36
Grundfos Manufacturing	6,276	4,104	2,172

When analysing the profitability for each actor in the value model, we need to assume that the actors who pay for the services on offer (here the Industrial Customers and the Utility Company) are satisfied with the cost/benefit ratio of the services they buy. To put it simply, these actors are willing to pay the given amount for the services as the benefits they receive in return are of equal or higher value for them. We may therefore conclude that the business system is overall profitable and each actor is profitable, which indicates a high chance of the business model being sustainable over time.

The profitability sheet does not claim to be accurate in absolute terms, but indicates that sustainability can be achieved by carefully focusing on the value objects, decomposing actor activities into relevant value activities and by introducing new actors into the business system to achieve additional funds.

2.5.2 Self managed diabetes care in the healthcare sector

In the healthcare domain, enabling patients with chronic diseases to manage and monitor their condition from home or away, thus avoiding spending hours in the doctor's office for regular check-ups, will not only mean that patients are more mobile and less dependent on their GP or the surgery's opening hours, it will also enable patients to take control of their disease. eu-DOMAIN will allow patients to self-manage their disease through the use of home testing devices and two-way remote communication with their GP, nurses and the hospital.

Improving chronic patients' condition and lives will be a major challenge for Easter Birmingham Primary Care Trust (EBPCT) in the future as more and more patients develop chronic diseases like diabetes. Providing remote monitoring will enable EBPCT to meet this challenge; patients' lives will be improved, the monitoring of the disease will improve and at the same time, EBPCT will be able to save money on commissioning fees as patients will need less consultation time with GPs. Moreover, EBPCT will be able to cut down on hospital costs as unnecessary admissions may be avoided and as the length of hospital stay can be cut down as patients will be able to be dismissed earlier and instead be monitored closely at home. A graphical representation of the full business model is shown in Figure 29.

EBPCT is the main actor in the extended business scenario. EBPCT has a value activity called "Fund management and healthcare provision" where they commission primary healthcare from GPs and secondary healthcare from hospitals. EBPCT's funding is generated by general tax revenues. The main focus in the development of new business systems has been on reducing the cost for EBPCT of diabetic care, which is already running relatively higher than the average costs of a given disease.

Taxes are being paid by the market segment consisting of all patients with diagnosed diabetes in the geographical area served by the EBPCT. The market segment consists of individual actors (diabetic patients), who perform an activity called "Need of diabetes care". In the vocabulary of our business model, this activity is a "value activity" because in the viewpoint of the healthcare providers, it is casually related to the activity of providing (and provisioning) health care services.

Another market segment comprises all GPs commissioned by the EBPCT. GPs are responsible for providing NHS primary care and receive healthcare funding per patient from EBPCT. By establishing remote monitoring and self management programmes, GPs save costs (by not seeing patients so often) and increase the quality of their services (by having more well-regulated patients).

Finally, the third market segment comprises the hospitals commissioned by EBPCT to deliver secondary healthcare in EBPCT. Hospitals offering remote monitoring can save a significant number of admissions and can thus save on costs. This saving is in turn passed on to the EBPCT, which uses it to pay the eu-DOMAIN service provider. The surplus can be spent on upgrading other disease areas (thus realistically excluding tax cuts).

The extended business model has thus uncovered potential for a re-prioritising of the financial structure within EBPCT. An overall profitability analysis has been carried out based on the value model and using the e^{3}value tool. The profitability sheet below shows the result of the analysis:

	Baseline model			Extended model		
Market segment / actor (M€)	**Revenues**	**Expenditures**	**Gross profit/deficit**	**Revenues**	**Expenditures**	**Gross profit/deficit**
Diabetic patient (7560)	0	19.0	-19.0	0	19.0	-19.0
GP (140)	0.6	0.35	0.25	0.605	0.330	0.274
Hospital (3)	22.0	0	22.0	21.00	0	21.00
EBPCT	19.0	22.5	-3.5	19.00	22.26	-3.36
eu-DOMAIN Service Provider	-	-	-	0.832	0.550	0.282

The profitability sheet shows that all actors in the model are able to increase their cost/benefit ratio from the new services when compared with the baseline model. EBPCT will see a gross reduction in the cost of diabetic healthcare and GPs will be able to reduce their average expenditure per consultation because they will have a smaller number of direct consultations. The eu-DOMAIN Service Provider also has a good profitability and overall we conclude that there is a high chance of the business model to be sustainable over time.

2.6 Validation of business models

The proposed business models will be validated as part of the planned socio-economic validation. This kind of validation will test if the eu-DOMAIN services meet the expectations and requirements of its intended users from the industrial service domain and the healthcare domain.

The chosen method to conduct this kind of validation is the "**European Awareness Scenario Workshop**" (**EASW**®). The idea underlying EASW® is to involve different participants' profiles and let them discuss these in two separate phases. In the first phase, homogeneous groups are created to develop a common vision on a so called scenario zero, while in the second phase participants are divided into heterogeneous groups in order to reach a wider perspective and scenario.

The EASW® methodology allows the definition and validation of the eu-DOMAIN functionality and business models with a wider audience than just the project's users and it will help to identify new exploitation opportunities.

3. Products and services

The main result of the project is a Europe-wide, mobile, ambient intelligence services platform which will enable mobile ambient intelligence awareness by allowing the user to integrate his virtual user profile into any location thereby providing context aware decision support. Furthermore, eu-DOMAIN will give content providers the possibility of delivering augmented reality services to mobile users thus creating new collaborative work environments and new methods of working across geographically distributed organisations.

The eu-DOMAIN project will result in a range of commercially exploitable products with three main products selected for further analysis and business planning in the project exploitation plan. The selected products are:

1. The eu-DOMAIN **service platform**
2. The eu-DOMAIN **web service components**
3. The eu-DOMAIN **consultancy services**

The business analysis will be confined to just the service platform, where new business models need to be developed and analysed. The other two products will be addressing traditional markets within known business segments. They will be dealt with in more details in D9.6 Exploitation plans.

3.1 The eu-DOMAIN service platform

The eu-DOMAIN Ambient Intelligence (AmI) Service Platform is a web based service that offers all eu-DOMAIN functionalities to Service Providers. Logically, it consists of three different layers as illustrated in Figure 2.

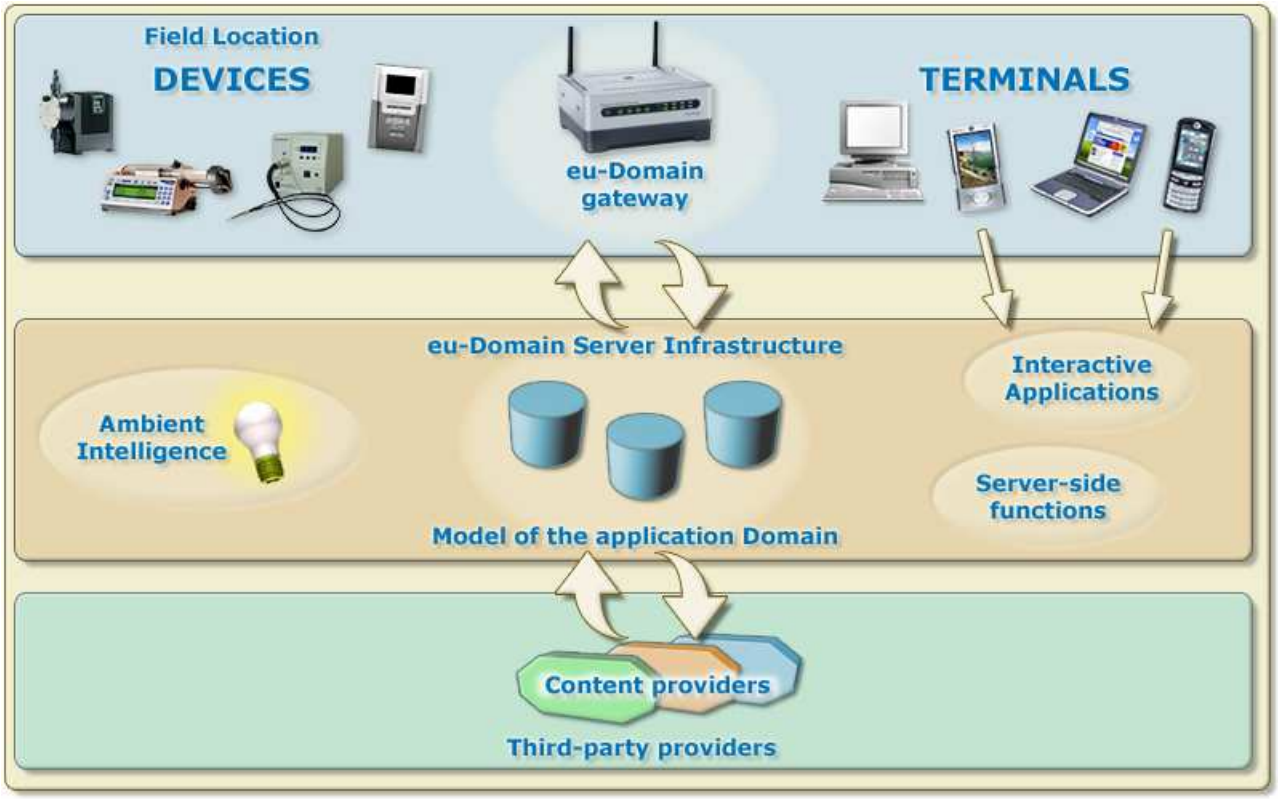

Figure 2 Logic overview of eu-DOMAIN architecture

The upper layer of the eu-DOMAIN platform comprises user and device interfaces, geographically distributed and designed for mobility and automatic configuration across heterogeneous networks.

All conceivable devices will interact with the platform through existing networks and through local service gateways. In this context, a device means any sort of equipment, sensor control installation, sensor, actuator, etc. Further, the users may use any kind of known terminal type including mobile devices such as phones and PDA's as well as stationary devices such as PC's.

The central layer of the eu-DOMAIN platform consists of the actual web services and software architecture providing the ambient intelligence functions. This allows the user to interact with any device, terminal or external repository, acquire and store data, and activating devices and terminals using rules-based ambient intelligence functionalities programmable in the system. Web based communication is providing the connectivity between the eu-DOMAIN central server and the physically distributed service gateways and the mobile and fixed users.

The bottom layer of the eu-DOMAIN platform consists of external Service Providers providing data, services or other content to be delivered through the eu-DOMAIN infrastructure. Typical examples of data repositories are product databases, electronic patient records and weather forecasts.

3.2 Three-tier ambient intelligence

The eu-DOMAIN operates with three specific "ties" of ambient intelligence (as seen from the user):

- The ***Application Intelligence*** tier provides the intelligence related to a particular eu-DOMAIN *application*, i.e. a specific application developed for a specific user domain such as security, healthcare, tourist board, etc. The Application Intelligence is partly integrated in the eu-DOMAIN infrastructure (in the eu-DOMAIN rule engines) and partly in the third party user domain ("black boxes" and web services). Internal intelligence is typically responsible for routing user requests to the correct domain model, setting up rules based decision support for users, implementing correct domain security policies, etc. External intelligence is typically found in product databases, where the manufacturer will not make construction details available to the public, but will respond to specific inquiries from registered customers. The eu-DOMAIN platform handles the request but the application repository investigates the inquiry and provides the answer.
- The ***Location Intelligence*** tier provides the intelligence related to the *location* infrastructure, i.e. data, processes and knowledge related to a given location (gateway), including local workflow procedures and resource allocation. The Location Intelligence is thus the core part of the gateway based intelligence and is supporting the Application Intelligence in location specific instances. This can be intelligent building access systems, burglary or fire systems, medical monitoring systems, etc. where intelligence and functionality are already at hand and accessible though the service gateway using the required interface. A dedicated medical monitoring apparatus may be used for monitoring specific clinical patient parameters and providing certain types of alarms. The results can be made available to GPs through the service gateway.
- The ***Network Intelligence*** tier provides the intelligence related to the eu-DOMAIN *infrastructure* as a whole, i.e. the operation, management and functionality of the eu-DOMAIN platform and its components. The Network Intelligence thus becomes a core supporting part of the other eu-DOMAIN intelligence. The network intelligence is thus responsible for compiling and downloading service bundles to gateways, logging resource consumption in the network for traceability and billing and overseeing that the eu-DOMAIN platform is fully functional and operational.

Combined, the three-tier system provides unique ambient intelligence support with full use of existing local systems and with due respect for open access to proprietary data repositories.

3.3 The client architecture

Each physical location must have one or more service gateways installed. They form dynamic, local intelligence clusters and access points to existing local area networks, through which two-way communication with devices and other control systems in the location (e.g. alarm systems, energy

control, etc.) can be established. The gateway can communicate via built in device nets, e.g. LONWorks, WLAN or ZigBee wireless data protocol. The gateway also facilitates access to the eu-DOMAIN server and to local user terminals.

Figure 3 below shows the client-side functions when fully implemented[2].

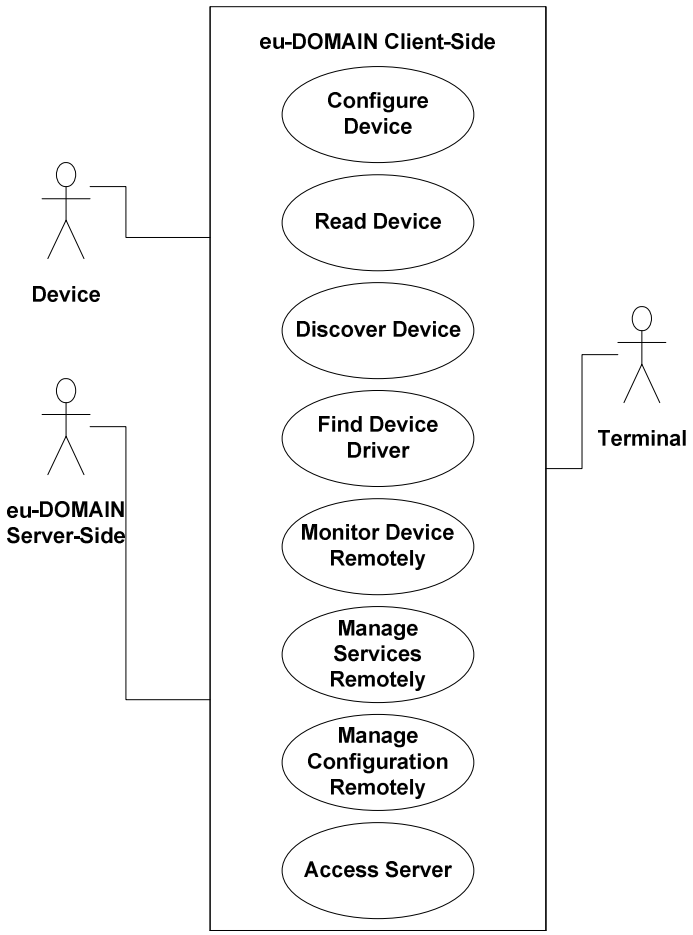

Figure 3 Typical functions in the eu-DOMAIN client-side architecture

Service gateways are configured with an OSGi Framework for bundled services and are able to download a wide variety of services made available by the eu-DOMAIN server. Examples of typical service bundles are: Device monitoring interfaces, user profiles for access to content repositories, local alarm handling in emergency cases, etc.

The service gateways also provide Location Specific Intelligence, i.e. intelligence that can and should be provided locally, without involving higher hierarchy intelligence layers. This intelligence is either provided through active bundles developed for dedicated eu-DOMAIN applications, or the intelligence can be provided through interfacing to local control systems depending on the customer's application. Bundles and data are downloaded on demand through the eu-DOMAIN server, either from domain specific repositories or as a result of semantic search on the web.

The actual behaviour and functionality of the eu-DOMAIN gateway needs to be customised (programmed) in each application. This work must be done by the Service Provider, as part of the application development work, according to customer requirements.

The hardware can be any kind of computing devices, which suit the application purpose in technical and economic terms. For private homes (healthcare) or small businesses, a number of different types of in-door residential service gateways are emerging on the market. They are cost efficient

[2] In the project demonstrator, the actors are other eu-DOMAIN system components and not external entities

and most are prepared for OSGi frameworks. For demanding industrial purposes, heavy-duty industrial computers may become necessary. In either case, the hardware needs to be configured with the relevant interfaces (WLAN, LONworks, EIB, etc) and the corresponding network protocols must be installed.

The gateway software components comprise the operating system, a JAVA VM, the OSGi framework and other relevant system components. The actual application functionality must be developed in the server side framework and downloaded to the service gateway for execution in the form of OSGi compliant bundles.

When an extended local intelligence is needed, such as the use of existing control or monitoring systems in the application, the customer must also specify or develop the necessary interface and communication protocols.

3.4 The server architecture

The eu-DOMAIN infrastructure is capable of delivering application services directly to the remote locations. External services are negotiated from a third party Service Provider, e.g. an Electronic Patient Record system (the "Columna" system from Systematic will be used for demonstration). Free web-content services, such as general health information related to the patient's current status, can also be searched and delivered to the user. Services can either be one-way service delivery or two-way interactive services.

The figure below shows the perceived service provisioning platform as it would be implemented by a eu-DOMAIN service provider.

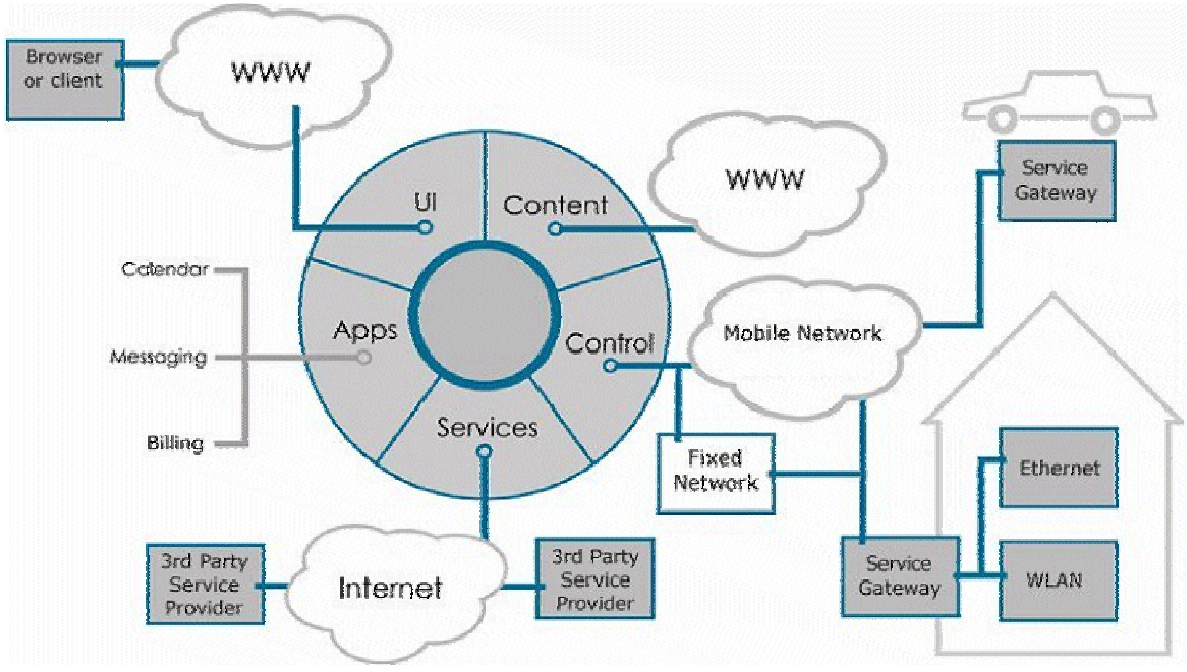

Figure 4 Typical service provisioning structure

The eu-DOMAIN service platform is hosted on a server park consisting of a set of powerful servers performing various tasks in the eu-DOMAIN platform and the ambient intelligence functionality. The server park typically consist of front-end interaction servers for user access, a gateway server for gateway connectivity, web service servers for third party service provider connectivity, an application server for domain models and application intelligence and data base server for data storage.

The server park is set up by the eu-DOMAIN service provider.

4. Actors and stakeholders

This chapter will discuss the generic roles of the stakeholders composing the business environment in which the eu-DOMAIN platform is going to be deployed. The scope of this chapter is to introduce the stakeholders to be involved in delivering and buying eu-DOMAIN services and describe their primary business objectives. In the subsequent chapters, we will further explore the business rationale related to the creation of value through new services, transactions and interrelations among the stakeholders.

4.1 Business framework

The general business model framework can be seen as a pyramidal structure as shown in with thee value levels. At the top (Meta) level we find the business activities of providing conceptual solutions to support eu-DOMAIN services.

At the middle "Primary Chain" level we find the actors actually engaging in exchanging value-added services based on the eu-DOMAIN infrastructure.

At the lowest level, we find the support actors engaged in delivering network infrastructure, devices and terminals and other support functions. These actors will not be analysed in detail.

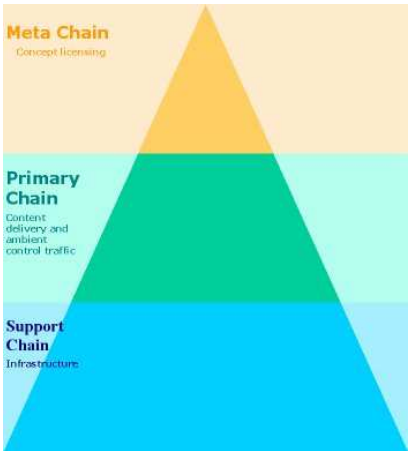

Figure 5 Business model framework

Each stakeholder has a certain business environment that will determine the most appropriate business model to be used in each case. In this section we will provide a generic description of each stakeholder. Relevant stakeholders will be analysed in greater depth when we develop value models for typical service scenarios.

4.2 Stakeholders at the Meta level

The following Meta level stakeholders have been identified:

4.2.1 Concept Owner

The Concept Owner licenses the right to use the eu-DOMAIN platform concept to one or more Service Providers. The Concept Owner develops the concept in a suitable form, based on customer requirements. The Concept Owner may develop specific domain models for the customers or he may provide the necessary development kits for the customers to program their own applications. The customer pays an initial eu-DOMIAN license fee plus a usage fee for the right to use the concept. In addition, the customer may pay development and customisation costs for the Concept Owner to develop a specific solutions. The eu-DOMAIN consortium will initially all be operating as Concept Owners.

4.3 Stakeholders at the Primary chain level

In the primary chain we find the actors actually engaging in exchanging value-added services based on the eu-DOMAIN infrastructure. Some stakeholders are delivering actual services directly to end-user in a traditional supplier-customer relationship. Others are providing the services as Application Service Providers, working on behalf of the supplier. Yet other stakeholders are enriching the basic services with additional services.

The flow of services in a generic primary chain is visualised in the following figure:

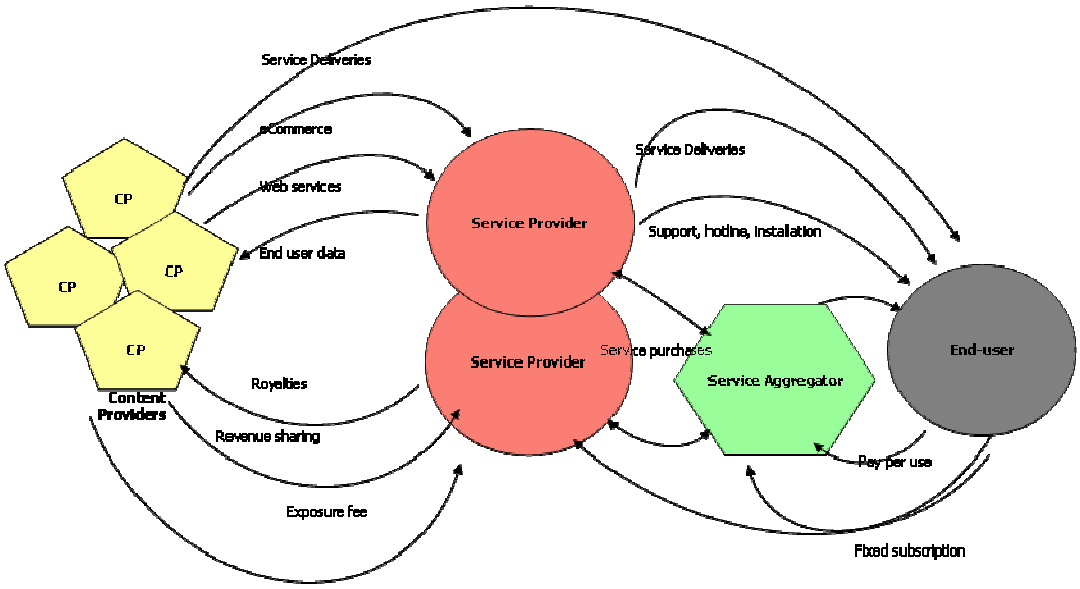

Figure 6 Actors and service flow in a generic primary chain

We can exemplify the various roles by thinking of the two well known domains: healthcare and Industrial Services

In the healthcare sector, the NHS in the UK acts as a **Service Aggregator** of eu-DOMAIN home-care services. The NHS charters one or more **Service Providers** to install and operate the eu-DOMAIN platform nationwide and provide its functionality to the local health authorities as part of the nationwide healthcare service network. Each Primary Care Trust (PCT) will thus act as a **Content Provider** that delivers the eu-DOMAIN home health service to its patients (**end-users**) and staff. Other co-operating health care professionals may join the network as Content Providers and deliver bundled services with the individual PCT. Each PCT will define its own set of services to be provided on the platform. Most likely, the development of such services will not be undertaken by the Service Providers or even the **Concept Owner**.

In the Industrial Services sector, Grundfos is a **Content Provider** of pump maintenance services. Grundfos may opt to offer the eu-DOMAIN services to **end-users**, i.e. its business partners, such as subsidiaries, importers and service partners, as well as independent end-users, such as installers, facility managers and even final end-users. Grundfos may opt to use the eu-DOMAIN platform of an external **Service Provider** (ASP). Based on the volume of traffic and the importance of customer relations, Grundfos may also wish to provide the service in its own name thus acting as a **Domain Service Provider**. The operations may still be outsourced to an external partner, but the core services are exclusively aimed at the Grundfos universe.

In the following, we will look bit closer on the primary chain stakeholders:

4.3.1 End-users

End-users are individuals (people, technicians, patients, etc) that buy or consume one or more services provided on the eu-DOMAIN infrastructure.

Typically, the end-user can also buy bundles of services from one Service Provider with each service coming from a specific Content Provider.

4.3.2 Content Providers

Content Providers are owners of the content and the services that the end-users ultimately are going to benefit from, including for example energy monitoring services, on-line maintenance of technical installations, healthcare services, security or even entertainment. Content Providers are either paid by the end-users for their usage of the services or they compensate the additional costs of the services by obtaining higher efficiency and lower operational costs.

Content Providers that participate in bundled services are being paid by revenue sharing schemes or directly by one of the other Content Providers or by a Service Provider. If the Content Provider is directly reimbursed by the end user, the main revenues typically comprise the following payments:

- Initial charges for installation and hardware (e.g. service gateways, devices, etc)
- A periodic (e.g. monthly) subscription.
- Content usage fees (i.e. proportional to the quantity of content delivered).

Alternatively, the Content Provider can be paid through the Service Provider, who in turns collects the money from the end-users.

In more complex cases involving bundling of services, the other Content Providers typically get reimbursed on a revenue-sharing basis, with revenues either being collected by a Service Provider or by the lead Content Provider.

4.3.3 Service Providers

A Service Provider is an organisation or firm that establishes the eu-DOMAIN platform and offers the functionality of the eu-DOMAIN infrastructure to end-users. The Service Provider uses one or more Network Operators as backbone and last mile delivery platform to the end-user.

Typically, a Service Provider will offer the services on behalf of a customer (Content Provider) in an ASP-type (Application Service Provider) arrangement and the Service Provider can thus operate several concurrent but separated services for various Content Providers.

The Service Providers generate revenue streams in the form of service fees from the Content Provider and possible subscription and usage fees paid by end-users depending on the contractual framework. Part of the fees can be passed on to other Content Providers that enter into a value constellation with the aim of delivering value-added bundled services to the end-users.

4.3.4 Domain Service Providers

In the case where a Content Provider wants to operate the eu-DOMAIN service exclusively for its own purpose and offer customised, dedicated content and services using the eu-DOMAIN infrastructure in its own domain, we use the term Domain Service Provider.

These services can be embedded into a larger Service Provider service portfolio, but they are completely customised and secluded and fully integrated in the Domain Service Providers product offering.

4.3.5 Service Aggregators

When the Service Providers separate themselves completely from the services delivered on behalf of the Content Providers and specialise in just operating various network infrastructures, e.g. for a series of Domain Service Providers, we use the term Service Aggregators.

Service Aggregators can be likened to network operators (and are often such) that offer capabilities for value-added services on their networks. They only take responsibility for the technical operations of the service and front-end customer support is always directed to the Content Provider or to the Domain Service Provider.

Service Aggregators derive their revenue streams from network traffic fees from end-users or from fixed service fees from the Content Providers or Domain Service Providers or both.

5. Value and value creation

In order to define the term value creation we will start by defining the term "value". Value is co-produced by actors who interface with each other. They allocate the tasks involved in the value creation process among themselves and to other actors.

It follows from the basic human character that a sustainable business can only be built, if its transactions are creating true, lasting values. If there is no added value for the stakeholders, the business will eventually disappear. In this respect, it also makes sense to look at the definition of added value. You *add value* to an organisation when enabling it to grow its business. You *destroy value* from an organisation when reducing its business. The added value from your transaction is thus equal to the size of the pie when you are in the game minus the size of the pie when you are out of the game (Brandenburg & Nalebuff, 1996) [1].

The process of value creation is essential to developing sustainable business models for both Service Providers and customers of the eu-DOMAIN platform. In this section we will therefore take a close look at value, value creation and value constellations.

5.1 Value chains

Michael Porter (1985) [2] defined a value chain as a set of activities through which a product or a service is created and delivered to customers. The value chain model thus describes a sequence of value-adding activities of a single organisation, connecting the organisation's supply side to other actors, where each actor in the chain acts according to hers/his own business objectives.

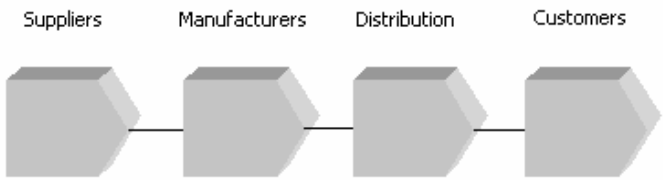

Figure 7 Traditional value chain models

The term value chain implies that the value is created in terms of buying inputs, adding value to it and selling it to the next link of the chain.

It can be argued that the main goods that flow through an e-Business organisation are information. Building on this insight, Rayport and Sviokla (1995) [3] propose a "virtual" value chain that includes a sequence of gathering, organizing, selecting, synthesizing, and distributing information. While this modification of the value chain concept corresponds better to the realities of virtual markets, and in particular to the importance of information goods, it still falls short of fully describing e-Business activities. It may not fully capture the value creation opportunities that result from new combinations of information, physical products and services, innovative configurations of transactions, and the integration of resources, capabilities, roles and relationships among suppliers, partners and customers. This last characteristic highlights the importance of networks in virtual markets.

We shall also point out that in real life value creation is often not limited to the exchange of objects between two partners in a buyer/seller relationship. Value creation can equally well be observed where there are unbalanced, multiparty transactions such as in the healthcare system: In this system, a healthcare service delivered to a patient may be paid for by e.g. tax revenues. Thus in a simplified case, the patient pays for the service delivered to her/him through taxes or insurance premiums. The healthcare commissioner (government or insurance company) pays a healthcare provider to provide the service to the patient and thus closes the loop. In the real world, the setup is even more complicated due to more actors involved, complex and variable (inconsistent) decision-making processes and broken up temporal decoupling between payment and delivery.

Value chain analysis can thus be helpful in analysing value creation in physical products markets but have only limited usability in virtual markets like those based on eu-DOMAIN e-Business services, where the value chain model does not fully capture the essence of the value creation mechanisms.

5.2 Value nets

The highly dynamic world of Internet services and e-Business, which began to flourish in the beginning to mid 1990s, needed a new value paradigm in order to fully capture and understand the value creation process in virtual markets.

Normann and Ramirez (1993) developed a value creating system concept by observing that new technologies are opening up new ways of creating value. They argue that value creation is the process of *co-producing* offerings (products and services) in a mutually beneficial seller/buyer relationship. This relationship may include other actors. In the value constellation relationship, the parties behave in a symbiotic manner leading to activities that generate positive values for them.

The actors came together to interact in a process of co-producing value and the concept of value nets was introduced by Brandenburg and Nalebuff (1996) [1] where they asserted that business is simultaneously both competition and cooperation.

Business strategy frameworks must increasingly look to the role of *complements* in their product offerings. A player is a *complementor* if customers value hers/his product more when they have the another player's product than when they have the product alone. A player is a *competitor* if customers value hers/his product less, when they have the other player's product than when they have the product alone.

In value nets, customers and suppliers play symmetric roles. Mistreating the supplier when serving the customer can destroy value instead of creating it, i.e. suppliers are needed for serving customers. Competitors and complementors play mirror-image roles. A single company can be a competitor in certain instances and complementor in other (e.g. emerging vs. mature markets).

Whereas competitors divide markets, complementors help to create or grow markets (in emerging markets most participants are complementors). With the emergence of Ambient Intelligence networks and global connectivity, a new paradigm has evolved where information, connectivity and time define new business opportunities. Information is richer in quality and quantity, promoting collaboration among actors. The end results are highly competitive environments where rivals can emerge overnight from unexpected places, such as traditionally non-competing industries.

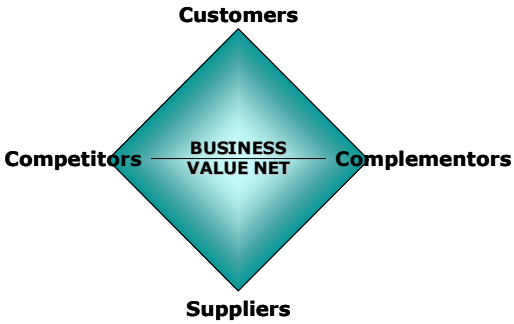

Figure 8 Business value net

The existence of eu-DOMAIN will enhance business dynamics and make the collaborative value inherent in co-operation more necessary than ever.

5.3 Value constellations

This new logic of value has significant implications for the firm's strategy. According to Normann & Ramirez (1993) [4], strategy is the art of creating value. In a competitive environment, strategy is no longer a matter of positioning a fixed set of activities along a value chain. Their focus of strategic analysis is not the company or even the industry but the value creating system itself, within which different economic actors – supplier, business partners, allies, and customers – work together to co-produce value. The key strategic task is the reconfiguration of roles and relationships among the constellation of actors in order to mobilise the creation of value in new forms and by new players.

As value is created within these complex constellations, competition is no longer between firms but between offerings, which are, in turn, the result of cooperation between complementors. The notion of offering now addresses this issue of value co-production. Offering is the result of a complex set of value creating activities involving different actors working together to produce it for and with the customer.

The new logic of value thus presents companies with three strategically important implications:

1. The goal of a business is not to make or to do something for customers, but to encourage customers to take advantage of a multitude of offerings and hereby create value for themselves
2. *Companies* do not compete with each other any more. *Offerings* compete for time and attention of customers. The notion of the company and/or supplier becomes secondary.
3. A company's principal strategic task is the reconfiguration of its relationships and business systems to align it with the new customer focus.

The concept "value constellation" replaces the value chain idea. One key word in value constellation is value co-production. Within this framework, it is not companies that compete with each other, but different offerings in terms of combinations of products and services. Value occurs not in a sequence way but in complex constellations of different actors.

5.4 Applying Dynamic Value Constellation principles

The eu-DOMAIN platform is capable of delivering a number of simultaneous services from a number of different content providers and is thus fully capable of supporting organisations' business models based on the Dynamic Value Constellation concept.

For each of the two scenarios that were developed for healthcare and industrial services, Dynamic Value Constellation is applied as follows:

In the healthcare domain, different content providers such as the local GP Dr. Hayworth, the Patient Advisory and Liaison Service (PALS) outreach service organisation, and the Muslim Health Diabetes Support Service (MHDSS) centre are cooperating to supply a bundled healthcare service to the patient and her family. The Service provider is Eastern Birmingham PCT under contract with the national healthcare commissioner NHS. The service offering is a complex service of clinical investigations and diagnosis, expert consulting and training, clinical monitoring, life-style support and feed-back as well as prevention of critical situations. The offering is constantly changing in content and delivery according to the patient's acute needs.

In the industrial service domain, the different content providers are AEM Facility Management, Servizio Provinzia S.r.l., and Grundfos. Combined they deliver Total Facility Management services to the customer Giovanni di Prolongo. The Consorzio del Prosciutto di San Daniele is the overall commissioner of the combined cold store facility in the Friuli area, having responsibility for all members' cold stores, whereas the total management and operation has been outsourced to AEM Facility Management. The service offering is a complex bundling of services like knowledge-based preventive and predictive maintenance, remote monitoring, and operational compliance and documentation. The offering is constantly changing in content and delivery according to the operational conditions of the cold stores.

6. Value engineering

eu-DOMAIN services are advanced e-Business (electronic business) services delivering value to customers and other actors through electronic interchange. e-Business is, in its simplest form, the conduct of business on the Internet. It is a more generic term than e-commerce because it refers not only to transactions of buying and selling but also servicing customers through electronic services and collaboration among business partners and mobile workers. In 1997, IBM was one of the first to use the term when it launched a campaign built around the term.

e-Business and e-commerce are often used concepts in conjunction with the use of Internet technologies by organisations. There is a subtle but important difference between e-commerce and e-Business. To explain the difference, we use the definition introduced by Hartman et al. (2000):

> *An e-Business initiative is any Internet initiative - tactical or strategic - that transforms business relationships, whether those relationships be business-to-consumer, business-to-business, intra-business, or consumer-to-consumer.*
>
> *An e-commerce initiative is a particular type of e-Business initiative that is focused around individual business transactions that use the Internet as medium of exchange, including business-to-business as well as business-to-consumer.*

These definitions differ mainly in scope: e-Business is about supporting and enabling business or organisational relationships in general, while e-commerce is about pure business transactions between different companies and/or end-consumers.

Today, a very large number of organisations are rethinking their businesses in terms of electronic services in order to exploit the convenience, availability, and global reach of the Internet. Some industries are forced to find new value propositions because of fundamental changes in their underlying business environment due to the emergence of disruptive technologies or globalization of the market place. For instance, the digital content industry must find new ways to deliver their products due to the emergence of digital recorders such as the mp3-players. The industrial components manufacturers, such as Grundfos, must find new ways to deliver higher-value products to the global facility management industry.

Over the past decade, many innovative e-Business ideas have been implemented revealing new value propositions, enabled by new technological possibilities. However, in the late 1990s it became painfully clear that many e-Business ideas were not successful and the providers were not able to derive profits from them.

An important reason for the failure of these ideas is a more or less complete lack of a sound value proposition to the customers. The solutions are predominantly derived from "technology hype" rather than from real customer needs. Moreover, many e-Business ideas do not contribute sufficiently to the firms' profitability, but are focused on other business goals such as maximising market shares and/or establishing customer loyalty and hence are allowed to sustain despite poor economic performance. In e-Business solutions involving several suppliers and providers, the lack of a full understanding of the value creation process often leads to unbalanced revenue streams and thus unevenly distributed profits across the value system.

The lack of profitability is still very much the problem in a variety of e-Business concepts above basic e-commerce initiatives, such as digital content delivery, remote monitoring, remote meter readings, telemetry, etc. The objective of eu-DOMAIN platform is to prove that many potential successful e-Business ideas can be developed as long as the value proposition is clear and acceptable to all stakeholders, that the value creation in the value net is fully understood and that the distribution among the different actors allows sufficient profitability to be generated in each node.

The target group of the eu-DOMAIN platform encompasses a variety of different organisations, some of which are operating purely with the aim of creating economic profits to their shareholders (e.g. Grundfos); some with the aim of maximising cost/benefit to the society or other stakeholders (e.g. EBPCT). For the sake of simplicity, we will assume that *all of these organisations will be using the eu-DOMAIN platform to conduct e-Business activities*. This means that the common goal of these

actors is to create profit (or positive cost/benefit), or to obtain products or services, which are of economic (or cost/benefit) value to them. To do so, they perform value activities, for which they need to exchange objects of economic value with each other.

A challenge in putting e-Business ideas into operation, in addition to satisfying the profitability requirements, is that business and technology must work closely together. The eu-DOMAIN platform has been designed to meet precisely this challenge:

- The eu-DOMAIN Domain Model concept will accommodate most, if not all, of the known business domains (possibly excluding military applications).
- The embedded Ambient Intelligence rules engine allows for the modelling of practically any existing business process.
- The local service gateway concept allow for direct integration with both existing and new business installations.
- The unique three-tier intelligence system creates full flexibility in business processes and integration with existing, standardised and proprietary data repositories needed for creating particular business cases

In this chapter we will look at a theoretical modelling framework suitable for describing the value creation on each of the two domains: Healthcare and Industrial Services.

6.1 Value modelling

The notion of an e-Business service (as facilitated by the eu-DOMAIN platform) in which an actor offers something of economic value to another actor, and that such a value proposition is an important profit generator for actors, is relatively new to the requirements engineering community according to Gordijn [5], but will be typical for many future eu-DOMAIN projects.

The first key question to be answered in the engineering of a particular new e-Business service based on the eu-DOMAIN platform is the feasibility of the idea in terms of value proposition to the customer (or the actor who is providing funds for the service) and in terms of profitability of each of the actors in the value net. This question must be answered for all new services, with many different types of stakeholders involved and in a short timeframe. Also, stakeholders must have a common understanding of the e-Business idea, before they can engage in a more detailed requirements engineering track.

In a typical engineering situation for a new e-Business service, the Service Provider (or concept owner) of the eu-DOMAIN platform will analyse the service proposition together with a potential customer (or service aggregator). The analysis must be performed quickly and often with an imperfect or partly unknown data foundation, which is subject to frequent update. The analysis must provide answers to the following questions:

1. Is the service feasible in terms of value proposition to the customer or to the end-user?
2. Is the service overall profitable or has it a positive cost/benefit ratio?
3. Is the global profitability fairly distributed on all the involved actors?
4. Is the intended service feasible in terms of usability (scenario implementation)?
5. Is the service easily understood and acceptable to all stakeholders?

In order to provide the answers to these questions, a conceptual modelling tool should be at hand. Based on the above requirements, and with a view to the future exploitation of the eu-DOMAIN products, we will, in this section, specify and identify a suitable value-modelling tool with the following characteristics:

- A lightweight approach to carry out the value analysis in a limited timeframe.
- An economic value aware approach to capture and evaluate a value proposition (question 1).
- A multi-viewpoint approach to deal with a wide range of stakeholders (question 3).
- A graphical conceptual modelling approach to create a common understanding (question 5) and rapid evaluation and value analysis of the e-Business idea (question 2) with frequent updates to the underlying data foundation.

- A scenario approach to create a common understanding of an e-Business idea (question 5), to capture and present a value proposition (question 1), and to evaluate the usability of the e-Business idea (question 4).

Based on an extensive search for suitable value modelling tools (se chapter 7 below), we have selected the **e^{3}value** methodology and tool to be used with the eu-DOMAIN platform.

The e^{3}value methodology and underlying conceptual modelling techniques was developed by Jaap Gordijn at the Vrije Universiteit Amsterdam for evaluation of bundling of complicate products and services based on the analysis of economic value creation, distribution and consumption in multi-actor network [5]. The e^{3}value methodology has also been used in the OBELIX project (Ontology-Based ELectronic Integration of CompleX Products and Value Chains, IST-2001-33144) [6].

The e^{3}value software tool was developed in PROLOG by Arthur Koks, Stephan Hoekstra and Dennis Veltrop at the Vrije Universiteit Amsterdam [7] and has kindly been provided to the eu-DOMAIN project by Dr. Jaap Gordijn.

6.1.1 A lightweight approach

The developments of new eu-DOMAIN e-Business services are characterized by short development times. A typical timeframe is expected to be in the range of three to six months from idea to a first implementation. Only a portion of this timeframe is available for exploration of the e-Business ideas. Further, the analysis is often performed as part of a sale and marketing activity with the objective of attracting a new business partner, so the amount of time invested in the analysis should be kept relatively low. So, within a certain timeframe, only limited manpower is available. Consequently, the first phase of e-Business requirements engineering should be a lightweight approach.

The notion of lightweight methods is often used in the realm of formal methods. Gervasi & Nuseibeh [8] define lightweight methods as methods whose adaptation costs is a small fraction of that of the overall requirements engineering process including training, application, and computational costs. To do so, a lightweight approach should support partiality in modelling, in analysis, and in composition.

To have partiality in modelling, the e^{3}value methodology emphasizes the goals to be reached with the help of developing models and avoids details, which do not contribute to those goals. A first goal is to create common understanding of the essentials of the e-Business idea. A second goal is to gain confidence in the economic feasibility of the e-Business idea. To this end, the e^{3}value methodology focuses only on substantial expenses and revenues related to the idea, sufficient to do a sensitivity analysis. Moreover, rather than detailed financial effects, the methodology only performs partial analysis: value propositions and business processes with respect to substantial revenues and expenses. As regard partiality in composition, the e^{3}value methodology uses a limited number of viewpoints and relates these viewpoints only loosely by using operational scenarios.

6.1.2 A graphical conceptual modelling approach

A conceptual modelling approach comprises the activity of formally defining aspects of the physical and social world around us for the purpose of understanding and communication [9]. The activity of modelling is well known and accepted in the information technology community for describing information system requirements, but business oriented stakeholders, such as customers or domain Service Providers seeking to exploit the eu-DOMAIN platform, are often unaware of this approach. Such stakeholders use natural language requirement representations, but there are a number of drawbacks with natural language representations, such as noise (irrelevant information), silence (omission of important information), over-specification, contradictions, ambiguity, forward references, and wishful thinking [10].

The e^{3}value methodology has proven to be very useful for the exploration of e-Business ideas, because it can be easily communicated to business oriented stakeholders in order to enhance the common understanding of an e-Business idea and it can be used to evaluate an e-Business idea with respect to economic feasibility. It has a graphical language, which can be used to express almost any kind of e-Business model and the semantics of the language is commonly understood by stakeholders to facilitate a common understanding of the models.

6.1.3 A multi-viewpoint approach

In development of innovative eu-DOMAIN services, stakeholders with a technical or traditional business background will need to work side-by-side with value proposition oriented stakeholders, such as healthcare commissioners or Facility Managers. It can be foreseen that during eu-DOMAIN development projects, the value proposition oriented stakeholders will play a dominant role, because such projects create new products or services for an organisation.

The development work will thus need to represent different perspectives grounded in differences in skills, responsibilities, knowledge and expertise of stakeholders. In requirements engineering, viewpoints are seen as a mechanism to deal with the aforementioned multi-perspective problem, by decomposing complicated requirement issues into self-contained perspectives, which can be addressed and decided on relatively independent from each other. As such, Finkelstein et al. define a viewpoint as: *"a combination of the idea of an actor, knowledge source, role, or agent in the development process and the idea of a view or perspective which such an entity maintains".* [11]

The e^{3}value methodology use viewpoints as a way to clarify stakeholder discussions and use the various kinds of stakeholders as a driver for viewpoint identification.

6.1.4 Scenarios used for validation

A main requirement with respect to an e-Business idea is that all actors will be profitable, or in the case of end-users, that it will produce something of economic value for them. It is not possible to prove this, but doing sensitivity analysis may contribute to an increased confidence in the business model. Validation of the business model is therefore mainly about assessing profitability as experienced by the involved stakeholders. For doing so, the e^{3}value methodology exploits scenarios and scenario paths.

The purpose of scenarios in this context is to capture the e-Business idea and provide a starting point for modelling it. From a content point of view the scenarios put the end-users' needs into operation thus enforcing the stakeholders to take an outside-in perspective of the business model. Scenarios thus have a narrative, informal and textual form and the scenarios developed in eu-DOMAIN can directly be incorporated into the e^{3}value methodology, as discussed in section 10 below.

During specification of the e-Business model, the scenarios are detailed and defined more precisely by scenario paths. A scenario path can be seen as a specific instance of a scenario and shows causal relations between events. Scenarios paths take the form of use case maps (UCMs), lightweight, semi-formal, graphical way of specifying scenario paths.

Scenarios are used to relate and integrate viewpoints but a danger of using various requirement viewpoints is that they become unrelated and/or inconsistent, while they should refer to the same phenomena in reality. To address this, the e^{3}value methodology uses the same basic scenario but details it on the different viewpoints with different scenario paths. The content captured by scenario paths thus depends on the viewpoint they are defined for. Because the scenario paths on the various viewpoints are based on the same basic scenario, viewpoints remain related.

6.2 Modelling tools

A number of relevant business models and corresponding modelling tools have been investigated in order to find the most appropriate tool for eu-DOMAIN.

6.2.1 Value chain analysis

Value chain analysis decomposes the firm into its activities and then studies the economic implications of those activities. It includes four steps: (1) defining the strategic business unit, (2) identifying critical activities, (3) defining products, and (4) determining the value of an activity. The main questions that the value chain framework seeks to address are the following: 1) what activities should a firm perform, and how? And 2) what is the configuration of the firm's activities that would enable it to add value to the product and to compete in its industry? Value chain configuration includes primary activities that have a direct impact on value creation, while support activities affect

value only through their impact on the performance of the primary activities. Primary activities involve physical products and include inbound logistics, operations, outbound logistics, marketing and sales, and service.

Value chain analysis can be helpful in analyzing value creation in real markets. However, value chain analysis may have only limited applicability for virtual markets. Stabell and Fjeldstad (1998) [12] found the value chain model more suitable for the analysis of production and manufacturing firms than for services firms where the resulting chain does not fully capture the essence of the value creation mechanisms of the firm. Citing the example of an insurance company, they ask: "What is received, what is produced, what is shipped?".

Since business modelling related to eu-DOMAIN involves complex value constellations, value chain analysis has not been seen as a useful tool that can provide the answers we are looking for.

6.2.2 UML specifications

The most widespread tool in the ICT world is the Unified Modelling Language (UML) specifications, which we can use to model actors, interactions and various information technology requirements from different angles. However, there is no technique available for representing a value proposition in such a way. Modelling a value proposition is needed to allow for a more detailed value offering analysis.

6.2.3 The GEMINI project

The IST project GEMINI (IST-2001-33400) has, within the context of Digital Television, developed an integrated mediation platform to fulfil viewer's demand, through the use of content aggregated from various Content Providers [13].

The project exploits the dynamic constellation form of cooperation and has developed a Dynamic Value Constellation business model that can assemble various partners of the digital value chain, but focused mainly on content providers.

The GEMINI business model is based on the traditional value chain model in the media industry, where the network platform and the consumer/user environment constitute two elements of the supply or value chain starting from content creation through to content packaging, service provision and final delivery to customers. The term value chain means that the value is created in terms of buying inputs, adding value to it and selling it to the next link of the chain. The project then introduces the concept of "value constellation" to replace the value chain idea. This move allows for the inclusion in the business models of new actors like GEMINI Service Providers, advertising agencies as well as concepts of content syndication. Finally, by making the value constellations dynamic (supported by the GEMINI technology infrastructure) the end result is a dynamic value constellation business model where Content Providers and Service Providers dynamically constellate in order to fulfil customers demand for value added services.

The GEMINI does not use a formalistic approach to business modelling and does not offer a modelling tool for the model description.

6.2.4 The OBELIX project

The IST e-Business ontology project OBELIX (IST-2001-33400) focuses on researching and providing smart scaleable integration and interoperability capabilities needed in the e-Business stage of dynamic value constellations, characterised by much more complex products and services, supply chains and value networks, and associated electronic market transactions. As such, OBELIX has developed a generic ontology server, an ontology library for smart collaborative e-Business and several ontology-based application tools.

The entire value modelling in the OBELIX project is based on the e^3value tool described below. The main aim of the OBELIX project is thus to build an on-line ontology library and validate the business models in various real life applications of customised commercial offerings (Digital Music, Energy Trading and Servicing, Online Design of Events).

7. The e³value methodology

In the preceding chapter we argued why we have chosen the e³value methodology for defining and validating eu-DOMAIN business models. To bring about innovative sustainable business models for eu-DOMAIN services, we need a model to identify and represent *economic value creation* and to capture *value propositions* in complex e-Business systems.

Our decision was based on the notion of economic value and how actors create, exchange and consume objects of economic value. We also decided to concentrate on the *value viewpoint*, which focuses on creation, distribution and consumption of economic value objects. We concluded, after consulting with the inventor of the e³value methodology, that the use of this tool would most likely suite our needs.

This chapter briefly outlines the e³value methodology adopted from Japp Gordijn (2002). For a comprehensive description of the methodology and the modelling tool, we refer to the thesis by Dr. Gordijn and to the user manual for the software tool.

7.1 The e³value ontology

The ontology specifies generic terms and definitions for important concepts. It provides a vocabulary for the language used to handle information and operational data in eu-DOMAIN scenarios. We use the ontology to describe concepts and relations between the many instances of data and relationships in eu-DOMAIN framework, which makes up our value models.

The e³value ontology is organized in three sub viewpoints each discussing related requirement types.

The global actor viewpoint

This viewpoint shows the *actors* involved and the *objects of economic value* created, exchanged, and consumed by these actors. It also shows the objects of value, which actors expect in return for an object of value delivered, or the mechanism of *economic reciprocity*. Further it shows objects, which are offered or requested *in bundles* and *phenomena* that cause *exchanges* of objects between actors.

The detailed actor viewpoint(s):

This viewpoint shows the *partnerships* between actors when actors request or offer objects of value jointly, *constellations* of actors, which need not to be seen on the global actor viewpoint, e.g. to avoid unnecessary complexity plus *requirement expressions* as on the global actor viewpoint, but then only for actors expressed on the detailed viewpoint.

The value activity viewpoint(s):

This viewpoint shows the value-*creating or adding activities* and their assignment to actors. The main purpose of the global actor viewpoint is to explain the overall value model to all stakeholders involved. It hides complexity, which can be shown on detailed actor viewpoints.

The reason to include a detailed actor viewpoint is twofold: (1) representation of constellations: a decomposition of a part of the global actor viewpoint to reduce complexity, and, (2) representation of partnerships: actors who decide to offer and/or request products or services as one virtual actor to/from other actors. Finally, the value activity viewpoint is included to show what actors do to create profit or to increase value for themselves.

7.2 The global actor viewpoint

The ontology is explained by presenting a description for each concept, properties of the concept, relations with other concepts, and the way of visualisation in a value model. Japp Gordijn exemplifies the ontology by looking at a free Internet Service Provider:

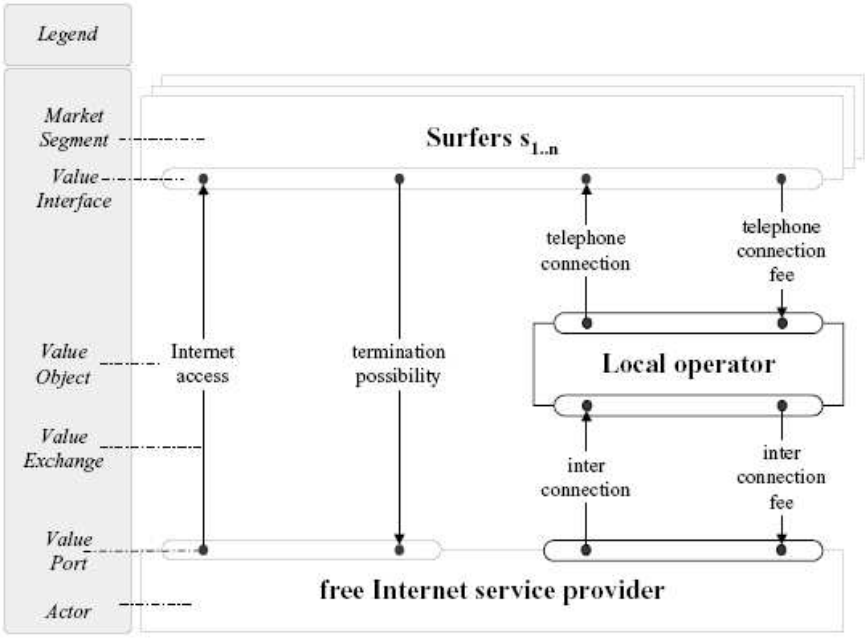

Figure 9 The e[3]value concept exemplified with a free Internet Service Provider (Jaap Gordijn, 2002)

Figure 10 shows the various concepts and relations of the e[3]value ontology using the global actor viewpoint. The notation is based on UML class diagrams. Rectangles are concepts, related by associations (lines). Concepts play a role in an association. Also, cardinality constraints are expressed. For instance, the association between actor and value interfaces reads: a value interface is assigned to zero or one actor, and, an actor has one or more value interfaces.

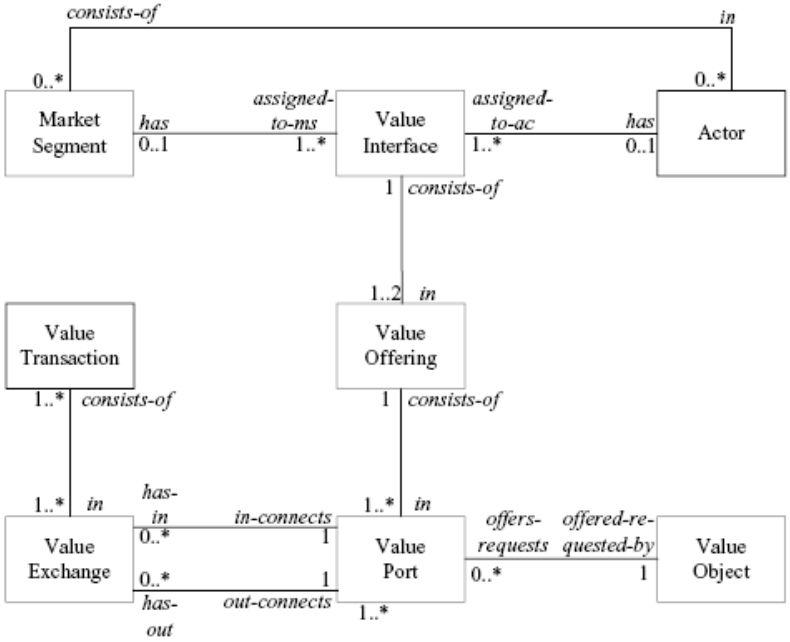

Figure 10 The e[3]value ontology expressed in a UML class diagram (Jaap Gordijn, 2002)

In this brief overview, we will concentrate on the main definition in the ontology, so that the reader may get acquainted with the terminology before we start to build the actual eu-DOMAIN models in a later chapter.

Actor. An actor is an economically independent entity. Firms and end-consumers, government agencies and patients are examples of actors. Economically independent refers to the ability of an actor to be profitable after a reasonable period of time (in case of an enterprise), or to increase value for him/herself (in case of an end-consumer). In the case of government agencies and not-for profit organisations, the profitability motive takes the form of cost/benefit maximisation or budget fulfilment. A sound and viable e-Business idea requires that each actor can be profitable or can increase her/his value.

Properties. An actor has a name or a role name that represents the role such an actor plays.

Visualisation. An actor is depicted by a rectangle, with its organisation or role name.

Market Segment. A market segment is defined as a concept that breaks a market consisting of actors into segments that share common properties. The notion of market segment is employed to show that a number of actors assign economic value to objects equally. This construct is used to model when a large group of end-consumers value objects equally (e.g. pump customers). Most likely no actor will in reality value objects exactly the same, but the assumption is a simplification needed to arrive at comprehensible value models.

The modelling purpose of the market segment construct is not to model each actor individually. However, actors are independent companies or individuals and as such, a specific actor in a market segment may exchange other value objects than those mentioned in the market segment. Consequently, a market segment groups value interfaces of actors, exchanging objects that are valued equally, rather than grouping actors themselves. If an actor, who is part of a market segment, has additional value interfaces, which other actors in that segment do not have, such an actor must be modelled explicitly.

Properties. A market segment has a name and a count, which indicates the number of actors in the segment.

Relations. Because a market segment is a set of actors, a value interface can be assigned to zero or one market segment, just as an interface can be assigned to an actor. Actors in the segment value objects exchanged via this value interface equally.

An actor can be in a market segment. This relationship is needed to represent actors who have, besides value interfaces of a market segment, additional value interfaces of themselves. The additional interfaces are then directly related to the actor, while the relationship between actor and market segment is used to represent an actor's interfaces stemming from a membership in a market segment.

Visualisation. A market segment is shown as three stacked actors. A value interface of a market segment is presented on one of the edges of the topmost actor. An explicitly modelled actor who is also part of a market segment is mentioned in the name of the market segment. Value exchanges drawn to a segment is a substitute for value exchanges drawn to all actors in that segment.

Value Object. Actors exchange value objects. A value object is a service, a product, a medical therapy or just well-being, which is of economic value for at least one of the actors involved in a value model. Actors may value an object differently and subjectively, according to their own valuation preferences. While the valuation of services and products in the industrial service sector can be relatively straight forward, it poses considerable problems to perform valuation in the healthcare sector. We will deal with the issues of valuation more thoroughly in a later chapter.

From a modelling point of view, we are interested in the *kind of value objects* which actors exchange, and not so much in the actual instances themselves. Therefore, when we speak about value object, we mean the kind of value object for all instances of a particular value object. In some cases, it is necessary to refer to the actual instances of objects of value exchanged by actors. These objects are then called *value object instances*.

Properties. A value object has a name that expresses the object from an economic value point of view.

Visualisation. A value object is presented by showing the name of the object nearby a value exchange representing a potential trade of such an object, or by showing the name nearby value ports offering or requesting objects (to be discussed below).

Value Port. An actor uses a value port to provide or request value objects to or from her/his environment, consisting of other actors. Thus, a value port is used to interconnect actors so that they are able to exchange value objects. A value object flowing into or out of an actor denotes a change of ownership.

The concept of a value port is important, because it enables to abstract away from the internal business processes, and to focus only on how external actors and other components of the e-Business value model can be "plugged in". The notion allows us to model a typical e-Business exchange: e-service port out and a money port in, or the other way around.

Properties. A value port has a direction, which can have the values "in" (called an in-port) or "out" (called an out-port) indicating whether a value object flows into or out an actor (seen from that actor).

Relations. A value port offers or requests *one* value object. A value object can be requested by or offered by zero or more value ports.

Visualisation. The value port is depicted by a small black filled circle. Value in-ports have an incoming arrow. The name of the value object offered/requested by the port can be depicted.

Value Offering. A value offering models what an actor offers to (an out-going offering) or requests from (an in-going offering) her/his environment, and closely relates to the value interface concept (see below). A value interface models an offering of an actor to the environment, and the offering such an actor requests in return from the environment. An offering is a set of equally directed value ports exchanging value objects, and implies that all ports in that offering should exchange value objects, or none at all.

Some objects may only be of value for an actor if they are obtained in combination (the notion of bundling). In-ports exchanging such objects then form an in-going offering. Actors may also decide to offer objects only in combination (the notion of complementors). Ports offering such objects then form an out-going offering.

Relation. A value offering consists of one or more equally directed value ports. A value port is in exactly one offering.

Value Interface. Actors have one or more value interfaces. In its simplest form, a value interface consists of one offering, but in many cases, a value interface groups one in-going and one out-going value offering. It shows then the mechanism of economic reciprocity since actors are only willing to offer objects to someone else, if they receive adequate compensation (i.e. other value objects in an in-going offering) in return. So the value interface can model that an actor is willing to offer something of value to the environment but requests something in return, whereas a value offering models that objects can only requested or delivered in combination.

Either all ports in a value interface (via value offerings) precisely exchange one value object instance each, or none at all. This ensures that if an actor offers something of value to another actor, the first actor always gets the compensation in return.

Relations. A value interface is assigned to zero or one actor and consists of one or two value offerings; the latter case being an out-going offering and an in-going offering. Each actor has it's own value interface. Multiple value interfaces can be assigned to an actor and a value offering belongs to exactly one value interface.

Visualisation. A rounded box at the edge of an actor visualises the value interface. Value ports are drawn in the interior of the rounded box. Note that a value offering is not visualised explicitly. However, value offerings can be easily seen by grouping all out-going value ports in a value interface (the out-going offering), or by grouping all in-going value ports in a value interface (the in-going offering).

Value Exchange. A value exchange is used to connect two value ports with each other. It represents one or more potential trades of value object instances between value ports. As such, it is a prototype for actual trades between actors. It shows which actors are willing to exchange value object instances with each other. A value exchange does not model actual exchanges of value object instances. The actual exchanges are called *value exchange instances*.

Relations. The value ports involved in a value exchange are represented by the "has in" and "has out" relations, which relates to exactly one in-port and exactly one out-port. A value port may connect to zero or more value exchanges.

Visualisation. A value exchange is shown as line between value ports. The name of the value object, which is exchanged, is presented nearby the value exchange.

Value Transaction. A value interface prescribes the value exchanges that should occur, seen from the perspective of an actor the value interface is connected to, because all ports in a value interface should exchange objects, or none at all. Sometimes, it is convenient to have a concept that aggregates all value exchanges, which define the value exchange instances that must occur as consequence of how value exchanges are connected, via value interfaces to actors. This concept is called a *value transaction*. In its simplest form, a transaction is between two actors but can be between more than two.

Relation. A value transaction consists of one or more value exchanges. The exchanges in a value transaction must be consistent with the way these exchanges are connected to value interfaces. A value interface requires that if a value object is exchanged via a port, exchanges must also occur via all its other ports. These exchanges must also be part of the transaction.

Visualisation. A value offering is shown by a line intersecting the value exchanges it contains. Small filled circles show the intersection points.

7.3 Scenario paths

During the business modelling work, the eu-DOMAIN scenarios are defined by scenario paths. A scenario path can be seen as an instance of a scenario element, and shows causal relations between the different actors and their value exchange.

Scenarios are used to relate and integrate viewpoints and to explain the viewpoint models to stakeholders. We use elements from the eu-DOMAIN scenarios and detail these scenario elements with different, but related, scenario paths. One business model can thus contain multiple scenario paths reflecting the same scenario.

The scenario paths are presented by dashed lines. They originate from a start stimulus and always end in an end stimulus. In the diagrams, two frequently used scenario path constructs are used. The AND construct is used to spawn (AND-fork) and synchronize (AND-join) multiple parallel scenario

paths. The OR construct is a mean to express that a scenario path continues in alternative directions and may end up in different end stimuli.

7.4 Value model evaluation

After the successful creation of a value model, it must be analysed and evaluated. This is done by creating profitability sheets for actors and by using the scenarios to assess sensitivity for foreseen future events and misassumptions.

To facilitate the creation of profitability sheets, the e^{3}value tool uses predefined Excel spreadsheets, which are filled in automatically by the graphical model tool (see chapter 8 below). There are four types of profitability calculations:

- Elementary actor
- Composite actor
- Market Segment
- Value Activity

The *actor profitability sheet*s show the estimated profitability or consumer value on various abstraction levels for value activities, individual actors, composite actors (complementors), and market segments. Profitability contribution is calculated on the actor level, but also on value interface and scenario path level. The actor profitability sheet uses the value transaction/value exchange to calculate effects of value objects flowing into and out an actor as a result of scenario path execution. To do so, valuation functions are used, which in turn may use special e^{3}value valuation properties defined in the model. Please refer to chapter 10 for an evaluation of the baseline value models for both Industrial Service and Healthcare (chapters 12 and 13 provide an evaluation of the new business models developed).

8. The e3value graphical visualisation tool

A consistent application of the e3value methodology in complex business modelling quickly reveals a need for a modelling tool to support the development, analysis and communication of model results. Constructing one or more value models, creating profitability sheets and calculating profitability numbers takes too much time, if it is to be done manually and limits the number of model iterations one can do in a given time frame.

Hence for the modelling work in eu-DOMAIN, we will be building value models, analysing business cases and present these using the e3value software tool developed in PROLOG by the team at VU Amsterdam (Arthur Koks, et al., 2002).

8.1 The graphical components

Figure 11 shows the collection of visual elements in the e3value tool. Most of the concepts in the e3value ontology are found in this figure. The grey areas represent actors, market segments and value activities. The value interfaces are oval white areas on the edge of actors and market segments and the tiny triangles in these value interfaces represent value ports. Some ports are directed outward from a value source; others are directed inward to distinguish in-ports and out-ports. On the outward side, ports are connected to other value sources. These connections represent value exchanges.

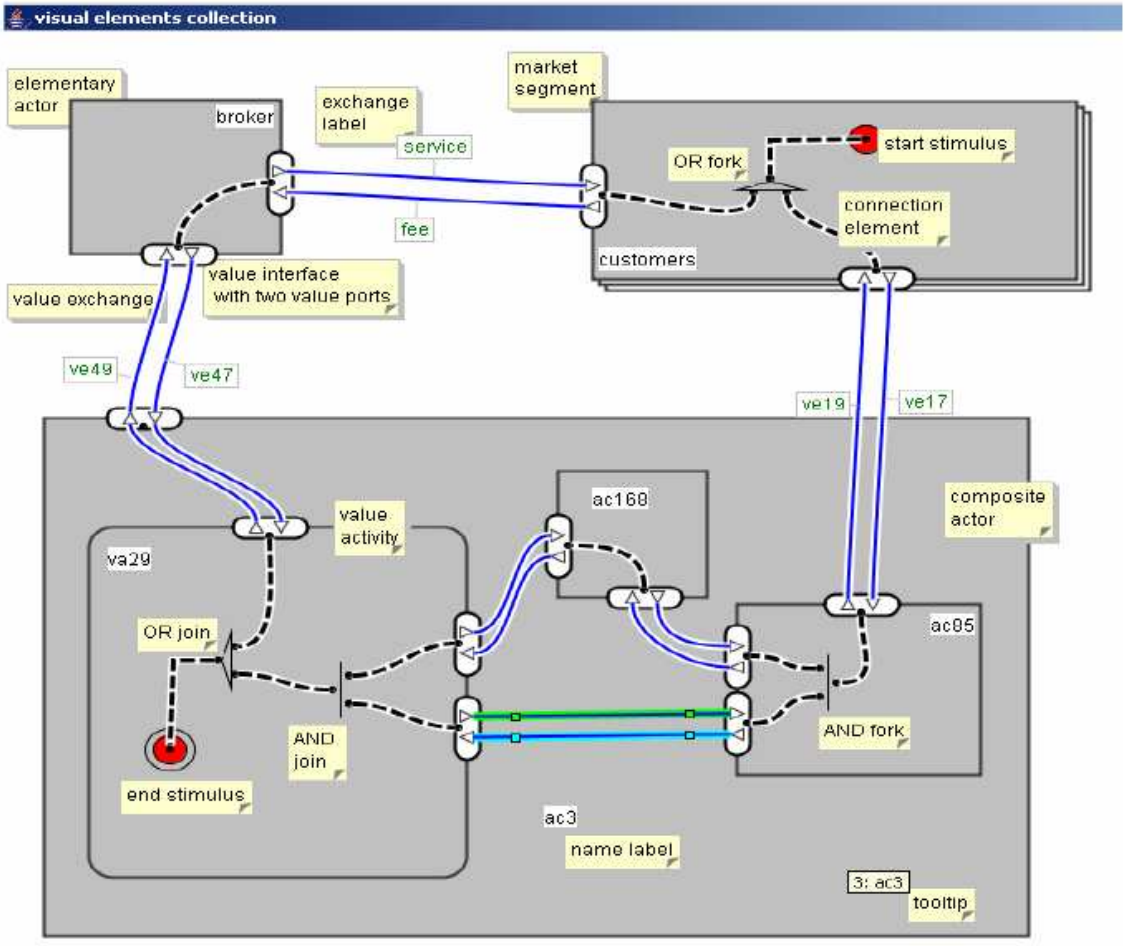

Figure 11 Graphical presentation of the e3value model (Arthur Koks, et al., 2002)

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

8.2 Building the model: Adding components

Building a value model starts with the establishment of market segments and actors. All segments and actors are created in the model tool using drag and drop techniques. Actors that operate as part of market segments or as part of other actors are placed inside these. Market segments and actors are then assigned proper, describing names.

The next step consists of assigning value activities, i.e. the value-creating or adding activities, to the actors in the model. The value activities are placed inside the actors who perform these activities.

With all actors and value activities in place, it is time to add value interfaces, ports and exchanges. Value interfaces are dropped on actors and market segments and as many value ports as are required can be inserted into the value interface. Value ports are then configured as in-ports or out-ports. Finally, value exchanges are modelled by connecting two value ports. More complex structures, such as bundling, complementors, alternative value offerings, etc. can be modelled at this stage. When all value components have been modelled, the basic model is complete.

Next, the task of building the scenario begins. First, we need to add the start-stimulus and one or more end-stimuli to the model. The scenario path is constructed by connecting the start-stimulus from one scenario element to another, eventually reaching the end-stimuli with dotted scenario path lines. AND and OR forks are introduced to describe alternative scenario paths.

Thus having built the basic e^{3}value model, we start to assign properties to the model elements, in order to be able to analyse the business model behaviour. All the objects of the e^{3}value model have properties. Besides the graphical properties (size, colour, font, etc.) the special e^{3}value properties are used to provide information to the model on business characteristics. For example, we define a value port exchanging a value object called "Money". In the value object properties we can set properties such as currency and exchange rates to be used on formulas involving this value object, as shown in Figure 12.

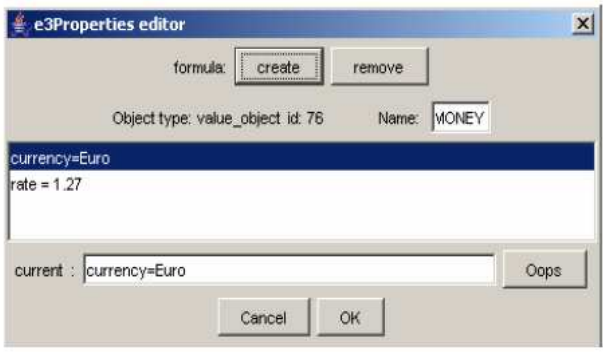

Figure 12 Properties editor used with value object MONEY

8.3 Building the model: Adding transactions

Now we can move on to model the value transactions. When modelling value exchanges, it is important also to create the appropriate value transactions and assign them to the value exchanges correctly. The e^{3}value tool uses value transactions in the process of generating parts of the profitability sheets, and therefore it is required that value transactions be correctly assigned in the model. Value transactions are created by selecting all the value exchanges that belong to the transaction and collect them in a single value transaction, as depicted in Figure 13.

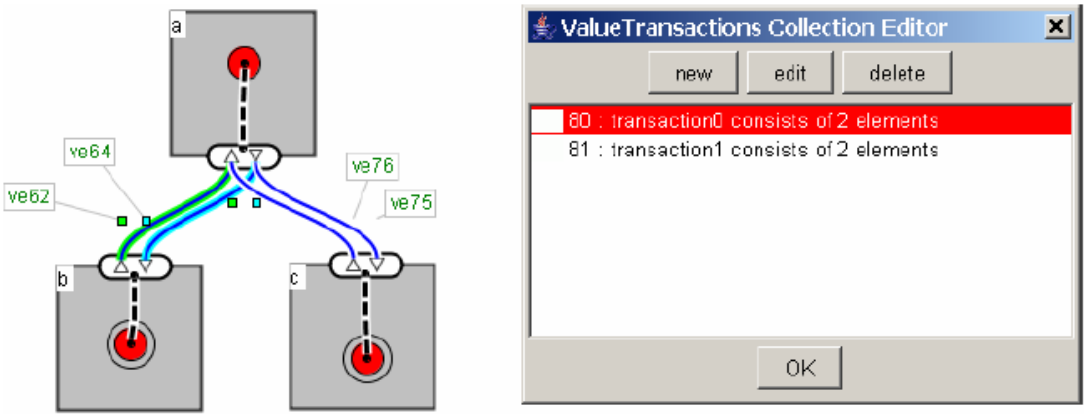

Figure 13 Creating value transactions from value exchanges

Scenario elements like ports are not parts of the e^{3}value ontology, so there are no special e^{3}value properties to consider. Only the graphical properties of scenario elements can be set.

8.4 Building the model: Creating profitability sheets

One of the main objectives of the e^{3}value tool is to produce profitability sheets to assess the viability of the business models. The profitability sheets are produced in a Microsoft Excel spreadsheet format.

Using Excel, the profitability sheets can then be loaded, financial parameters can be changed and the financial outcomes of the business model can be inspected or processed further. Formulas in the e^{3}value tool are also based on Microsoft Excel, which makes it possible to write formulas in the model tool and to maintain them when generating profitability sheets.

The Excel documents generated by the e^{3}value tool are divided into three sections, each section consisting of one or more:

- Formula sheet
- Model concept sheets
- Actor / Value Activity / Market Segment sheets

The *formula sheet* is a single Excel sheet that contains a list of all object instances and their respective attributes and formulas in the model. The formula sheet is used as a storage place for attributes and formulas.

A separate *model concept sheet* is created for each e^{3}value class (e.g. "value interface") of which instances exist in the model. Each of these sheets contains an overview of all instances of its particular class and the respective attributes and formulas for each of these instances.

A separate actor / Value Activity / Market Segment sheet is created for each instance of the following classes:

- Elementary actor
- Composite actor
- Market Segment
- Value Activity

9. Selected user domains

9.1 The European Industrial Service sector

As we discussed in detail in the deliverable D2.5 Societal issues (annex), the term "Industrial Services" lacks a clear definition and there is a great deal of overlap with other topical themes such as "Facility Management". For the purpose of maintaining a strict and rigorous methodology, we need to establish a clear definition and a technical, contractual and business framework for both of these terms.

From a business perspective, the main difference between Industrial Services and Facility Management has really been the "management" element and the greater responsibility that goes with it. In this respect management shall be understood to include technical, work process and human resource issues and also legal, ethical, health and safety and social issues. The large number of value offerings that businesses and Service Providers may consider can thus be grouped in a structure as shown in the following figure:

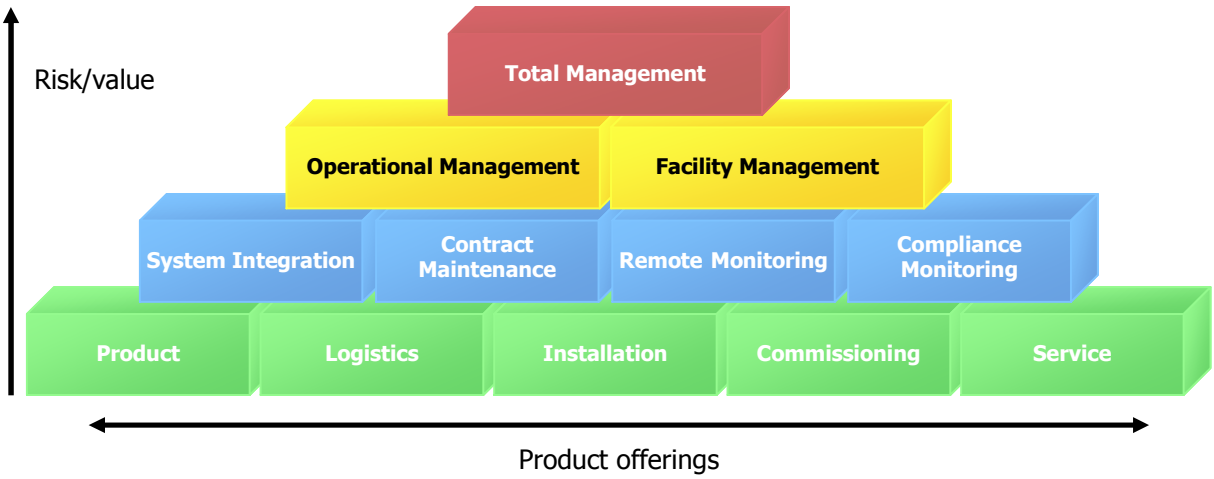

Figure 14 Risk and added value in product offerings

Traditionally, more involvement in management issues means greater value creation, but also greater risk. Firms need to balance the risks and the business opportunities stemming from the value creation process of assuming increasingly greater management responsibility (read: liability).

Product companies traditionally initially expand their business horizontally at the lowest level. They provide logistics support for their customers, perform installation and commissioning of their products and offer various degrees of basic services. All of these offerings are closely related to the firm's own products and will not greatly increase business risks; neither will it add significant value to the business processes over and above keeping the customers happy and maintaining a competitive position in the market. Except for maybe the products themselves, companies may choose to provide any offering in co-operation or alliance with business partners.

When firms seek to go further in creating value offerings for their customers, it inevitably involves some degree of management and thus greatly increases responsibility and risk. "Operational Management", "Facility Management" and "Total Management" involves companies taking over large portions or even all of the management responsibilities previously vested with the owner and operator of manufacturing operations or process facilities.

According to a recent study performed by Monitor Group [14], industrial services are "all business transactions which, subsequent to the sale/installation of a physical product, are intended to

maintain and/ or optimize the operational processes, upgrade performance and cover its resource needs throughout the entire life cycle."

Following this definition, we use the term "Industrial Services" in the eu-DOMAIN context to identify the business activities related to the maintenance and upkeep of specific technical installations and production equipment in a wide variety of industries including in some instances also installations in private homes[3]. The business activities are aiming at absorbing outsourced tasks relating to the whole lifecycle from installation and commissioning over maintenance to end-of-life retirement and replacements of components and complete installations, as well as new value added services such as remote monitoring and compliance services.

This approach is consistent with the selected scenario on Industrial Service, "Serving your every need!", developed and chosen by Grundfos GMC experts during the scenario building process. The scenario reflects the current trends of the European market that is facing the challenge of renewing the offering of services by implementing the technological solutions that are available, already now or in a near future, on the market: the ultimate goal is to increase the value for the customers and, as a consequence, for the companies themselves.

There are, however, a number of key issues that need to be addressed, as far as these new solutions concern the treatment of sensitive data, on one side, and the identification of new value paradigms, on the other one.

9.1.1 Industry characteristics

Industrial services have been traditionally considered as "necessary add-ons" to the physical product: they have been centred on custom-design only in an initial phase and around the simple provision of spare parts in a second phase. This has changed a lot in the last decades: as Monitor [14] underlines, there is a dramatic shift from "engineering and manufacturing companies" to "performance providers". Services have become powerful instruments to retain customers and to generate new revenues for component manufacturers.

The largest portion of industrial service revenues (approximately 45%) derives from spare parts and, so far, this business line produces more than 60% of the industrial service profits (source: Monitor). However, there are growing opportunities for differentiated service solutions and intelligent product/service combinations: in fact, revenues from performance upgrades (replacement or addition of one or more hardware and/or software components of the physical product), inspections (periodical examination of physical product for flaws) and reconditioning (restoring physical product to good condition, especially by renovating or rebuilding) are rising. Monitor, moreover, underlined that customers are more willing to pay for performance upgrades and inspections than for services such as technical consulting or training units.

In a wider perspective, considering the global outsourced services market, future trends imply business models in which a firm will only be interested in its core business, hence outsourcing non-core activities to a main contractor. In this perspective, referring also to the outsourced services market could be meaningful. Outsourcing is becoming more and more articulated. The term now includes different activities like Facility Management, Asset Management, Property Management, Project Financing, Global Service etc. In particular, Global Service is intended as a supply contract in the maintenance field, signed by a customer with a single supplier company.

According to the European Standard EN 13460:2002 "Maintenance - Documents for maintenance", the maintenance function is considered as a part of the quality system of the company. An adequate set of documents supports the information needed to perform the different tasks and also the relations with the rest of the organisation areas. In this way stakeholders try to standardise and regulate the different maintenance and management services concerning to properties and related activities (e.g. maintenance of electrical equipment, heating system, conditioning plant, safety devices etc.).

The European Federation of National Maintenance Societies is an umbrella organisation for the non-profit National Maintenance Societies. Amongst other activities it co-ordinates maintenance matters

[3] http://www.fabricom-gti.com

between European National Maintenance Societies and establishes contacts with Maintenance Societies outside of Europe. It also promotes the awarding of prizes and distinctions relating to maintenance and initiates and promotes the publication of the results of scientific and practical work in the maintenance field.

9.1.2 Actors and suppliers in the Industrial Services sector

In relation to the commercial exploitation of eu-DOMAIN on the Industrial Service European market, the main stakeholders in the Industrial Services Business to consider are:

- Component manufacturers
- System integrators
- Customers

Component manufacturers refer to companies that produce products and major components of products selling them to customers as new. Moreover, it can also happen that these companies acquire a product/component and then they incorporate it into a new product with their brand name or they proceed to modify or bundle it before distributing it to their customers.

An interesting consequence of the activity of the component manufacturers consists in the fact that consumers when choosing replacement parts for their products or equipment, prefer to purchase parts that were made by the same manufacturer that produced the original equipment.

Many cases can be presented referring to this kind of stakeholders. A clear example of component manufacturer is provided by Grundfos, one of the world's leading pump manufacturers.

In spite of popular and business press enthusiasm about the "new economy" and the arrival of the post-industrial society, manufacturing — including the durable-goods manufacturing that dominated the so-called old economy — remains critical to the health of the European economy. This sector, and particularly its component manufacturing base, faces enormous pressures from all sides: Heightened international competition, especially from low-wage regions; persistent recession at home; and relentless demands for price reductions coupled with continuous improvement in quality, delivery and design.

Most European manufacturers are now operating in stagnating markets where the growth is limited: thus, they are forced to find new ways to enrich their offer. This means to bundle products with new services, to emphasize reliability, performances and customer satisfaction. Companies partnered to change the process of bringing goods and services to market. Manufacturing became a complex and dynamic value chain driven by information, reputation, and trust. It is worth underlining that high quality is considered nowadays a truism.

They must be able to communicate different messages to different stakeholders; for instance in Grundfos case:

To the wholesaler the key issues to be underlined are:

- Fewer models on stock / increased stock turnover
- Greater Profit Before Tax (PBT)
- Image

To the independent system integrators:

- Easiness to install / no extra call (e.g.: having the right component in the van)
- Greater PBT
- Image

To the customers:

- Higher comfort
- Smaller energy bill
- Less wear and tear / last longer
- "Show Case"

System integrators are value-added engineering organisations that focus on industrial control and information systems, manufacturing execution systems, and plant automation systems for help designing, installing, connecting, and commissioning the various components of new and retrofit automation systems (VanDoren, [15]).

A system integrator is any contract-engineering firm that can supply the time, talent, and technology required to integrate the disparate components of an industrial automation system with a facility's production equipment. That would include every company capable of providing integration services such as vendors, distributors, and also architecture & engineering (A&E) firms with their own system integration divisions.

Control and Information System Integrators Association estimates that, worldwide, some 2,200 integrators fit its definition, but surely the total number that match the broader definition is much higher.

Component manufacturers take in high consideration the system integrators: for instance, Grundfos concentrates about 60% of its communication effort on this category, while only 20% on the end users.

Some years ago VanDoren [16] already pointed out that engineers of all kinds had been quietly moving into the automation system integration business. Distributors had added engineering services to supplement product sales. Service and repair companies had started offering pre- as well as post-installation assistance. Software houses, especially PLC programmers, had begun installing hardware while panel shops have gotten into the programming business. With very low start-up costs, brand new system integration firms can begin small and expand as one project leads to another.

The following list divides the system integrator into several broad categories and describes the general functions of each. These are by no means hard and fast job descriptions. Most companies fit into more than one definition and some switch from category to category as clients' needs change:

- Application engineers that work for vendors or their distributors generally concentrate on applying the vendor's equipment to a client's project. Some application engineering departments will offer design and implementation services as well; others will provide little more than technical advice. A few will even work with products from competing vendors if the client so desires.
- Consulting companies range in size from single individuals to huge multi-national corporations. They provide consulting and design services in specific technical disciplines such as civil, mechanical, electrical, and automation engineering. Larger consulting firms may also assume ultimate responsibility for completing the entire project. Individual consultants and smaller consulting firms generally do not.
- Electrical Contractors - Electricians and technicians working for electrical contractors actually run the wires and hook up the electrical equipment specified in the project's design. They may also design and build the required control panels.
- Independent system integrators that, to varying degrees, work on every aspect of an automation project other than actually manufacturing the control equipment. They may design and implement the control system required by an A&E's overall plant design. They may perform all of these functions themselves or subcontract pieces of a project to specialists such as panel shops and software houses. A system integrator generally assumes ultimate responsibility for completing the entire project from initial consultation through final checkout. Truly independent integrators do so without favouring any particular vendor's products.
- Value added resellers (VARs), value added distributors (VADs) - VARs buy products from a vendor, add something of value, and resell the complete package to the end-user. The value they add may be other compatible products or services such as software configuration, troubleshooting, or complete system integration. VARs generally focus on a particular vendor's products or a particular industry's applications. VADs also maintain product inventories and provide technical advice

Customers are generally organisations whose core business deals with at least one of the following activities:

- Facility planning and forecasting
- Architectural/Engineering planning and design (e.g.: maintenance, code compliance, etc.)
- Operations, maintenance, and repair

Typical examples of these categories are facility managers. It is the job of the facility manager to create an environment that:

- encourages productivity
- is safe
- is pleasing to clients and customers
- meets government mandates
- is efficient.

Beside their functions, it is worth mentioning that today's market and the availability of new ICT solutions impose a dramatic enrichment of their capability.

Fist of all, a new expectation among facility owners and managers is that control systems be integrated and provide a level of "building intelligence." This concept speaks to managing facilities as assets transforming building data into knowledge and using that to make intelligent business decisions in real time. The driver of building intelligence and many other major trends is economic pressure to increase efficiency and productivity continuously and to do more with less. In addition to this, facility management agreements are more and more based on incentives about savings: this implies that facility managers strive for find opportunities for savings in order to share them with the end users.

Moreover, according to LONmark, what most facility managers want today is plug-and-play interoperability. In fact, the concept of interoperability for facility executives can be traced back to three elements:

- Harmonic coexistence: in this case, what a facility executive wants for his buildings are products from different manufacturers that operate independently without interfering with each other.
- Interchangeability: in this definition of interoperability, all chillers operate so identically, for example, that only the nameplate distinguishes one from another
- Integration that allows for individuality: most facility executives, however, want interoperability somewhere between these two extremes. They want plug-and-play interoperability. They want products that can be integrated easily without using custom hardware or software. But they also want to leave room for supplier differences within product lines.

9.1.3 Factors to be addressed in the business models

9.1.3.1 Profit as motivation for cooperation

As Monitor [14] underlines in its study, the main challenge of managing industrial services consists in defining and implementing strategies which enable the company to capture the value of long-term relationships while at the same time capitalizing on changing market trends and service opportunities. In other terms, there is the need of answering the following questions:

How can real value be generated for service customers?
How long will this business stay attractive?

The biggest misunderstanding is that value can be created simply by simply adjusting a few of the processes involved in the service provision. Monitor [14] shows that value creation is closely connected to innovation and technology and its application to customers' needs.

In other terms, the Service Provider must be able to clearly demonstrate and show to the service users the advantages, such as:

- Cost predictability and feasibility
- Access to innovative technology
- Improved service availability
- Implementation of advanced maintenance systems

Therefore, when defining business models for industrial services based on the eu-DOMAIN platform, some important factors should be taken into account:

1. Industrial services are related to the whole lifecycle from installation and commissioning over maintenance to end-of-life retirement and replacements of components and complete installations. New value added services, such as remote monitoring and compliance services, should support various parts of this product/service life-cycle in various value constellations with complementors. The actual constellations can be modelled for optimum value creation and maximum value proposition to the end-user.
2. When looking at the risk assessment we see that the most critical assets to protect are the domain data, notifications, identity and billing information. Especially attacks against them that cause tampering with data, information disclosure or denial of service are considered important. There might be some trust requirements by law in the area of privacy in some countries, but these laws are rarely (if ever) related to the technical solutions. They are rather related to what data you are allowed to collect and how it can be used (privacy is very important to the average user).

Maintenance, as any other function in business, requires a suitable information flow between the different points of its internal organisation and with the rest of the functional and organisational units of the business, in order to fulfil its objectives of reaching an acceptable performance.

9.1.3.2 The role of ICT in industrial services

As concerns the role of ICT in service business, Normann [17] has identified five issues:

1. Cost rationalization: ICT systems, used in interaction with the customer or at the back-office, are often used for substituting manpower in order to decrease costs or to increase efficiency.
2. Effective quality control: ICT systems may be used to ensure that a specific standard of quality is maintained.
3. Enabling higher quality: ICT can provide a higher level of service, for example 24-hour availability.
4. Linkages closer to the customer: the Service Provider can integrate the customer more tightly to its service system with ICT, as is observed more or less in all e-services.
5. Enabling new service products: ICT enables new services as service becomes less tied to time and place and technology, and ICT allows for managing data effectively to create information intensive services.

9.1.3.3 Regulatory and societal aspects

There is a widespread acceptance of the need to protect environment and safeguard people safety and health. In the developed countries, a wide range of regulations has been enacted to control industrial pollution and prevent accidents in the workplace. Scraps, defects and inefficient use of materials and energy are sources of pollution. They are often the result of operating plant and facilities under less than optimal conditions. Machine breakdowns interrupt production. In chemical production processes, a common cause of pollution is the waste material produced during the start-up period after production interruptions. Apart from producing waste material, catastrophic failures of operating plant and machinery are also the major cause of industrial accidents and health

hazards. Keeping facilities in optimal conditions and preventing failures are an effective mean to meet ever more demanding societal challenge of pollution control and accident prevention.

Some important issues concerning security, such as privacy, legal interception, ownership of location data and access to content etc., have to be addressed as part of the business framework. The security polices to be adopted for each organisation involved in the e-Business may be drafted according to the ISO-17799 and related standards.

Moreover, if the services involve performance monitoring and work surveillance measures, the service is regulated by the EU Directive on Data Protection (Directive 95/46/EC).

9.1.4 Business opportunities

Traditionally, capital goods industries founded their strategies on products, while they are now being obliged to consider service business as a huge opportunity for growth and margin potential, as fundamental changes, such as globalization and deregulation, are occurring.

Moreover, as the competition will drive prices down more and more across the entire product and service life cycle management, Monitor [14] says that industries will be able to maintain their profitability only by:

- Enhancing customer retention through higher integration with service customers
- Increasing service buying frequency among existing customers
- Offering new service products to existing customers
- Clearly focusing on creating economic benefits for service customers
- Becoming a leader in innovation for technology as well as in creating value for customers

This means that successful component manufactures will have to make long-term service contracts more attractive to their customers by offering individually designed service solution bundles, which could be based on the model of risk and gain sharing and, additionally, the speed of successful new technology development and its application to products or solutions is one of the key success factors today, and it will become more critical still in the future.

9.1.5 Market potential

Industrial Services are closely related to manufacturer's products and no separate market analyses exist for these services. However, several estimates show that the European Industrial Service market could be as high as 3-4% of the total industrial market and could be as much as €60-70 billions annually.

Monitor [14] shows that the industrial services market offers considerable growth and profit opportunities across many industries with an estimated annual growth rate of services (2000-2005) from 5-10% (e.g. metallurgy equipment industries) to 15% (e.g.: rail vehicles industry). Moreover, service margins could be as high as 15-20%, exceeding the average margins in the product business by a factor of 4 to 5. Today these margins are also subjected to increasing pressure: it is worth highlighting that growth only stems from the service business while traditional component manufactures business is stagnating in the industries that Monitor considered in its study.

Many sources, such as Outsourcing Institute, European Facility Management Found, International Facility Management Association (IFMA), Centro Ricerche Economiche Sociali di Mercato per l'Edilizia e il Territorio (CRESME), point out that the world's largest market for outsourcing is the USA, which exhibited a turnover of €448 billions in 2003. The European market is the second largest in the world with an estimated value of €343 billions in 2003 or 5 times the core Industrial Services market estimated above. The three main European markets for outsourced services were the United Kingdom, Germany and Italy. Within the European outsourcing market the amount rate specifically related to Facility Management is about 16 billions euros, with a perspective of an increment up to 20 billions euros in 2006.

9.2 The European healthcare sector

The European healthcare sector is dominated by public provisioning and funding of healthcare services. The central governments are responsible for national legislation and policies on healthcare. National budgets for healthcare are generally set at central level based on both historical data and negotiation with healthcare providers. In most EU Member States, the healthcare system is decentralised (in Greece and France the systems are more centralised) with varying degrees of regional control and management of the allocated financial resources, as well as control of how to best meet national guidelines and standards (including public demands and requirements) on healthcare services.

In the UK, Denmark, Sweden, Italy and Spain the healthcare system is tax-based, i.e. the funding of the healthcare sector is based on revenue from general national taxation. Healthcare services are provided by the public sector free of charge; however, Sweden and Italy have some limited user-charges for public primary healthcare service, such as a small fixed fee for visits to a GP. The private healthcare sector in these countries is minimal.

In France and Germany the healthcare system is based on statutory social health insurance funds, i.e. the funding of the public healthcare sector is based on non-risk related contributions to the statutory insurance schemes which provide public healthcare services. The private healthcare sector is more extensive and sources of finances more diverse. In Greece, the healthcare system is based on a mix between a tax-based system and a statutory insurance system. Greece has the most privatised healthcare system in Europe with an almost equal division between public and private sources financing the healthcare system.

The tax-based healthcare systems in Europe offer mainly publicly provided and managed healthcare services. Public bodies often act as both providers and commissioners (purchasers) of health services. In general, there is a very limited number of private healthcare providers who provide healthcare services directly to the patient on a fee-for-service basis. In the Scandinavian countries, national legislation, coupled with a comprehensive public healthcare sector and general consensus, place general restrictions on the development of a private healthcare sector. Generally, only specialists have private practices but their services are usually covered by the national health insurance schemes when patients have been referred to specialist treatment by their GP.

Statutory insurance contribution-based healthcare systems in Europe have a greater mixture of public and private providers of both primary and secondary healthcare services. The statutory health insurance schemes mainly act as purchasers of healthcare services from both public and private providers, albeit they may provide some healthcare services as well (as in Greece). The statutory social health insurance schemes are responsible for providing public healthcare services and are the major source of financing healthcare. In France, statutory health insurance funds approximately three quarters of total health expenditure, while in Germany statutory health insurance funded approximately 57% in 2002, with other statutory insurance funds contributing 10%. Overall, public funding accounted for approximately three quarters of health expenditure in Germany in 2002.

The structures of European healthcare systems are very diverse and it is therefore necessary to be aware of fundamental differences in order to be able to commercially exploit eu-DOMAIN successfully across Europe. Hence, the healthcare systems of eight chosen EU member States (UK, Denmark, Sweden, France, Germany, Italy, Spain and Greece) were analysed in the annex to the deliverable *D2.5 Societal user requirements specifications*, which the present deliverable draws upon. However, we will limit the analysis to the UK healthcare system. The reason for this is twofold. Firstly, we need to validate the business models in the user environment of the Eastern Birmingham PCT and secondly, the conceptual core of the business models that we aim to develop is indifferent to the country of deployment as long as the healthcare system is based on tax revenues for funding and public provisioning. Of course an array of adaptations to national and regional sector specific requirements must be made, but we see this mostly as a task for exploitation planning.

9.2.1 UK healthcare market

The National Health Service (NHS) provides healthcare to all according to need. Most healthcare services are free at the point of use. The NHS is mainly funded through general taxation: direct taxes, value-added tax and employee income contributions. Local taxation provides further funding for social services. In 2003, the Government announced that an extra 1% of income was to be levied as an earmarked tax through national health insurance.

In July 2000 a new NHS Plan "*The NHS Plan. A plan for investment. A Plan for reform"* was introduced with the aim of modernising the NHS in the UK. In June 2004 "*The NHS Improvement Plan. Putting People at the Heart of Public Service"*, building on the achievements of the NHS Plan 2000, was published outlining the aim of reshaping the NHS with the patient in focus.

In order to deliver the modernisation of the NHS, the government has subsequently increased the funding of the NHS significantly; investment in the NHS has more than doubled from 1996/97 (€48 billion) to 2004/05 (€98 billion), and is expected to rise to €130.5 billion by 2007/08.

Two important features of the NHS plans which are very relevant for defining sustainable business models for eu-DOMAIN services in the UK, are 1) the government's aim to develop and implement more ICT in healthcare in order to deliver services faster and more conveniently for patients and 2) the government's aim to improve long-term care for patients who are chronically ill and the elderly.

9.2.2 Characteristics and size

The United Kingdom has devolved responsibility for healthcare to its constituent counties. They mainly fund healthcare services through national taxation, deliver services through public providers and have devolved purchasing responsibilities to local bodies: primary care trusts (PCT) in England, primary care partnerships in Northern Ireland, health boards in Scotland and local health boards (LHB) in Wales. Please refer to the *deliverable D2.5 Societal requirements and specification (annex)* for a description and analysis of the UK healthcare system.

The main characteristics of the UK healthcare system can be summarised as follows:

- Healthcare system is tax-based, i.e. funded by revenue from general taxation
- Primary Care Trusts (PCTs) are the main commissioning bodies
- GPs are commissioned by PCTs to provide primary care
- Secondary and tertiary care is provided by mainly public hospitals commissioned by the PCTs
- Public funding covered 83% (2002) of total expenditure on health
- The total expenditure (public and private) on health as of per capita US$ PPP (purchasing power parity) was 2160 US$ in 2002, placing the UK 6th after Germany, France, Denmark, Sweden and Italy.
- NHS Connecting for Health will deliver the National Programme for Information Technology by bringing modern computer systems into the NHS.

9.2.3 Actors and providers in the UK healthcare sector

In relation to the commercial exploitation of eu-DOMAIN on the UK healthcare market, the main actors and providers in the healthcare system to consider are:

- Department of Health
- Strategic Health Authorities (SHAs)
- Primary Care Trusts (providing primary care)
- NHS Trusts (providing secondary care)
- Foundation Trusts

The Department of Health has overall responsibility for health and social care in England. This is delivered by the NHS and social services. The Department of Health sets the standard and broad

working practices of the NHS and local social services. At national level the Department of Health works with strategic health authorities and Arm's length Bodies.[4]

Specifically, the Department is responsible for:

- Setting overall strategic direction of the NHS and leading its transformation into a modern health service which works in full partnership with social care and is built around the needs of patients.
- Setting national standards to improve quality of services – such as the National Service Frameworks which set out standards of care for priority areas including cancer, coronary heart disease and mental health.
- Securing sufficient funds from overall government spending to ensure the NHS and social care are able to deliver these services.
- Working with key partners to ensure that NHS and social care organisations have the support they need to deliver the best quality care – including Strategic Health Authorities, The Commission for healthcare Audit and Improvement (CHAI) and the Commission for Social Care Inspection (CSCI).

Actual care is provided by NHS staff in general practices, hospitals, treatment centres, pharmacies, NHS walk-in centres and in other community settings. The NHS employs around 1.3 million people, 633,000 of which are professionally qualified clinical staff. This includes 108,000 hospital doctors and general practitioners (GPs), 386,000 nursing, midwifery and health visiting staff, 122,000 scientific, therapeutic and technical staff and 15,000 ambulance staff who together diagnose, treat and support patients. These staff groups are supported by 360,000 other staff, such as nursery nurses and health care and nursing assistants. A further 199,000 people provide general infrastructure support in areas such as IT, catering, finance and management.

Strategic Health Authorities (SHAs) are responsible for managing and setting the strategic direction of the NHS locally. There are 28 SHAs covering England and they are the key link between the NHS and the Department of Health. SHAs support PCTs and other NHS organisations and make sure they are performing well.

Specifically, SHAs:

- Monitor how well Primary Care Trusts and NHS Trusts (hospitals) in their area are performing and take action to improve services when they are poor or failing.
- Develop plans for improving health services in their area – including strategies for making better use of information technology.
- Increase the capacity of local health services so they can provide better care to more people – for instance recruiting more NHS dentists or enabling more GPs and nurses to train in specialist areas such as coronary heart disease and asthma so they can treat more people in the community.
- Ensure national priorities are fully-reflected in local health service plans - for example, programmes for improving cancer and coronary heart disease services.

Primary Care Trusts (PCTs) are now at the centre of the NHS and control 80% of the total NHS budget. Because they are local organisations, they are in the best position to understand the needs of their communities.

PCTs are responsible for:

- Assessing the health needs of all the people in their local area and developing an insight into the needs of their local community.
- Commissioning the right services, for instance from GP practices, hospitals and dentists, to meet these needs.

[4] Arm's length bodies are a key part of the health and social care system. They are stand-alone national organisations sponsored by the Department of Health.

- Improving the overall health of their local communities.
- Ensuring these services can be accessed by everyone who needs them.
- Listening to patients' views on services and acting on them.
- Making sure that the organisations providing these services, including social care organisations, are working together effectively.
- Carrying out an annual assessment of GP practices in their area.

There are 303 PCTs covering all parts of England. They have been in place since April 2002 and report directly to their local Strategic Health Authority. As well as buying and monitoring services, they also play a crucial role in supporting NHS organisations. They help local GP practices, NHS Trusts and other parts of the NHS think more innovatively about how they deliver better, more convenient care to their local patient communities

NHS Trusts run most hospitals and are responsible for specialised patient care and services, such as mental health care. The trusts' role is to make sure that hospitals provide high quality health care and spend their money efficiently and some pay for private treatment to clear backlogs and waiting lists. They employ most of the NHS workforce from hospital doctors and radiographers to security staff. The different types of trust include:

- Acute trusts**:** These look after hospitals that provide short-term care, such as Accidents and Emergencies, maternity, surgery, x-ray
- Care trusts**:** These work in both health and social care and they can carry out a variety of services, such as mental health services. They are generally set up when the NHS and a local authority decide to work closely together
- Mental health trusts**:** There are a number of specialist mental health trusts in England, providing care, such as psychological therapy and specialist medical and training services for people with severe mental health problems
- Ambulance trusts**:** There are over 30 ambulance services for England, each run by its own trust. Ambulance trusts are responsible for providing transport to get patients to hospital for treatment.

Foundation Trusts are high-achieving NHS trusts which have opted out of NHS control, thus receiving foundation status. This means that their hospitals can effectively run themselves. Although they remain part of the NHS and people continue to receive free healthcare, foundation trusts have more freedom and financial flexibility and less central control and monitoring.

NHS foundation trusts form part of a major programme of investment, expansion and reform of the NHS over a ten year period. This programme will deliver the vision of the NHS Plan for prompt, convenient and high quality services, with patients treated as partners and staff fairly treated and properly rewarded. Within a framework of clear national standards, subject to independent inspection, power is being devolved to locally run services with the freedom to innovate and improve care for patients. The programme builds on the values of the NHS; services will be centred around the needs of patients so that wherever NHS patients are treated they receive high quality care, free at the point of use and based on clinical need, not ability to pay.

Foundation Trusts are owned by their community, local residents, employees and patients and have the power to manage their own budgets and shape their healthcare provision according to local needs and priorities – for example, by having the option to address long waits for certain treatments. The Trusts also have more access to funds for investment and this can come from the public or the private sector.

NHS Foundation Trusts will enter into legally binding agreements with local NHS PCTs who will buy relevant services for the population served by the Trusts. These contracts will set out the number and type of services NHS Foundation Trusts will provide. They are held accountable by an elected board of governors and an independent regulator monitors their performance. Like all healthcare

organisations, they are inspected by the healthcare Commission. The Government hopes that by 2008 all NHS trusts will be able to become foundation trusts.[5]

9.2.4 Factors to be addressed in the business models

9.2.4.1 Regulatory and ethical aspects

In the UK, the Data Protection Act (1998) regulates the processing of the personal information relating to living individuals. The DPA does not prohibit the processing of personal data for medical research purposes (section 33). Personal data is defined as data, which can identify the individual but actions can be taken to make personal data anonymous, in which case such data is no longer defined as personal. Please refer to deliverable D2.5 Societal user requirements specification (annex) for more details (section 2.2.1.4).

In relation to the implementation of the Data Protection Act, a UK governmental committee defined a set of guidelines referred to as The Caldicott Principles. The Caldicott Principles outline the guidance rules as to how personal data must be handled. It consists of six main principles which are defined as follows:

1. Justify the purpose for collecting personal data information
2. Only use patient identifiable information if it is absolutely necessary
3. Use only the minimum necessary patient identifiable information
4. Ensure that patient identifiable information is accessed only on a strict need to know basis for your patients only
5. Ensure that everyone with access to patient identifiable information is aware of their responsibilities
6. Understand and comply with the law

The Caldicott Principles are defined in such a way which makes the interpretation very subjective; the way in which an organisation implements the principles is flexible and subject to interpretation.

Security and protection of data is a crucial issue within the NHS Connecting for Health programme and must be observed by and included when designing the business model for eu-DOMAIN within the healthcare domain. Some of the main issues defined in the document 'A Guide to the National Programme for IT' are:

- Stringent and robust safeguards to protect the security and confidentiality of each patient's NHS Care Record
- Access to a patient's record limited to those with a legitimate relationship to the patient
- Rights to see clinical information dependent on role
- Audit trail of access to each patient's record and alarms when access to rules are breached
- Patients able to have access to their NHS Care Record and able to see the information being shared

9.2.4.2 UK Market Access

All procurement by the National Health Service and by Local Authorities is governed by European Union Directives on public sector purchasing. These Directives have been incorporated into UK law and all public procurement abides by this. There are four main Directives, which apply and which eu-DOMAIN deployment strategy must address in an appropriate way:

- **The Consolidated Supplies Directive (93/36/EEC)** – was adopted in UK with effect from 14.6.94. Covers purchase or hire of goods by "public authorities" - the State

[5] To be eligible to apply for foundation status, NHS organisations must: a) be an acute or specialist NHS Trust (in the future foundation status may be available to other types of NHS Trusts), b) hold a 'three star' rating in the annual NHS performance ratings and maintain this throughout the application process, c) prove that they have strong leadership and a commitment to modernising services for the benefit of patients and local communities and d) have the support of staff and other local stakeholders for their vision for reform.

(Government Departments and Parliament), local authorities, and a wide range of mainly public sector bodies not of an industrial or commercial nature.

- **The Works Directive (71/305/EEC, amended by 89/440/EEC)** – concerning the co-ordination of procedures for the award of public works contracts.
- **The Services Directive (92/50/EEC)** – was adopted in the UK with effect from 1.7.93. Covers procurement by public authorities. Based on the Works Directive, but allows greater freedom to use the negotiated procedure with a prior call for competition.
- **The Compliance Directive (89/665/EEC)** – was adopted in the UK with effect from 21.12.91 to ensure compliance with the Supplies, Works and Services Directives, the Regulations which implement them or other relevant EC law. Provides for interim and final remedies, including damages, for relevant suppliers, contractors and service-providers harmed or at risk of harm from a breach.

Within the NHS, there is no single, standard procurement system. Each individual organisation makes its own decision as to how it will do its purchasing.

They have the choice of:

1. Employing their own staff to negotiate and buy products
2. Contracting with NHS Supplies for it to provide a purchasing service on their behalf
3. Purchasing from NHS Supplies, which is able to buy directly, often in bulk, and resell in appropriate quantities to NHS Trusts.

9.2.5 Business opportunities

The current trends within healthcare delivery and the government's visions for the future indicate good opportunities for the commercial exploitation of eu-DOMAIN. The heightened focus on improving care for people with chronic conditions and for concentrating this focus on improving self-management, community-based care and home care proves that the validation scenario "Patients as Customers" represents a very realistic picture of the near future.

Other important factors include the emphasis on Practice Based Commissioning and devolution of commissioning to GPs. This opens up for a healthcare delivery system based on each patient's specific needs in accordance with the general trend of patients being more informed about – and demanding more control with – different healthcare options and pathways. Patients may therefore look for services that are more convenient for them, such as being able to carry out tests and simple monitoring at home using medical devices and internet communication with nurses and GPs.

The government calls for an improvement of coordination between services, particularly for services provided to patients with long term conditions. Poor coordination and communication systems often results in patients staying at hospital longer than necessary, simply because there is no effective system in place to offer them appropriate care after hospitalisation. This is expensive and is unsatisfying for patients. eu-DOMAIN could offer the appropriate infrastructure and platform for sharing of patient information, thus making coordination more effective.

For example, case management is considered vital to improve healthcare services for people with chronic conditions and high intensity needs, as well as reducing unnecessary – and costly – admissions and re-admissions to hospitals. Health and social care communities are therefore being encouraged to adopt case management approaches now as a means of ensuring that these patients get fully joined-up health and social care. Case management is designed to ensure a high quality and personalised care provided to patients with complex long term conditions. It aims, among other things, to provide the least invasive care in the least intensive settings, support effective primary care and identify people who are at risk of unplanned hospital admissions. The case management approach ensures that any long term condition patient admitted to hospital for an unplanned admission is followed up in the hospital by the primary care team to ensure continuity of care and to facilitate early, safe discharge.

The Case Management Approach could benefit tremendously from mobile communication and alarm systems which could alert the case managers of a patient's condition and location. This would ensure a quick response to a patient's need (caused by a change or complication of health) and thus prevent unnecessary admission to the A&E (Accident and Emergency) or hospitalisation.

The National Programme for IT – delivered by NHS Connecting for Health – is an important initiative which will truly modernise the healthcare system. eu-DOMAIN could offer services to support the many services and objectives envisioned in the programme, such as the Care Records Service and the Patient Administration System.

9.2.6 Market potential

In order to successfully exploit the UK market, it is useful to define some essential figures of the healthcare domain (Table 1):

What	Number of
PCTs	303
GPs employed in NHS	34,085
GP Practices	8,542
Patients per GP (average)	1,666
District Nurses employed in NHS	8,542

Table 1 Number of PCTs and relevant staff employed in NHS (2004)
Source: Department of Health

In relation to the eu-DOMAIN validation scenario "Patients as Customer" and the participating user partner in the eu-DOMAIN project (i.e. EBPCT), it is useful to define some key factors related to diabetes and the main characteristics of EBPCT.

9.2.6.1 Diabetes in the UK

Britain has the fastest growing rate of obesity in the developed world. In total, about 3% (1.3 million) of the population have diagnosed diabetes. It is estimated that 2% of the population have undiagnosed diabetes. Table 2 Table 1illustrates the prevalence of diabetes in the UK:

Year	Prevalence
1940	200,000
1960	400,000
1980	800,000
1996	1,400,000
2004	1,800,000
2010	3,000,000

Table 2 UK prevalence statistics for diabetes
Source: Diabetes UK

There are an estimated 100,000 new cases of diabetes a year (this does not include the cases of undiagnosed diabetes). Type 2 diabetes accounts for the majority of cases (75%) due to the aging population and increasing number of overweight and obese people in the UK.

Differences in diabetes prevalence are evident in minority ethnic populations, particularly South Asian communities living in the UK. Type 2 diabetes tends to develop around five years sooner in people from African Caribbean and Asian backgrounds and prevalence of the condition is at least five times higher amongst these communities and may be higher. There is also increasing evidence of Type 2 diabetes in children, particularly in South Asian populations. 20% of the South Asian community and 17% of the African-Caribbean community has Type 2 diabetes in contrast to 3% of the general population.

It costs about €14.50 million per day treating diabetes, which is equivalent to 5% of the NHS budget. This figure is expected to rise to 10% in 2011. Up to 10% of hospital budgets are spent on treating diabetes and its complications. People with diabetes spend 1.1 million days per year in hospital for inpatient care and complications. People with diabetes are spending over €725 million of their own money on coping with the condition and Social Services costs for people with diabetes are around €333.6 million. New cases of diabetic kidney failure are costing the NHS up to €43.5 million a year to treat.

9.2.6.2 EBPCT

EBPCT covers a population of 251,000 people living in 10 wards of Britain's second city. Based on the Index of Multiple deprivation, nine of these wards fall within the 20% most deprived wards in England. When income deprivation is measured, all wards fall into the 25% most deprived wards in England; nine are amongst the country's 25% most employment deprived. All wards are classified as urban and are classified within the 25% least healthy. There is a relatively high rate of chronic disease e.g. diabetes, which is partly related to these facts. Another important factor to consider in relation to diabetes is the fact that Eastern Birmingham is home to distinct populations whose diversity impacts on health related values.

There are 59 GP practices and about 140 GPs; 12 of whom are salaried to the PCT. 53% of practices are singled handed. On average, each GP has about 1,792 patients.

The three acute hospital NHS Trusts used most by people from Eastern Birmingham are: Birmingham Heartlands and Solihull NHS Trust, Good Hope Hospital NHS Trust and University Hospital NHS Trust.

The PCT budget is €888 million; €409 million direct allocation for the provision of health services to the population of Eastern Birmingham and €479 million for services hosted by the PCT on a pan Birmingham or pan West Midlands basis.

In relation to the budget for direct allocation for the provision of health services, approximately 90% goes toward commissioning services, i.e. GPs, hospitals as well as prescription costs. About €29 million is paid to primary care (GPs, pharmacists, dentists etc.), £217.5 to secondary care (hospitals), €43.5 million towards prescription costs and €101.45 million to tertiary care. The remainder 10% covers organisational and provisioning expenses (e.g. district nurses, health visitors, health centres).

Considering the national figures of patients with diagnosed diabetes, we can roughly estimate that there are 7,530 patients with diagnosed diabetes and 5,020 people with undiagnosed diabetes. These figures are probably higher in reality considering the ethnic, economic and general health status facts of the population (see above). Also, this means that on average each GP in EBPCT has a rough estimate of 54 patients with diagnosed diabetes.

10. Baseline business systems

In this chapter we will perform the initial definition of the business model framework to be used for identifying and assessing the sustainability of future business models based on services delivered on the eu-DOMAIN platform.

In chapter 6 we discussed the need for a lightweight, easy to use, value based model ontology, which we could use to analyse various business constellations and depict the economic outcome and attractiveness of value offerings in terms of profitability or cost/benefit ratios to the various actors in a business scenario. In chapter 7 we further argued and explained the selection of the e^{3}value methodology to be used for this work.

Before we proceed to model the complex value constellation we foresee as sustainable business model for eu-DOMAIN services, we have chosen to make a validity check of the applicability of the e^{3}value methodology to the user domains we have chosen. In particular, we are interested in validating the use of profitability value models in a public domain such as healthcare.

Although the e^{3}value methodology is a relatively new approach, it has already been reported in the literature to have been applied successfully to a number of e-Business solutions involving complex value constellations in various domains. We have in particular looked at the following lessons learned:

1. An early application of the e^{3}value methodology was presented by Gordijn in the case of free Internet Service Providers [5]. Gordijn was here able to demonstrate how internet access could be offered free to consumers, because the local Telco was willing to pay the internet Service Provider a termination fee for the users using the dial-up network to connect to the Service Provider's access point. Gordijn has also demonstrated why a free on-line service of providing electronic newspaper articles in The Netherlands failed. Using the e^{3}value tool it becomes evident that the profitability of one of the important actors in the value constellation is not secured. Using the e^{3}value methodology Gordijn and Akkermans have subsequent demonstrated how such free on-line article service can become sustainable by incorporating termination fees derived from telephone companies [18].
2. In the electricity domain, the EU project BUSMOD (project no NNE5-2001-00256) successfully used the e^{3}value tool to model the use of Distributed Generators in shifting demand in peak hours in Spain and the use of networked business scenarios for small scale hydropower plants in Norway [19].
3. Another EU project OBELIX (IST-2001-33144) further used the e^{3}value methodology to develop business models for bundling of electricity services with complex goods and services (e.g. bundling of electricity supply, broadband access, energy savings) offered by different providers [20].
4. Finally, Osterwalder et. al. have investigated how insurgents such as Skype disrupt established markets. They have been using the e^{3}value tool to compare business models for Skype with business models for traditional Telco's [21].

In eu-DOMAIN, our validation is aiming at demonstrating the repeatability, accuracy, and robustness of the modelling tool, as well as to calibrate the tool against one or more known baseline cases.

Hence, our validation will be based on the analysis of two existing baseline cases, which have not been covered in the literature, i.e. the Industrial Services domain and the healthcare domain respectively, in which we have full knowledge of the value offerings, their profitability or cost/benefit ratios and the corresponding financial transactions taking place in this particular business environment. By modelling two business cases that are fully understood and used today, we will be able to verify the ontology of the e^{3}value model for each domain and to calibrate the formulas in the model that are needed to determine the economic results of the actor's value activities.

10.1 Industrial Services – the logistics of pumps

The Industrial Services baseline business model is taken from the Grundfos case of extended services offerings. Grundfos has, as user partner in the eu-DOMAIN consortium, had a very central role in the development of the domain scenarios and business models and will also be an active partner in the validation. Naturally, the baseline business model is most logically embedded in the business world of Grundfos pumps.

10.1.1 Grundfos products

With an annual production of more than 10 million pump units, Grundfos is one of the world's leading pump manufacturers. Circulator pumps, submersible pumps, and centrifugal pumps are the three major product groups. Today, Grundfos is the world's largest manufacturer of circulator pumps, covering approximately 50 per cent of the world market for these pumps.

Circulator pumps are used for heating, ventilation and air-conditioning in domestic houses, office buildings, hotels, etc. In the industry the pumps are used in processes as well as in the area of plant maintenance and in the water-supply and waste-water segment Grundfos offers a wide range of reliable pumps for irrigation, green houses and for municipal, private and industrial water supply as well as sewage applications.

In addition to pumps, Grundfos manufactures electric motors for the pumps and has a considerable production of electric motors for separate merchandising. Furthermore, Grundfos develops and sells state-of-the-art electronics for controls for pumps and other systems.

The entire Grundfos organisation operates according to three main objectives paraphrased as: BE Responsible, THINK ahead and INNOVATE (BE>THINK>INNOVATE). The guidelines are explained by the following statements:

BE responsible

Grundfos pumps must feature low energy consumption and the highest possible performance throughout their service life. Therefore, spare parts and replacement kits are defined already in the development phase.

THINK ahead

Excellent service and solutions form the basis for enduring customer relations and partnerships that are an essential element of Grundfos' commitment.

INNOVATE is the essence

Problems represent opportunities. Grundfos keeps records of all component failures and effectively informs all involved staff. This approach ensures that possible production problems are efficiently located and remedied.

As can be seen from these company objectives, service, reliability, performance and customer satisfaction are central elements in the daily business operations at Grundfos and any new business model will have to support these objectives fully, in order to be accepted at Grundfos.

Grundfos manufactures a broad programme of pumps for all sorts of applications. The main business areas are served with products manufactured by Grundfos in the following product groups:

- UP-OEM – Circulator pumps (OEM)
- DBS – Domestic Building Services
- DD – Drainage pumps
- WS – Water Supply pumps
- CBS – Commercial and Industrial Building Services
- I-OEM – Irrigation products (OEM)
- IEM – Industrial Energy Management
- WW – Waste Water pumps

Pumps are used in a variety of different applications. Some pumps are optimised for pumping hot and some for pumping cold water; some are used for removing waste water and some for providing fresh water; and some are used for pumping millions of litre of water, and some for just a few droplets. The main business application areas are:

- Home and garden
- Commercial and industrial buildings
- Irrigation and watering
- Industrial equipment builders
- Industrial processes
- Dosing
- Professional water supply
- Professional wastewater
- Sensors

For the eu-DOMAIN scenario and for the business modelling, we are focusing on the business area of *CBS Commercial and industrial buildings* and in particular, we will be looking at circulation pumps and related services for *air-conditioning and heating* in commercial and industrial buildings. The business processes and business models will all be based on this business segment, but the generality of the modelling methodology implies that the same methods can be extended to all the other business segments of Grundfos and in fact to the entire industry of Industrial Services.

10.1.2 Grundfos service and service contracts

Grundfos is also aiming at being a world-class provider of after-sales service by: Securing world-wide availability of service, organising training for customers, offering a wide range of flexible and targeted service and spare parts, giving prompt and timely assistance, being cost-effective, and operating a competent and motivated service team all over the world.

Generally, an industrial maintenance contract may take very different forms. For some customers, it is essential that service is available on demand, 24h a day, 365 days a year. Other contracts call for recurrent maintenance work at agreed prices. Mostly the work is done on the basis of a signed service agreement, which often is designed with particular focus on the customer's needs and expectations.

A service agreement for Grundfos pumps has been analysed in the appendix of the deliverable D2.5 Societal user requirements specifications (annex). The subject of this service agreement is to provide service and maintenance on installed Grundfos pumps at the customer's premises. The service product is offered in three versions: Basic, Extended and Total. The three products offer the same basic service, but with more features included and higher levels of service.

The Basic service agreement covers a number of visual inspections (typically one) per year within normal working hours. In most cases the service covers warranty and failure analysis with recommendations for needed repairs and adjustments based on the visual inspection. For some products and applications repairs and spare parts are covered; for other products the customer needs to pay extra.

The Basic and Extended service agreements cover different offerings depending of the customer and the specific product.

The Basic service agreement does not set out a service or quality level to be achieved in terms of responsiveness or reaction time for all products. For those products that do not cover 24-hours service, the customer can pay for this additional service.

With an Extended service agreement, all wear parts can be included and an additional 20% offered on other spare parts.

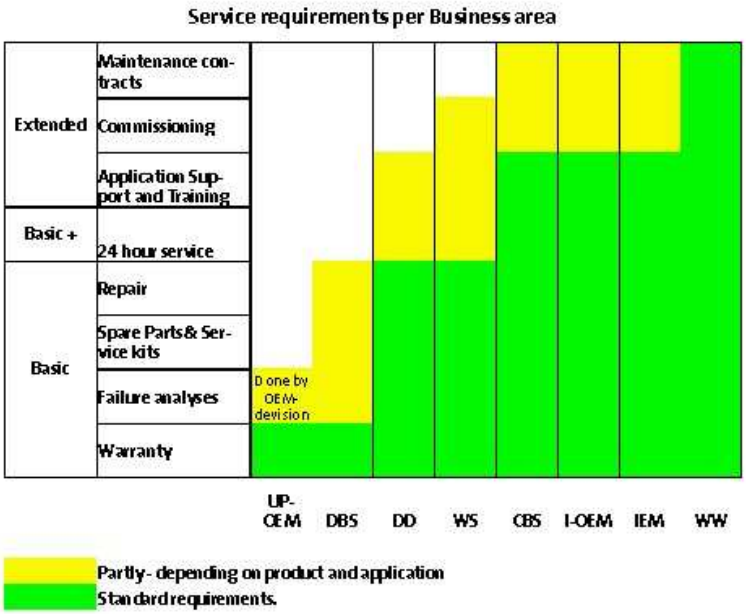

Figure 15 Grundfos service offerings for business areas

For some products, an Extended service agreement also includes commissioning, application support, training and additional, customer specific maintenance contracts.

With a Total service agreement, Grundfos, or one of its service partners, will make initial response within 12 hours of the reporting. If not, the customer will get the repair for free (normal charges for man-hours and driving on Sat.+ Sun. and outside working hours).

In summary, the value offering included in a Basic service agreement are:

B1: The on site visual inspection (including man-hour and transportation within working hours)
B2: A status report
B3: A recommendation report

The value offering included in an Extended service agreement are the above plus:

E1: All wear parts included and 20% discount on spare parts.

Finally, the value offering included in a Total service agreement are the above plus:

T1: All wear and spare parts included
T2: Evaluation of pump park with regards to energy optimisation
T3: Free call service (within working hours
T4: Fast response (less than 12 hours) or the repair is free.

10.1.3 Grundfos distribution system

The Grundfos Group is represented by companies in all parts of the world. It is represented by own sales and service companies in 39 countries around the world supplemented by more than 350 Service Partners. In addition, the products are merchandised by distributors in a large number of countries.

The distribution process for circulation pumps for the CBS Commercial and industrial buildings market sector is depicted in Figure 16.

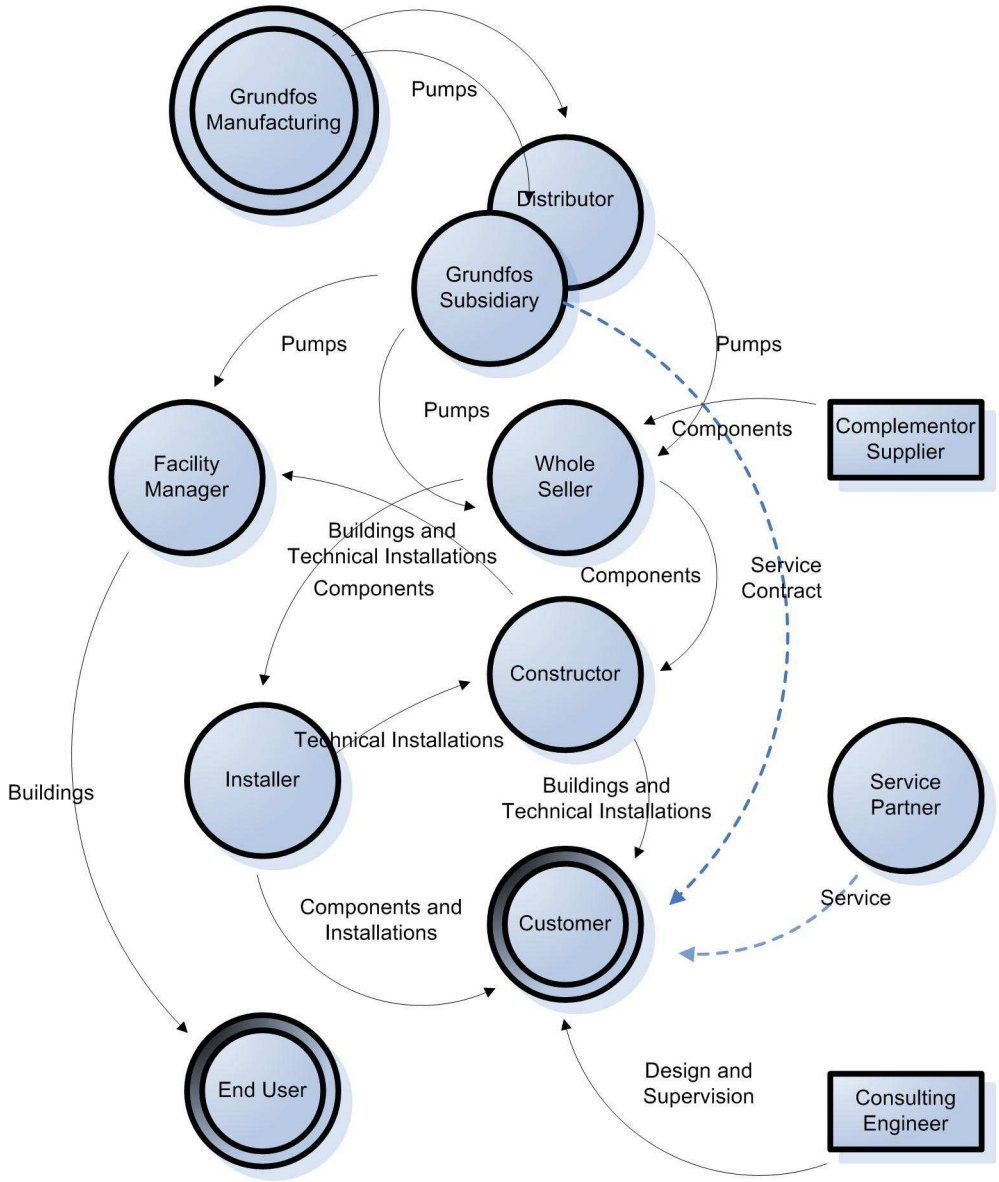

Figure 16 Grundfos distribution system

The Grundfos manufacturing companies sells the pumps in national markets through subsidiaries and distributors. The customer groups for these "importers" are mainly twofold:

Wholesalers buy large quantities of pumps for stocking and resale to smaller companies like installers or building constructors. Wholesalers carry a wide assortment of pumps and complementing parts and supplies, such as tubes and fittings, to be used in a typical installation.

Facility Management companies are large-scale facility or property managers that undertake total responsibility for the technical installations in buildings. They are so large, that they often bypass the wholesaler and buy directly from the subsidiary or distributor.

At the next level we find the *Construction* companies. These firms are mainly involved with new installations (in new buildings) or major renovations. The construction companies either have their own in-hours installation groups and buy pumps and components from the wholesalers, or they hire small, local installers to do the installation for them.

Large construction companies or installers may also bypass the wholesaler and have direct business relationships with the Grundfos subsidiary or they may have strategic partnerships with large installers.

Installers comprise the largest customer group and are very important decision makers in the market. The installers perform the actual installation and commissioning of pumps and pump systems. They normally source the pumps together with other supplies from wholesalers, either regional or through strategic alliances. Very small installers may employ just a few technicians whereas the large installers may have thousands of technicians covering wide areas of expertise. There is a converging trend in the market by which the large installers tend to be able to offer all types of installations such as plumbing, HVAC, gas, electrical power and telecommunication.

The installers' offerings consist of planning, sourcing of components, installation and commissioning. Their customers are building owners, construction companies and facility managers.

The Grundfos subsidiaries offer Service Agreements directly to customers in their markets. The service is to a large extent outsourced to local Service Partners, which are close to the customers.

10.1.4 The baseline scenario

Based on the above process description of the Grundfos business model, we will now choose a simple subset for further processing. Our baseline scenario will thus be limited to the value process of delivering pumps to customers through the logistic chain involving subsidiary and installers. We will also look only at delivery and installation of pumps and will exclude services for the time being. The rationale of this exclusion is twofold. Firstly, in the case of the Grundfos baseline scenario, the service offering does not add new aspects to the methodology. Grundfos services are offered as stand alone packages and are not bundled with the products or other services. As such, the business model is similar to delivering physical pumps and will not add to the validation. Secondly, we will deal extensively with bundled service offerings in the subsequent chapter, when building new business models based on eu-DOMAIN.

We can now proceed to model this scenario using the global actor viewpoint. Firstly, we will need to identify and describe the actors, value objects and interfaces, value offerings and other elements of the value model. Then, we will model the business model in UML form and use this for building the model using the e3value tool. Finally, we will populate the model and calculate and validate profitability sheets for the various actors in other viewpoints.

10.1.4.1 Identify scenario

The business model illustrates a simple case of a customer needing to install a cooling system in a commercial building, such as a prosciutto cold store as described on the "Serving your every need" scenario. We only focus on the pumping installation of the cooling system. We do not consider heat exchangers, building infrastructure, power distribution, etc.

Customers, or their building advisors, typically engage an installer and ask him to select and install a cooling system with the necessary capacity. Design parameters are typically the size of the building, the temperatures to be achieved, the pumping pressure, etc. In the "Serving your every need" scenario, the cold store is typically 50.000 m^2 and the temperature must be strictly between +4 and +7 degrees.

In our value model we use a standardised cooling installation. The cooling system has a capacity of 12,500 kW (250 W/m^2). The cooling media is water with an inlet temperature of 5 degree C and an outlet temp of 11 degree C. The installer has chosen to use four Grundfos end-suction pumps type NK200-400, of which one is spare, as the main pumping installation.

The total end-user price of the installation is assumed to be as follows:

Pumps and control equipment..... 100.000 €

Auxiliary installations and components..... 30.000 €

Installation (labour)..... 20.000 €

Total price of installation..... 150.000 €

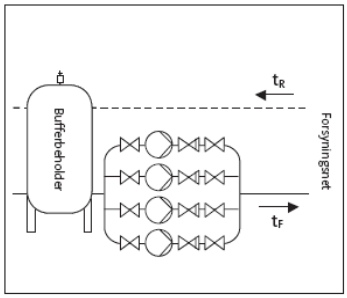

Figure 17 Pumps in cooling system

We use this pumping system as an average standard installation to model the market segment of heating and cooling installations in a large European market. We use the viewpoint of Grundfos as the pump supplier, and we do not include the competitive structure in the market model. Hence, we model only the part of the market segment that is related to Grundfos and we can assume Grundfos has a market share of 100%. The reason for this simplification is twofold. Firstly, in the first step, we only need to analyse relative economic performance such as increase or decrease in profitability from new services. Secondly, we are not interested in measuring shifts in market shares due to new services, only the economical impact these services will have by themselves.

We like to point out at this stage, that although the product constellations, design data and prices used for the scenario are based on real Grundfos product data, the scenario used in the model, and in particular the global data on market size and actor contribution are averaged data and not contributable to any one country or any one actor. At this stage, we are merely validating the general level of information accessible and the robustness of the value modelling tool.

10.1.4.2 Identify market segments, actors and value activities

Market segment 1: This market segment comprises all customers buying and using Grundfos circulation pumps for cooling and HVAC applications. The total number of new installations and replacements annually is 600, which correspond to a total installed based of approximately 20.000 cooling and HVAC systems.

Industrial customers: These are individual customers (actors) in the cooling and HVAC applications market segment. The all exchange objects that are valued equally. In the baseline model we only include the actors that are demanding new or replacement installations and only actors that eventually will end up with a Grundfos based pumping system.

Market segment 2: This market segment comprises all independent installers working with cooling and HVAC applications. There are 200 independent installers in this market segment.

Independent installers: The independent installer has in principle two value activities: Sourcing of parts and installation and commissioning. In the global actor view used here, the two value activities have been combined for simplicity. If we later need to look at the profitability for each of the activities separately, we will need to split the two value activities.

During the design, the installer engineers and projects the installation according to the technical requirements of the customer. He then proceeds to source the various components (pumps, control equipment, valves, pipes and fittings) and finally he installs and commissions the cooling installation at the customer's premises.

Wholesaler: The wholesaler buys and stocks a wide variety of components and products that are needed for the technical installation. Wholesalers tend to specialise in specific domains such as heating and cooling, electrical components, etc. but there is also a trend towards one-stop shopping.

There are typically relatively few wholesalers active in a specific market, but they may have several regional outlets. Hence for simplicity in the global actor viewpoint, we will only model a single wholesaler in the value model (a *composite actor*). The wholesaler undertakes two value activities: sourcing of components and stocking (warehousing). The two activities have been combined in our baseline scenario, but could be broken down in more value activities, if we need to study the value creation in the wholesaler actor in further details.

Component supplier: This composite actor is a representative of the numerous suppliers of complementor products such as valves, tubes and fittings, clamps and tools, which are needed to make a complete installation.

Grundfos subsidiary: The Grundfos subsidiary is the exclusive importer of Grundfos pumps to the market. The Grundfos subsidiary sells the pumps to the wholesaler. For simplicity, we ignore the few cases of very large installers who can buy directly from the Grundfos subsidiary. The value activity of the subsidiary is to make the Grundfos products available on the local market (logistic and warehousing).

Grundfos manufacturing: Grundfos manufactures pumps in different locations around the world. For simplicity, we assume that there is a single manufacturing entity outside Italy supplying pumps to the Grundfos subsidiary. The value activity of Grundfos manufacturing is obviously the design and manufacture of pumps, but also includes pre-sales consultancy and after sales support and service. Direct marketing activities may or may not be value activities in the viewpoint of other actors.

10.1.4.3 Identify value objects/ports and value offerings/ interfaces

A value interface consists of one or two offerings. In turn, a value offering contains ports which offer or request value objects, depending on the port's direction. For each actor, all these constructs have to be identified in the following steps:

- Identify value ports and objects exchanged by ports;
- Group value ports into value offerings;
- Group value offerings into value interfaces.

There are in the e^3value ontology two mechanisms for grouping value ports. The value offering is used to group equally directed ports, e.g. for showing mixed bundling, while the value interface is used to model the notion of economic reciprocity.

The industrial customer: This actor request a pumping system installed and commissioned in the cold store. Hence, the value objects consist of "Parts" and "Labour". The value object offered is "Money". The three value objects are exchanged in one value transaction.

Each value object delivered or requested by the industrial customer results in a port. Since parts and labour originates as a result of two different value activities, we want to have separate ingoing ports for each of these value objects. We do not see the installation and the parts as causally related value offerings but rather as mixed bundling of value objects. The mixed bundling is a way to increase total profit for the installer, since he/she can add overhead on the labour as well as on the parts. It is unlikely that an installer will supply parts only to a customer, and let another installer do the installation. It is equally unlikely that an installer will be happy to install equipment that the customer has sourced himself. In both cases, the installer is offering a bundle of parts and labour.

For the value object only one outgoing port is needed: Money. The industrial customer offers money in return for the installation and commissioning of a pumping system.

The independent installer: The independent installer has two value interfaces. As we already mentioned, the installer offers a mixed bundle of parts and labour to the industrial customer, which in combination leads to a complete installation and commissioning of the pumping systems. The offering is the result of the value activities within the installer: Sourcing and installation (labour) and the value objects are "Parts" and "Labour". The installer has a second value interface with the wholesaler. In this interface he requests the value object "Parts" (sourcing of pumps and components) and offers the value object "Money".

The wholesaler: The wholesaler has three value interfaces. From the value activity of "Sourcing and warehousing", he is able to offer the outgoing value object of "Parts" to the independent installer. For this value object, he requests "Money" as compensation (the principle of economic reciprocity). On a second value interface with the component suppliers, the wholesaler requests the value object of "Components" whereas he requests the value object of "Pumps" via the third interface with the Grundfos subsidiary. In both cases, the corresponding value object offered is "Money".

The component supplier: This actor offers the value object of "Components" and request "Money" in return. The value exchange takes place via the value interface with the wholesaler.

The Grundfos subsidiary: In the simple baseline scenario, the only value activity of the Grundfos scenario is to source and sell pumps. However, we include it in the baseline scenario because, as we shall see later, the subsidiary has a central role in providing services to the local markets.

The subsidiary has two value interfaces. On one interface with the wholesaler, it offers the value object of "Pumps" and requests "Money". On the other interface with the Grundfos manufacturing company, it requests "Pumps" and offers "Money". It is assumed that the offer and request of pumps are causally linked.

The Grundfos manufacturing company: This main actor provides the value object of "Pumps" for the scenario and requests "Money" in return. The only interface of this actor in the baseline scenario is with the importing subsidiary.

10.1.4.4 Identify value exchanges

The value exchange concept has been introduced to relate ports of actors exchanging objects. The connected ports have opposite directions.

The market oriented track that we have applied here to the baseline scenario starts with the identification of value exchanges rather than the value ports. Hence, we can directly map the value exchanges between the different value ports.

10.1.4.5 Value model

Given the above definitions and considerations, we are now able to model the value exchange system for the baseline scenario in the Industrial Service domain.

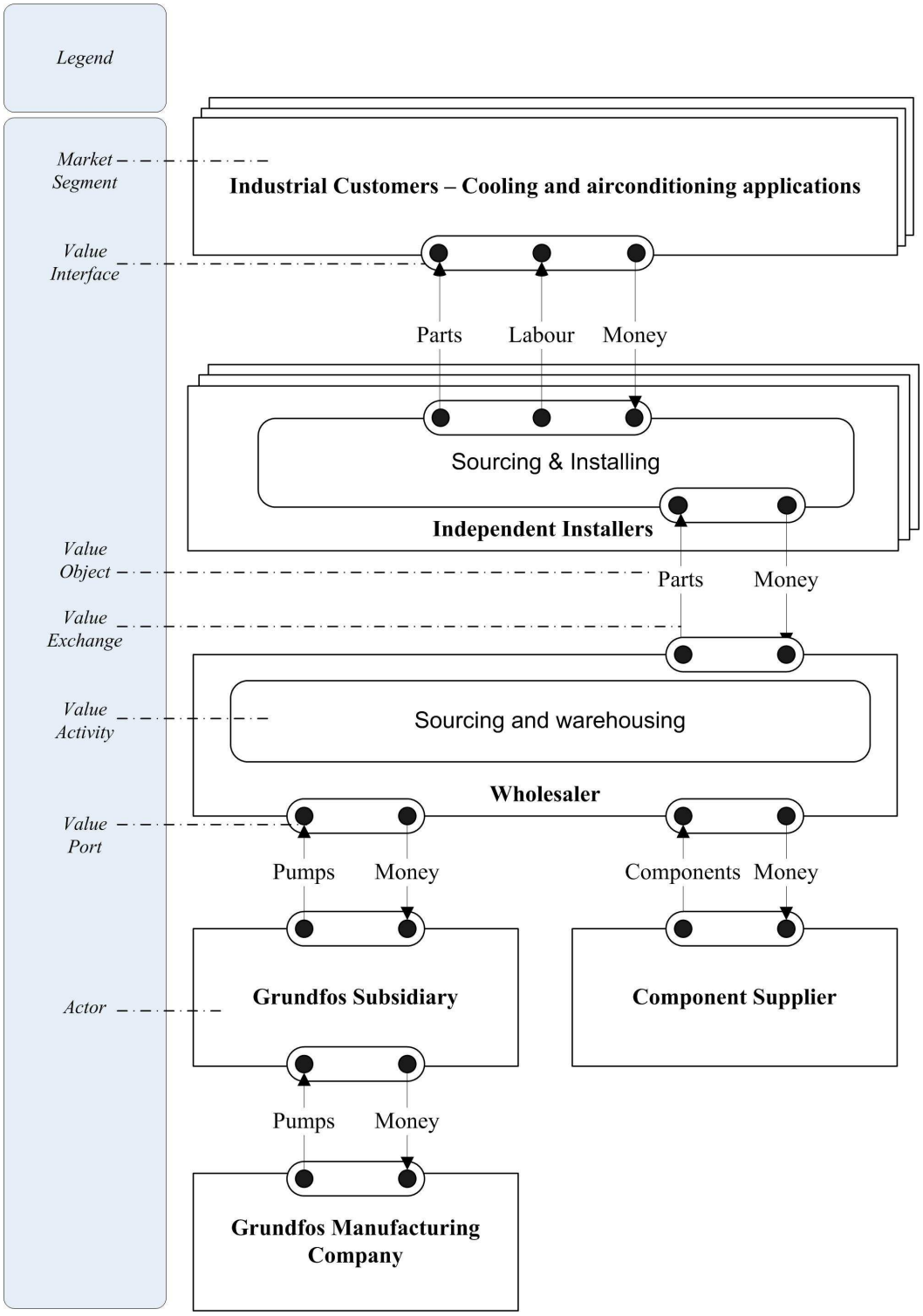

Figure 18 Baseline scenario in the Industrial Services domain

10.2 Profitability sheets

We use the e^{3}value tool to make a dynamic version of the value model and to calculate overall profitability for each actor involved, which makes it possible to evaluate the economic attractiveness of different actor constellations.

A first step in evaluation of the profitability of the business framework is to identify the value-added services to be offered in terms of an operational scenario. This was done in the previous chapter.

10.2.1 Scenarios

The second step is to relate the profitability to the specific use case. The operational scenario for our simple baseline business model is:

1. Industrial customer request cooling system installation
2. Independent installers source pumps and components and install the system
3. Wholesalers source pumps and components and stock them
4. Grundfos subsidiary imports and stocks pumps
5. Grundfos manufacturing manufactures pumps

Changes in a profitability sheet are caused by exchanges of values between actors via their value interfaces. The scenario path is touching the actors' value interfaces in a number of *responsibility points*. These points are used to model the changes in the profitability sheet of an actor as a result of executing the scenario path. If we estimate the number of times a scenario path is executed, (the number of cooling system installation requested) we can calculate the profitability of the e-commerce idea for one or all of the actors involved in the scenario.

The scenario path is showing as the dashed line on the model presented in Figure 19.

The start stimulus of the scenario path is caused by the request to purchase and install a cooling system.

This stimuli then progresses down through the value chain of installers and wholesalers. In the wholesaler actor, the scenario path branches out in two, because the wholesaler sources both pumps and components from different actors.

The pump branch extends further through the Grundfos subsidiary into the Grundfos manufacturing, which is also the end-point of the stimuli.

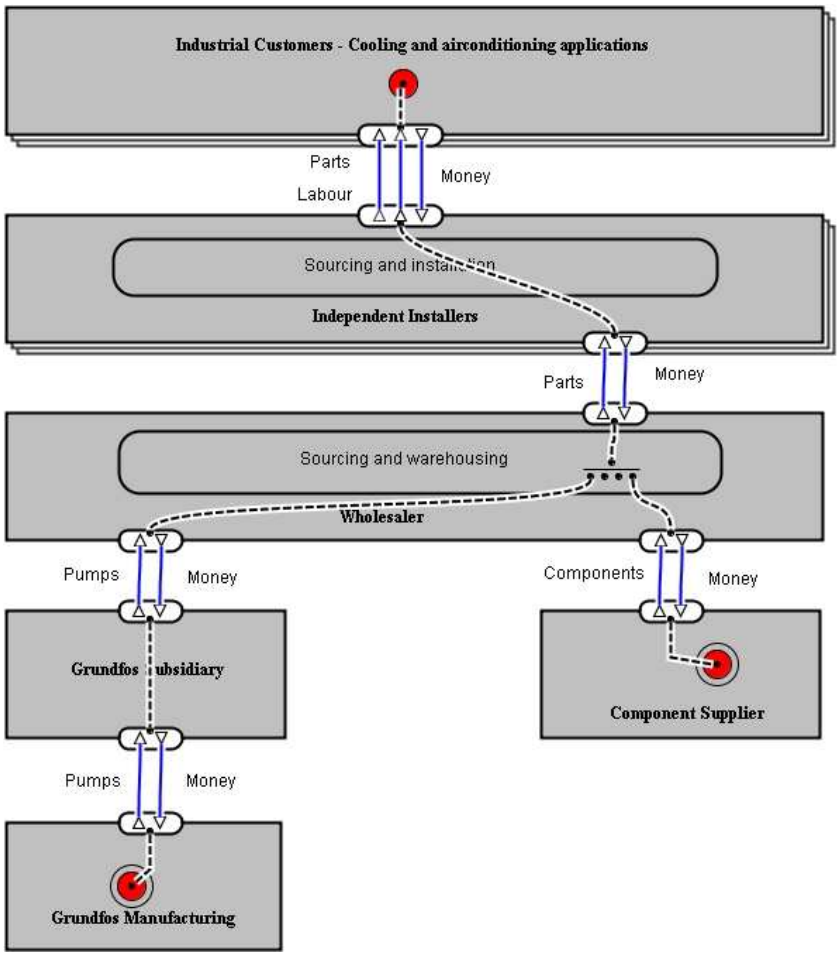

Figure 19 Value model of baseline scenario

10.2.2 Profitability analysis

The value exchanges between the actors, participating in the scenario and the profitability for the different actors are presented in the table below:

Actor / (€)	Value object in	Value in	Value object out	Value out
Industrial Customers - Cooling and air-conditioning				
Independent Installer	Buying pump system		Paying pump system	150.000
Independent Installer				
Industrial Customers	Installing pump system	150.000		
Wholesaler			Sourcing parts	110.000
Wholesaler				
Independent Installer	Delivering parts	110.000		
Component Supplier			Sourcing components	20.000
Grundfos Subsidiary			Sourcing pumps	65.000
Component Supplier				
Wholesaler	Delivering components	20.000		
Grundfos Subsidiary				
Wholesaler	Delivering pumps	65.000		
Grundfos Manufacturing			Importing pumps	50.000
Grundfos Manufacturing				
Grundfos Subsidiary	Exporting pumps	50.000		

Table 3 Value exchanges between different actors, participating in the scenario

The table shows for each actor, the value objects that are exchanged and the values assigned to them. The value exchanges are shown for each individual actor. For example, the Independent Installer sells the installed pump system to the Industrial Customer and buys the parts from the Wholesaler. The gross profit for this value exchange amounts to 40.000€.

10.2.3 Verification of baseline scenario

Since we know the total count of actors in each market segment, we can make an overall estimation of market sizes and profitability levels for each actor. This is an important feature to check the consistent profitability of the value proposition for each actor in the scenario. The profitability is shown in the table below:

Market segment / actor (M€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	90	-90
Independent Installer	90	66	24
Wholesaler	66	51	15
Component Supplier	12		12
Grundfos Subsidiary	39	30	9
Grundfos Manufacturing	30		30

Table 4 Value exchanges between different actors, participating in the scenario

The model shows that the total market segment amounts to 90 M€ in end-user prices (Grundfos share of the market) and total sales of Grundfos products amounting to 39M€. The table also shows that each actor conducts a profitable business with gross profit margins in the range of 20-30 per cent.

Based on our global assessment of Grundfos markets, we conclude that the baseline scenario represents a fair and accurate picture of the real-world business environment and that the value model used in the analysis provides an accurate and useful tool for our further modelling work.

Eastern Birmingham NHS
Primary Care Trust

10.3 Healthcare sector – the diabetes care system

The healthcare baseline business model is taken from case of primary care services for diabetes patients. The Eastern Birmingham PCT has, as user partner in the eu-DOMAIN consortium, had a very central role in the development of the healthcare domain scenarios and business models and will also be an active partner in the validation. Naturally, the baseline business model is most logically embedded in the public service world of diabetes care in Birmingham.

In building a business model for the healthcare system, we focus on the Primary Care Trust (in this case EBPCT) as the "business" who delivers healthcare services to its residents – and we here focus on healthcare to patients with diabetes as in the scenario "Patients as Customers". The following section gives a detailed description of the clinical pathway for a typical patient with diabetes. It will give us an idea of the various actors who are directly involved in delivering the appropriate healthcare services. In this sense, the Department of Health, EBPCT as organisation and the taxpayers are not included although they (as a whole) are essential players within the entire healthcare system.

The following figure illustrates the basic structure of the EBPCT healthcare system.

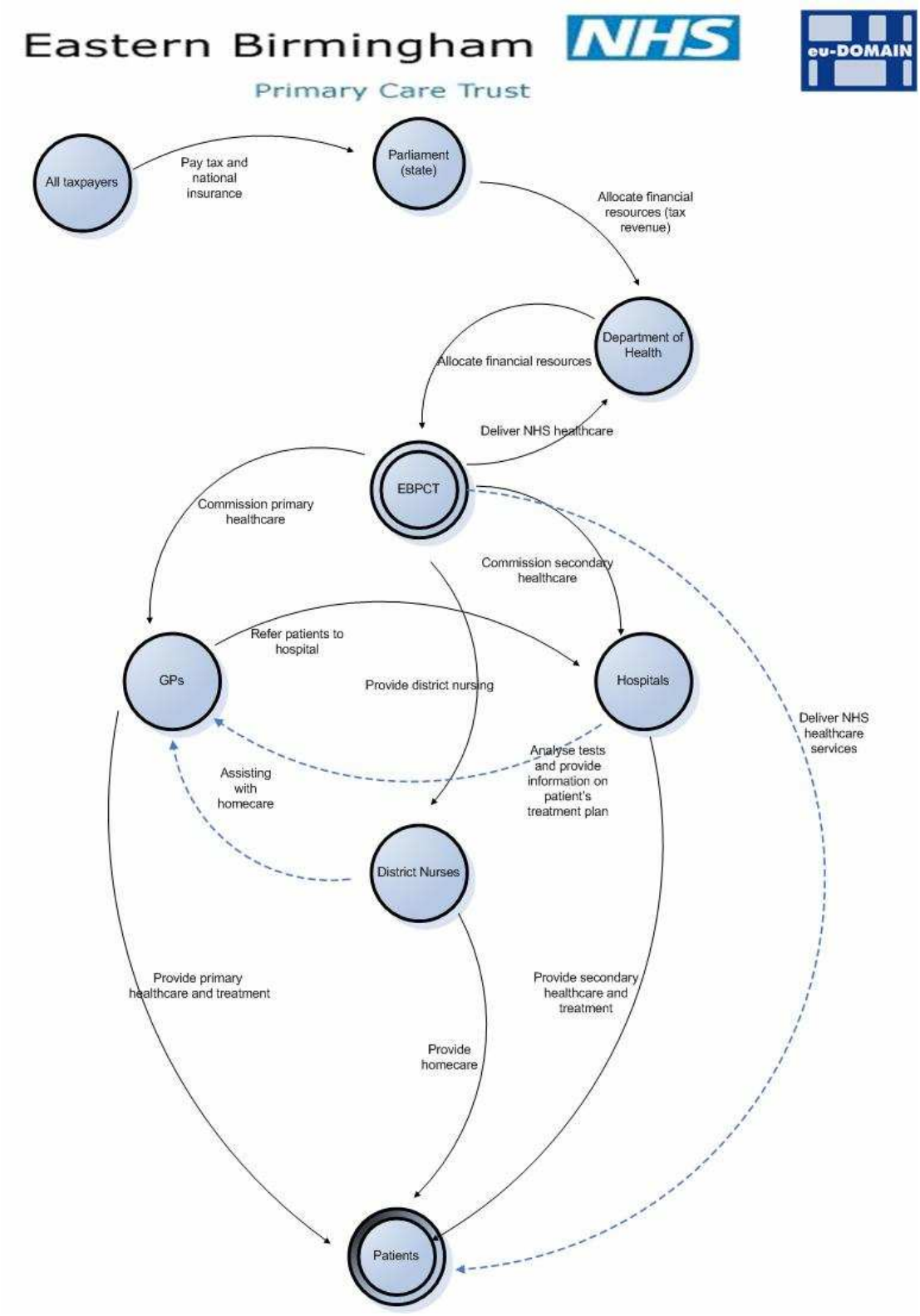

Figure 20 Structure of healthcare system from EBPCT's viewpoint.

The figure only shows the interaction between the main actors in the UK healthcare system from EBPCT's perspective and from the perspective of delivering healthcare services to patients. We have not included the different strategic and advisory bodies but focus on the delivery system of NHS healthcare services.

10.3.1 Typical diabetes care Process Map

EBPCT has a formal diabetes care process map which outlines the different activities and inputs from the various actors that occur onwards from the time of diagnosis. The exact details of the clinical pathways will inevitable vary from patient to patient since the disease will develop differently for each individual patient. Nevertheless, it is important to have an overall process map in place which explains the various stages of the clinical pathway. The following description of a clinical pathway for a patient with diabetes is based on information from the EBPCT. It will be followed by a specific description of the baseline scenario, including a definition of market segments, actors and value activities using the e^{3}value tool to create a business model.

The patient makes an appointment to see her GP for an examination and presents the different symptoms she is experiencing to the GP. Presented with these symptoms, the GP will perform appropriate clinical tests, which are sent to the hospital for analysis. The hospital will send the test results back to the GP who then inform the patient of the results and present the diagnosis.

When first diagnosed, the practice nurse will be assisting the GP with certain less complicated health care issues which are attended to at the GP's practice. This would typically be taking regular tests such as testing the patient's cholesterol, blood pressure, liver functions and blood sugar in order to monitor the disease. The practice nurse will then collect the data from the tests she has carried out for the GP and present these data to the GP.

The GP will assess the data and make a care plan in order to meet the patient's specific medical needs. In addition, the patient will need to be educated by the GP and the practice nurse about the disease and how to manage and control it. To supplement the information provided by the GP and practice nurse, the GP will also refer the patient to different health professionals who will further educate the patient on how to handle the management of diabetes. These professionals include: the district nurse, the hospital diabetes team, dieticians, podiatrists and community groups (education on diabetes community groups).

The GP and the practice nurse manage the medical treatment of the patient and new tests will be taken every 6 months in order to monitor the development of the disease. At the event of new developments or complications, the GP will refer the patient to the hospital for secondary care. The hospital will carry out the appropriate tests, analyse the results, inform the patient of the subsequent treatment plan and admit the patient for treatment. The hospital will also give feedback to the GP on the results and treatment plan for the patient.

Upon discharge from the hospital, the patient is instructed to see the GP, who will inform her of future treatment plan/control of the disease and discuss the available medications with her. If there are any changes to the medication, the GP will write up new prescriptions and inform the practice nurse. The GP and the practice nurse will continue to conduct appropriate tests every 6 months in order to monitor the disease.

As the disease progresses, the patient may not be able to come to the GP's practice for regular check-ups (including tests) or treatment of other symptoms caused by the disease. In this case, the GP will arrange for the district nurse to make home visits to the patient. The district nurse will carry out the same monitoring health services the patient received at the GP practice, e.g. testing cholesterol, blood pressure, liver functions and blood sugar. The district nurse will collect the tests and present the data to the GP.

In addition, the GP and the practice and/or district nurse will inform the patient of the existing options for support in the home and discuss with the patient what kind of support in the home (social services) the patient needs and would benefit most from. The GP will then contact the appropriate social services and arrange for them to contact the patient.

10.3.2 The baseline scenario

Based on the above process description of the clinical pathway (process map) for diabetes, we will now choose a simple subset for further processing. Our baseline scenario will be limited to the value process of delivering healthcare services to patients with diabetes but including the main actors involved, thus representing the global viewpoint of the e^{3}value tool.

We can now proceed to model this scenario. Firstly, we need to identify and describe the actors, value objects and interfaces, value offerings and other elements of the value model. Then, we will model the business model in UML form and use this for building the model using the e^{3}value tool. The model is shown in section 10.3.2.5. Finally, we will populate the model and calculate and validate cost/benefit sheets for the various actors in various viewpoints.

10.3.2.1 Identify scenario

The business model illustrates a simple case of a patient seeking healthcare within the NHS system. We are here only concerned with patients who get the diagnosis diabetes. The patient will initially go to his GP presenting the symptoms. The GP will give the diagnosis diabetes and as the disease progresses the patient will be referred to hospital for more specialised treatment. At the first point of contact with the GP, the patient thus enters the healthcare system and although he does not come in contact with other essential actors (i.e. Department of Health, EBPCT, other taxpayers), he is only able to freely visit his GP because of the interrelated roles and responsibilities these actors play, including their roles in the financial structures. However, for simplicity we have chosen not to include Department of Health and other taxpayers as actors in our model. Moreover, these actors are not directly involved in any value exchanges that are of consequence for our patients.

10.3.2.2 Identify market segments, actors and value activities

Market segment 1: This market segment comprises all patients with diagnosed diabetes in the geographical area served by the EBPCT, i.e. that group of people EBPCT provide healthcare services to.

There is an estimated 3% of the population with diagnosed diabetes in the UK. In East Birmingham, there are a total of 251.000 residents and 140 GPs. For the purpose of our model, we therefore estimate that each GP has 54 patients with diabetes, giving us a total of 7560 patients with diagnosed diabetes in East Birmingham (3.0478%). This may actually be a conservative figure considering the demographic and class factors in East Birmingham (see section 8.2.6.2).

Diabetic patients: The market segment consists of individual actors (diabetic patients), who perform a value activity called "Need of diabetes care". This value activity triggers two paths; patients go to their GP and to hospital.

This value activity needs further explanation: Diabetic patients initially go to their GP presenting specific symptoms which results in the diagnosis diabetes. Once diagnosed, patients must go to their GP twice a year for a regular check-up. We are here only concerned with these regular check-ups because all diabetic patients need these; we therefore ignore for simplicity any un-planned visits to the GP which are caused by other complications of the disease. Moreover, according to national statistics, we calculate that each diabetic patient spend on average one day a year in hospital.

Diabetic patients also perform a value activity called "Paying taxes". This activity is essential as it ensures the money flow via tax revenues to the NHS, thus funding EBPCT's healthcare commissioning services.

Market segment 2: This market segment comprises all GPs commissioned by the EBPCT. There is a total of 140 GPs in EBPCT.

GPs: These actors are individual GPs, commissioned by the EBPCT. GPs are responsible for providing NHS primary care to patients covered by EBPCT. GPs have a value activity called "Diabetes Diagnosis & Check-up".

There are 140 GPs in the EBPCT area. Each GP has in average registered 1,793 patients. However, in this baseline scenario we are only concerned with patients who are diagnosed with diabetes, so we can assume that each GP has 54 diabetic patients who require 2 yearly check-ups in order to monitor the disease.

Market segment 3: This market segment comprises all hospitals commissioned by EBPCT to deliver secondary healthcare in EBPCT.

Hospitals: The hospitals in EBPCT are responsible for providing secondary healthcare treatment to residents belonging to the EBPCT. There are three main hospitals used by EBPCT.

Here, we are only concerned with diabetic patients who need hospital treatment as a consequence of their disease. Hospitals thus have one value activity called "Diabetes Treatment". On average, every diabetic patient needs hospital treatment once a year.

The EBPCT: This actor has a value activity called "Fund management and healthcare provision". EBPCT commissions primary healthcare from GPs and secondary healthcare from hospitals.

EBPCT's funding is generated by general tax revenues. The model is designed on basis of the yearly funding EBPCT receives via general tax revenues.

EBPCT is an important actor in the model as we later take a look at a new business model (based on the extended PaC scenario) involving extra costs and extra savings to the EBPCT, i.e. increasing or decreasing the cost/benefit of diabetes healthcare costs.

10.3.2.3 Identify value objects/ports and value offerings/interfaces

A value interface consists of one or two offerings. In turn, a value offering contains ports which offer or request value objects, depending on the port's direction. For each actor, all these constructs have to be identified in the following steps:

- Identify value ports and objects exchanged by ports;
- Group value ports into value offerings;
- Group value offerings into value interfaces.

There are in the e^{3}value ontology two mechanisms for grouping value ports. The value offering is used to group equally directed ports, e.g. for showing mixed bundling, while the value interface is used to model the notion of economic reciprocity.

When using the e^{3}value tool to model business models within the healthcare system, some value objects may represent non-monetary concepts such as "opportunities" or "well being". The value object "being ill" is an example; there is no direct money exchange between the patient and the healthcare providers, since the NHS healthcare system is funded by general tax revenues. However, imposing a full scenario path across all actors, the money exchange will take place via taxes, funds allocation and provisioning.

Diabetic Patients: Diabetic patients have a total of three value interfaces. Via the value interface with GPs, diabetic patients offer the value object of "Being ill" to their GP. In return, diabetic patients request two value objects from their GP: "Diagnosis" and "Check-up". The value interface with GPs thus has one outgoing value port and two ingoing value ports.

There are no monetary exchanges between diabetic patients and GPs. The outgoing value object "Being ill" does not have a direct economic value. However, it represents an opportunity for GPs to collect a fee from EBPCT and as such is a non-monetary concept. Similarly, the two ingoing value objects "Diagnosis" and "Check-up" do not have a direct economic value but are of conceptual value to the patient; he is being treated for his illness and thus will feel better (see above).

Diabetic patients also offer the value object "Being ill" to hospitals and request the value object "Diabetic treatment" via the value interface with hospitals.

The value offering to hospitals should be seen in the same context as for GPs; hospitals are able to collect funding from EBPCT when they receive a patient who needs treatment. The ingoing value object "Diabetic treatment" also does not represent a direct economic value (see above).

Finally, diabetic patients offer the value object "Paying taxes" and request "NHS healthcare" via the value interface with EBPCT.

We here have to estimate how much of the amount diabetic patients pay in taxes that goes to the NHS. We therefore have to consider the total number of residents/patients in EBPCT and relate this to the amount we know EBPCT has available a year. This figure comes to £2500 per patient/resident a year.

The ingoing value object "Providing healthcare" is not a direct economic value (see above).

GPs: GPs exchange value objects with two different actors via two separate value interfaces. These two value interfaces should be seen in relation to the healthcare system where patients receive free healthcare service on the NHS and where Primary Care Trusts (e.g. EBPCT) are responsible for commissioning primary and secondary healthcare from providers (e.g. GPs and hospitals).

Via the value interface with diabetic patients, GPs have two outgoing value ports offering "Diagnosis" and "Check-up". In return, GPs request "Diabetic patients".

The diabetic patient's value offering to the GP should be seen in the context of how GPs are paid by EBPCT, i.e. per patient. In this sense, the value object "check-up" is of value to the GP because it enables the GP to collect a fee from EBPCT. However, in the direct exchange with the diabetic patient, the value object is non-monetary.

In the second value interface with EBPCT, GPs request the value object "Funding" and offer "Primary healthcare delivery" in return. The value object "Funding" has a monetary value of 80€ per patient (on average), whereas the value object "Primary healthcare delivery is a non-monetary object (has only indirect economic value).

Hospitals: The same types of value objects and interfaces exist with the hospitals as with the GPs; they also request and offer four value objects in two different value exchanges which should be seen in the same contexts as with GPs.

One interface is between the hospitals and the diabetic patients: the hospitals offer the value object "Diabetic treatment" and request the value object "Receiving diabetic patient". These value objects do not have a direct economic value but they consequently allow the hospitals to request the value object "Funding" (monetary value) and offer "Secondary healthcare delivery" (non-monetary value) in the value interface with EBPCT.

EBPCT's commissioning costs for hospitals is currently 217 million euro. According to national figures, diabetic patients account for up to 10% of hospitals' total budget. There are three main hospitals in EBPCT and we may therefore estimate that of the funds each hospital receive from EBPCT 7.3 million euros goes to treatment of diabetic patients. The value object "Funding" therefore has a value of 7.3 million euros.

EBPCT: Requests and offers six value objects in three different exchanges via three different value interfaces.

Via the value interface with diabetic patients, EBPCT offers the value object "NHS healthcare" and requests in return "Taxes". The latter has a monetary value of 2,500€ per patient.

Via the value interface with hospitals, EBPCT offer the value object "Funding", a monetary value object estimated at a total of 22M€. In return, EBPCT request the value object "Secondary healthcare delivery.

In the final value interface with the GPs, EBPCT offers "Funding" which has a monetary value of 80€ per patient. EBPCT request "Primary healthcare delivery" in return.

10.3.2.4 Identify value exchanges

The market oriented track that we have applied to the baseline scenario started with the identification of value exchanges rather than the value ports. Hence, we have been able to directly map the value exchanges between the different value ports.

10.3.2.5 Value model

Given the above definitions and considerations, we are now able to model the total value exchange system for the baseline scenario in the healthcare domain.

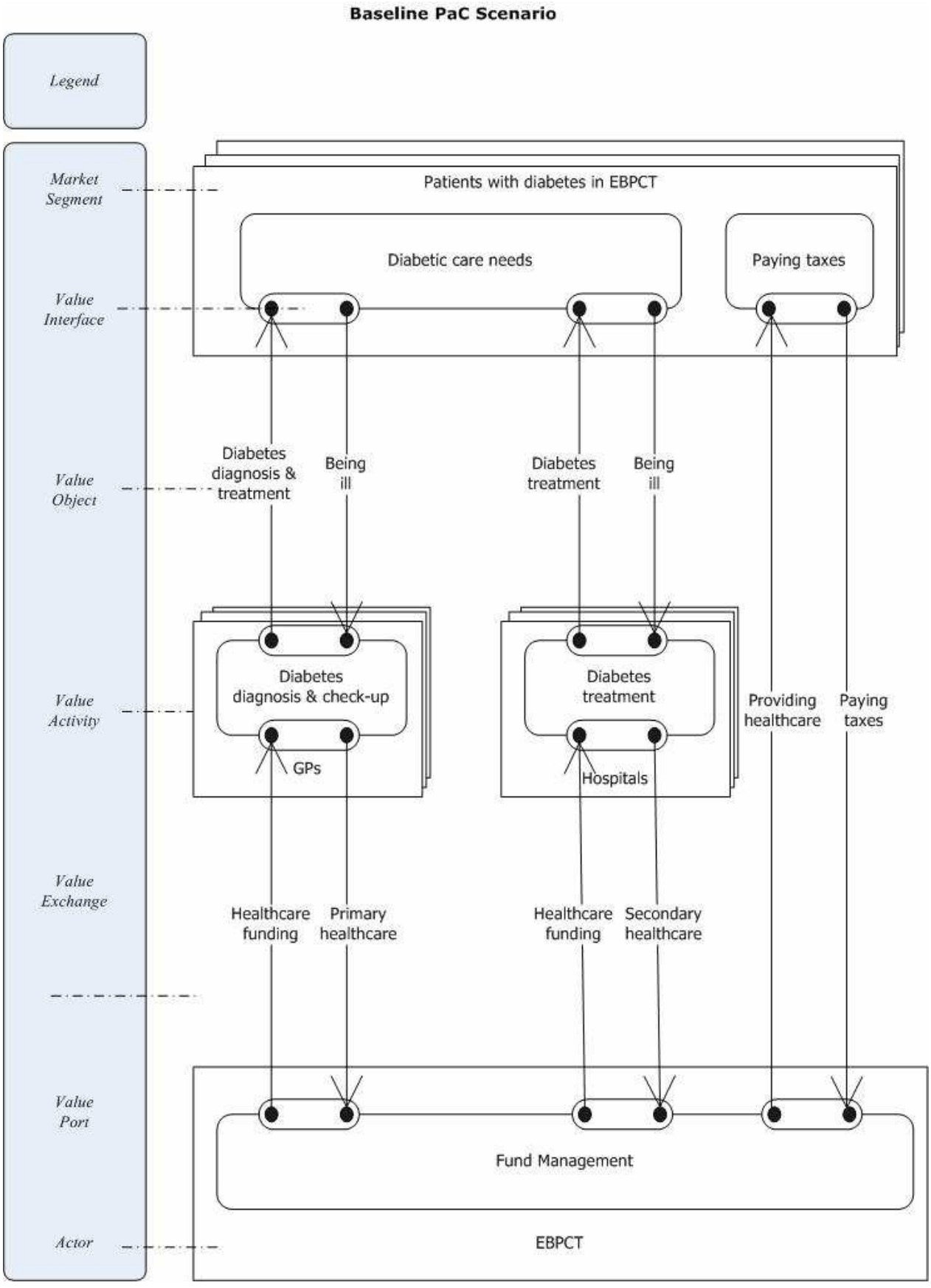

Figure 21: Baseline scenario in the healthcare domain

10.4 Profitability sheets

We use the e^{3}value tool to make a dynamic version of the value model and to calculate overall profitability for each actor involved, which makes it possible to evaluate the economic attractiveness of different actor constellations.

A first step in evaluation of the profitability of the business framework is to identify the value-added services to be offered in terms of an operational scenario. This was done in the previous chapter.

10.4.1 Scenario

The second step is to relate the profitability to the specific use case. The operational scenario for our simple baseline business model is:

1. Diabetic patients need a diagnosis and subsequently the appropriate care and treatment. They also pay taxes and thus contribute to the funding of the NHS
2. GPs provide diagnosis and regular check-up to monitor the disease effectively.
3. Hospitals provide treatment of diabetes
4. EBPCT commission healthcare services from both primary and secondary healthcare providers in order to ensure patients receive the necessary healthcare via the NHS.

Changes in a profitability sheet are caused by exchanges of values between actors via their value interfaces. The scenario path is touching the actors' value interfaces in a number of *responsibility points*. These points are used to model the changes in the profitability sheet of an actor as a result of executing the scenario path. If we estimate the number of times a scenario path is executed (the number of patients who have diabetes and need healthcare), we can calculate the costs/benefits for one or all of the actors involved in the scenario.

The healthcare scenario has two separate scenario paths related to two separate value activities performed by diabetic patients in East Birmingham. The scenario paths are illustrated by the dashed lines on the model presented in figure 22:

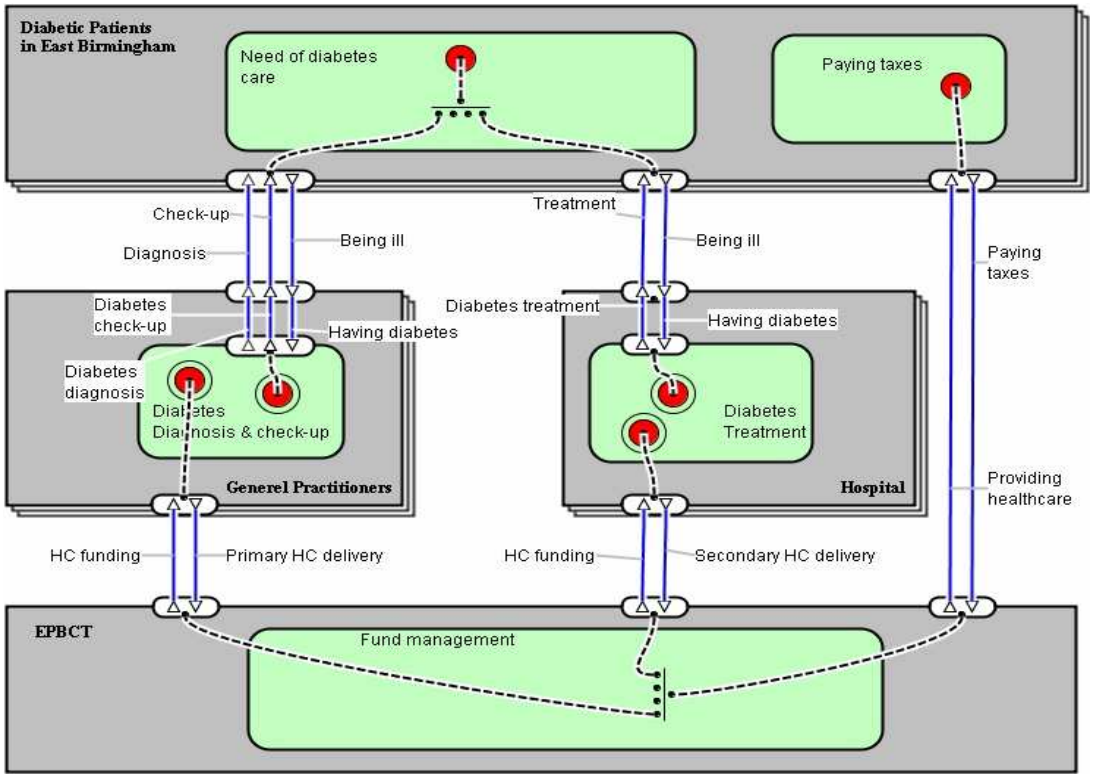

Figure 22 Value model of baseline PaC scenario

The start stimulus of the scenario path related to the value activity "Need of diabetes care" is caused by the healthcare needs of patients with diabetes. This start stimulus causes two scenario paths to

be executed: one leading to the market segment GPs and one leading to the market segment Hospitals. This is due to the fact that patients are diagnosed and receive two yearly check-ups by their GP *and* they spend on average at least one day in the hospital a year; patients receive healthcare from both GPs and hospitals. We therefore insert an "AND FORK" which allows us to model how the scenario path divides itself. The end-points of this stimulus are thus placed in both the GP and hospital market segment.

The other start stimuli related to the value activity "Paying taxes" performed also by diabetic patients in East Birmingham progresses down through EBPCT. It enters the value activity "Fund management" where it branches out into two paths via an "AND FORK": one going onwards to hospitals where it ends and the other going onwards to GPs where it ends. This scenario path illustrates the flow of money starting with the patients paying tax, which ultimately fund the healthcare services provided by GPs and hospitals.

10.4.2 Profitability analysis

The value exchanges between the actors, participating in the scenario and the profitability for the different actors are presented in Table 5:

Actor / (€)	Value object in	Value in	Value object out	Value out
		Diabetic Patient		
General Practitioner	Diagnosis		Being ill	
General Practitioner	Check-up		Being ill	
Hospital	Treatment		Being ill	
EBPCT	Providing healthcare		Paying taxes	2,500
		General Practitioner		
Diabetic Patient	Ill patient		Diagnosis	
Diabetic Patient	Ill patient		Check-up	
EBPCT	HC funding	80	Primary HC delivery	
		Hospital		
Diabetic Patient	Being ill		Treatment	
EBPCT	HC funding	2,900	Secondary HC delivery	
		EBPCT		
General Practitioner	Primary HC delivery		HC funding	80
Hospital	Secondary HC delivery		HC funding	2,900
Diabetic Patient	Paying taxes	2,500	Providing healthcare	

Table 5 Value exchanges between different actors participating in the scenario

The table shows the value objects exchanged by each actor and the economic value assigned to the value objects. Thus, we can see that each GP receives 80€ for each diabetic patient and that of the taxes paid by each diabetic patient 2,500€ goes towards healthcare for diabetes. At the same time, we know that diabetic patients account for 10% of hospital budgets, which means that each diabetic patient costs EBPCT 2,900€ in commissioning costs to hospitals annually. We have not included the hospitals' expenses in our model because the purpose here is to focus on the user-partner, EBPCT.

For simplicity reasons we refer only to patients with diabetes (our market segment) and use this market segment to calculate how much of their tax payment that goes towards diabetes healthcare. We know that healthcare to diabetics account for approximately 5% of the NHS budget and that 3% of the entire population has diagnosed diabetes. In other words, 3% of the population account for 5% of NHS healthcare expenses. We therefore estimate that of the taxes paid towards the NHS, 2,500€ goes towards healthcare services for diabetics. By doing so, we are able to demonstrate the discrepancy between number of diabetic patients and their share of the EBPCT budget as we shall see below.

10.4.3 Verification of baseline scenario

Since we know the total count of actors in each market segment, we can make an overall estimation of market sizes and profitability for each actor. This is an important feature to check the consistent profitability of the value proposition for each actor in the scenario.

The profitability is shown in the following table:

Market segment / actor (M€)	Revenues	Expenditures	Gross profit/deficit
Diabetic patient (7560)	0	19.0	-19.0
GP (140)	0.6	0.35	0.25
Hospital (3)	22.0	0	22.0
EBPCT	19.0	22.5	-3.5

Table 6 Value exchanges between different actors participating in the scenario

The profitability sheet shows that the total market segment of diabetic patients costs EBPCT 22.5M€ in commission fees to diabetic healthcare services. In comparison, EBPCT has only 19M€ available for diabetic healthcare from tax revenues. This leaves EBPCT will a gross deficit of 3.5M€ illustrating the higher cost of healthcare to diabetics (compared to the average patient); diabetic patients represent a significant expenditure in the EBPCT's total budget.

Each GP receives 80€ a patient regardless of the number of consultations needed. The expenditure for GPs is based on an average cost of providing a consultation to patients; it does not represent an outgoing value object but a fixed expense. The market segment GPs thus has a total gross profit of 0,25K€.

For the market segment hospitals, the table show a total income of 22M€. As mentioned above, we have not included hospitals' fixed expenses in this model and no out-going economic value, since we are only interested in relative changes in hospitals profitability.

Based on our knowledge of EBPCT's annual budget, the number of diabetic patients and the average annual cost of healthcare treatment to diabetic patients in both the primary and secondary healthcare sector, we conclude that our baseline scenario represents a fair and accurate picture of the healthcare domain. The e^3value model used in the analysis therefore provides us with an accurate and useful tool for our further modelling work.

11. The new business framework

11.1 Economic equilibrium

In the baseline business models we have been looking at real-world business systems where actors are operating in real world environments exchanging real world objects of products and services.

These business systems are assumed to be in a more or less perfect economic equilibrium. Actors undertake profitable operations or perform activities with a positive cost/benefit ratio. The equilibrium in the Industrial Service sector is mainly caused by the existence of competition at all levels: Installers compete by offering the best value-for-money installations. They buy pumps and components from the most economical manufacturers and so on. In the healthcare systems, the healthcare providers are assumed to compete to provide the best services for the allocated funds, governments "compete" to contain costs and thus keep taxes down and so on.

Throughout both systems, actors behave according to economic laws of maximising the benefit of a particular transaction relative to the associated costs of performing such transaction. Since all actors are profitable, the system is in a long-term *steady-state* or *equilibrium*. This does not mean that the system is *static*. Vivid competition between the different actors leads to continuous small-scale perturbations of the system state.

However, introducing disruptive technologies, such as eu-DOMAIN, can cause large-scale changes in the business state. New products or services may make existing products and services obsolete, may throw one or more actors into permanent non-profitability (and thus removing this actor from the business scene) or it may change the end-users' perception and direct the market demand into completely different supply-demand patterns. In either case, no actor is immune to being impacted in the new business systems arising from disruptive technologies.

An important additional aspect of the steady-state economic system is that it is often a closed system. In the system, only a fixed amount of money (profitability) is available. If new services are introduced, the profitability from these services must come either from the end-users being so convinced about the attractiveness of the value proposition that they are willing to direct additional money into the system (paying more for the improved or new services) or from one or more of the present actors being able to reduce costs elsewhere due to the new service, so that the net result is an increased overall profitability in the system.

11.2 Introduction of a Service Provider

Our analyses of new business models will be based on the introduction of a Service Provider, as defined in section 4.3.3.

The Service Provider is a firm[6] that establishes the eu-DOMAIN platform and offers the functionality of the eu-DOMAIN infrastructure in an ASP-type (Application Service Provider) arrangement to its customers. The customers are Content Providers, which in our case could be an industrial product company (i.e. Grundfos) or a healthcare authority (i.e. EBPCT). Hence in both cases, the eu-DOMAIN end-users are employees, business partners, patients, etc. of the Service Provider's customers.

For simplicity, we introduce only the concept of an external Service Provider. Of course, both Grundfos and the EBPCT (or the like) could decide to use a Service Aggregator or they could decide to use their existing in-house Service Providers (data centres). However, the convergence of Ambient Intelligence (eu-DOMAIN) and e-Business opens up many new challenges and opportunities for existing or in-house Service Providers. In particular, they need to address the challenges arising from the evolution from a two-tier client-server model (terminal-to-base) to a multi-tier model (device-to-base-to-terminal) with distributed systems and local gateways; an environment where the traditional application server roams at the centre of the network web and provides services for the

[6] The Service Provider could be a joint-venture company established by the eu-DOMAIN consortium or it could be any project partner alone.

ubiquitous devices and mobile terminals. Ultimately, the challenge to existing Service Providers is the capability of blending the real world and the virtual world in a seamless fashion so that the event in the real world can be translated into services in the virtual world. We consider these challenges to be so immense in the foreseeable future that most organisations will wish to outsource such services to specialised, external Service Providers using a dedicated eu-DOMAIN infrastructure.

In any event, none of the implementation variants have any conceptual impact on the business models and hence we have opted just to model the external Service Provider. This allows us to model, isolate and analyse the investments, costs and profitability of the new services and the isolated impact on all the other actors.

11.3 Profitability analysis

In the models, we have mainly chosen to take the viewpoint of the Service Provider, since we are interested in providing sustainable business models to be used in the exploitation planning to be discussed in deliverable D9.6 Exploitation plan.

This viewpoint implies that we start by assuming that the eu-DOMAIN service provided by the external Service Provider is profitable, i.e. the cost of providing the service is less than the price that is charged for such service. We then use the e^3value methodology and model to explore and analyse the impact on all other actors.

If the new service does not provide increased profitability or improved cost / benefit ratios for all the other actors in the model, we need to go back and adjust prices or costs of the Service Provider. Or we can adjust parameters of other actors. Or we can decompose some of the value activities and regroup them or even introduce new actors in the model universe. By following this iterative approach we aim at eventually arriving at a new, sustainable business model where all the actors are profitable.

In order to analyse profitability of all actors in the new business environment, we need to establish certain economic parameters for the Service Provider itself.

As described above in section 3.1 The eu-DOMAIN service platform, the Service Provider offers the eu-DOMAIN service based on three products:

1. The eu-DOMAIN server with its network connections, main infrastructure components, data storage, etc. providing on-line, continuous access 24 hours a day, 7 days a week
2. The location infrastructure centred on the location service gateway and its network of sensors and actuators
3. The necessary customisations and development of customer specific functionality, including instantiation of clients' domain models, security policies, user interfaces, etc.

In order to offer such a product, the Service Provider will have to make sizable investments in server infrastructure, including operating systems, hardware, server facilities, perimeter security and access control systems, etc.

In addition, the product demands sizable fixed operational costs for support and administrative staff functions, software licences, maintenance and upgrades, etc.

Finally the product has a series of variable costs for network communication, power, etc.

However, once the investment is made, the eu-DOMAIN server is capable of executing several mid to large size client installations on the same infrastructure.

For the purpose of modelling, we assume that the product price structure of the Service Provider consists of four elements:

- An initial one-time charge for setting up the specific client domain
- Hardware investments per user for the location gateway and additional sensors and actuators
- A fixed monthly use license to cover availability and support
- One or more pay-per-use charges to be paid per user and per data unit or similar metrics

In conclusion, and based on similar services, we arrive at the following "price list" for the eu-DOMAIN services, which we will use in the business models:

Cost items	Prices (€)
One-time entry-charge covering setting up basic domain models and customisation of the eu-DOMAIN server	30,000
Customisation, development of user interfaces, population of domain model, adaptations and "specials"	50,000 – 500,000 depending on platform size
Installation of a simple location service gateway with sensor network, but excluding sensors and actuators	1,000
Monthly base licence for availability, accessibility , support and upgrades, power and other fixed operating costs	10,000 – 100,000 depending on platform size
Monthly license per 1,000 users for availability, etc.	1,000
Monthly usage fee per 1,000 users (average)	500

These prices are "selling prices" offered by the Service Provider to its customers. They will be used in the business model analysis in the subsequent sections.

12. New business models in the Industrial Services sector

12.1 Business opportunities

Brand loyalty, customer intimacy, product customization, and service excellence are major ingredients that drive growth for product oriented businesses like Grundfos. Yet, today's environment puts a great deal of physical and mental distance between product companies and their customers. As shown in the baseline business model, independent installers, service partners, wholesalers, importers and others all help to facilitate the purchase, installation and use of a product, but at the same time they make it difficult to ensure a consistent and responsive experience for the customers. The result is that someone else is in control of their brand, their customer, their product, and their information. Product companies thus need to look at how they can improve their ability to speak directly with their customer or even with their product. The aim of our business modelling work is to identify e-Business concepts based on sustainable business models that allow the product companies to introduce a profitable business despite the additional costs of providing on-line access to their products and customers.

Internet-enabling of industrial products are bringing huge business opportunities, which we are only about to discover now. Everything from a pump, a building, an industrial machine, and an office's thermostat will have the potential to be networked thus creating a huge network of interconnected devices. Product companies can use their devices to enter into a customer service relationship that increases both revenue and customer management. In many ways, the product companies can use the networking technology to reduce the burden of Asset Management and reduce the total cost of ownership for the end-user. But it may not be the end-users that initially have the most to gain from the networking. It can well be the businesses that support them. Product companies can use device networking technologies to reduce costs, reduce installation time, improve effectiveness, neutralise learning differences, bridge knowledge gaps, gain more customers, and pursue new opportunity areas.

A recent research on the business value created by mobile & wireless technologies (mobile phones, Wi-Fi, RFId, etc.) involving about 70 enterprises has been carried out by Assinform[7] and the School of Management, Polytechnic of Milan. The study focused its research on the Field Force Automation (FFA), in which the activity of service engineers is more concentrated. The study concluded that in the near future many existing applications will be based on networking technologies. The case studies further indicated that the level of satisfaction related to the use of mobile and wireless applications is very high, with the most positive aspects being measurable benefits and short pay-back time.

Another survey conducted by the Wireless LAN Association and NOP World Technology also showed that the average payback for a wireless installation is about nine months. The survey also concluded that the average wireless user is 22% more productive than his or her wired counterparts. Productivity benefits are quantified at 48% of the total return on investment of a wireless network.

Most product companies will thus soon realise that device networking isn't only possible, it's essential for their future business. Moreover, in a market where customers continuously ask for more complex and integrated services, it clearly results that these new applications and intelligent solutions can help to reduce the risk that product companies take by assuming a greater and greater management responsibility (from simple installation to global service).

Business opportunities in the Industrial Services area were derived at the workshop at Grundfos. The following list is the conclusion:

- Data must be promoted to knowledge. Knowledge must be discovered and promoted to intelligence.
- Customer loyalty must be enhanced through "continuous service management", targeted service.
- e-Marketing activities must be explored.

[7] An Italian Association belonging to the Confederation of Italian Industry

- Installation and commissioning must be facilitated by supporting people and their servicing work process.
- Performance measurements can be used for increasing energy efficiency and decreasing environmental load and data can be promoted to knowledge and resold to internal and external recipients.
- Connectivity can be used to make new business with other sensor data and new external stakeholders such as monitoring firms, authorities, utilities, etc.
- Customers SLA will include compliance to external requirements on pump data.
- Predictability is very important to customers and requires focus on maintenance and prevention. Knowledge of pump performances must be filtered according to ntc – need-to-know criteria.
- Security is important, especially in relation to damage control.

In the following, we will identify a range of potential value added services that product companies can consider adding to their product portfolio. We will also take the most promising of these services and develop a new, appropriate, and sustainable business model.

12.2 Identification of value offerings

Networked products and devices is about enabling certain environments to be connected and operating together in an efficient manner. Services and products will utilise the embedded intelligence that resides in the networked devices in combination with the ambient intelligence provided by the eu-DOMAIN infrastructure to support completely new value added services.

By having remote access to their products, product companies can begin to change the nature of their business. Companies will increasingly engage as information brokers and service providers. They can start to offer a range of new services such as assisted installation and commissioning, remote diagnostics, repair and maintenance, energy management, asset optimisation, and information management.

Finally, the network platform can also provide product companies with better information, such as usage tracking, for use in their own product designs.

In this section we shall take a look at a multitude of new product and service offerings to be considered by product companies. Some of these potential services are categorised in the figure below:

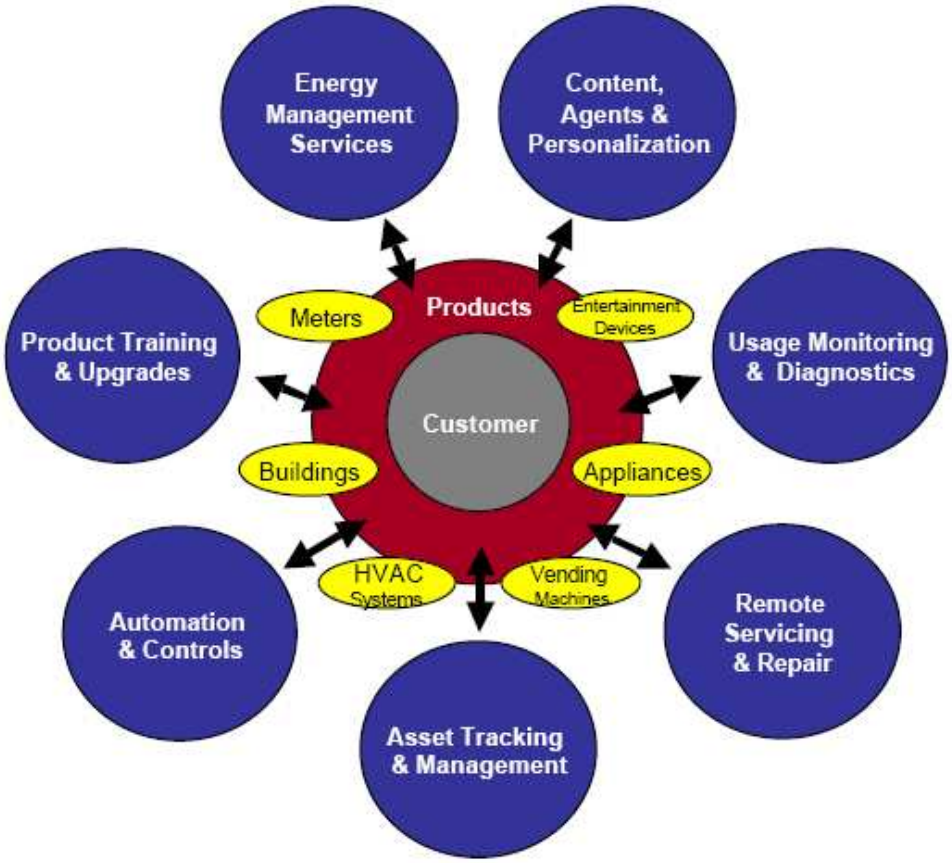

Figure 23 New services from networked devices (Habor Research [22])

12.2.1 Content, agents and personalisation

By regaining interaction and control with customers, product companies can manage and cater to the cultural, language, or usage differences in the global marketplace. They can thus ensure that their customers receive the same degree of service in the proper (self-chosen) cultural and linguistic context. They can additionally ensure that information on product upgrades, recalls, and maintenance is timely and properly delivered anywhere, anytime, as the customer may wish it.

Companies can also launch customised marketing campaign for products' replacement by knowing exactly the age and the functioning of the devices and elaborating these data in an "intelligent" way by pre-determined business rules.

Such e-Business solutions can both add value to the offering, for which the customer is willing to pay extra, and reduce costs with the product companies for e.g. multi-lingual training material and manuals.

12.2.2 Usage monitoring and diagnostics

New scenarios appear for Engineering Maintenance in relation with an improvement of the planning and of the provision of maintenance service. The opportunity of collecting and elaborating data from devices and applications would allow to provide precise and updated information on performance measurements (e.g. availability, reliability, etc.), SLA compliance, product lifecycle, etc.

The remote diagnostic technologies available with eu-DOMAIN allow the product companies to implement programmes for predictive maintenance which guarantee accurate monitoring of devices and installations, increase in productivity, and maximize the level of devices utilisation.

12.2.3 Remote servicing and repair

Product companies can dramatically reduce intervention costs and customers' complaints by a continuous and remote monitoring of the installations. This can give birth to condition-based maintenance, an alternative to the classical, time driven approach.

Instead of using expensive field assets (people, trucks, equipment) to fix a machine or device, product companies and their employees will be able to remotely diagnose and order parts for repair, and in some cases, provide fixes without having to make a visit to a customer site. Also, companies will be better able to apply employees with particular skills, languages, or schedules in a more effective manner for customers.

12.2.4 Asset Tracking & Management

The information associated with a product and its context can be as valuable as the product itself: e.g., its location, part number, where it was purchased, when it was installed, by whom, critical specifications, diagnostics, availability of spares, replacement alternatives, repair instructions, etc.

In some cases, regulatory forces requires companies to track how a product is being manufactured, sold, used, serviced, and disposed. With eu-DOMAIN it will become possible for a product company to follow a product from cradle to the grave.

Added value can also be derived from long term planned, preventive and predictive maintenance and value added services such as remote monitoring and compliance monitoring and documentation.

Firms offering Asset Management services can offer serious business propositions with very high added value. Not so professional or inexperienced players can still get involved by teaming up with smaller professional players and offer bundled services.

12.2.5 Automation and controls

Building owners, supervisors and tenants need to be kept constantly aware of conditions within their physical space. They need to manage HVAC, security, lighting, fire, water, and other building systems in a coordinated fashion. Security systems and indoor air quality monitoring, temperature control, and energy management, will all contribute to a tenant's ability to create a certain kind of workspace and culture.

These areas of responsibility are being met today through sophisticated building monitoring and control systems that let building operators know when and how resources are being spent. However, the challenge with existing systems is that they are not able to co-operate in an orchestrated way. Many users find that these systems do not give sufficient value for money, but by installing the eu-DOMAIN platform, all control systems could be made interoperable and remotely accessible. This means better product specifications, which can attract higher prices, and new, paid services.

A further way to increase business value is to look for related products and services and offer them as part of a complete installation. System integration is a valuable proposition seen with the customers' eyes and can attract higher prices. It also provides a single point of responsibility and minimises the risks.

12.2.6 Product training and upgrades

The cost of installation and commission increases sharply with the increased complexity of the products, the globalisation of markets and the need for training of highly skilled personnel. Assisted installation and commissioning are important cost saving propositions for product companies.

Using eu-DOMAIN, the technical experts from the company's headquarter can follow the installation process on display screens and participate in the virtual workgroup with auditory and visual advice and guidance. They can go through comprehensive tests and installation procedures with the technicians at the installation.

Augmented reality tools, such as goggles, can be deployed to assist the local staff by displaying design parameters and measured values directly on the real physical installation. When manual intervention is required, the goggle display shows the local technician what to do and what the expected outcome should be.

The eu-DOMAIN can thus provide substantial savings by reducing the time for installation and commissioning, by minimising expensive travel and staff costs for experts travelling to assist at the installation location. The savings are related to all aspects of installation and commissioning of technical equipment and machinery used in business environments, either directly in any kind of manufacturing process or as supporting machinery for infrastructures such as commercial, buildings, supply, support and logistics systems.

12.2.7 Energy management and services

As the world is experiencing a peak in energy prices and a continuing rise in the need for energy, the trend to enable the true "smart building" is becoming more and more obvious. Using eu-DOMAIN in combination with advanced facility management systems, data can be collected from a diverse set of building sources (e.g., HVAC, lighting system, elevators) and used for optimizing energy management and building automation requests. The facility management system aggregates and unifies the disparate information sources for trending, benchmarking, analysis, and decision-making, whereas eu-DOMAIN provides the platform for transmitting and exchanging data between heterogeneous platforms.

Savings from energy management can potentially be huge. For a typical big retail chain operator with about 800 locations, one degree in temperature deviation from the desired level can cost the company one million dollars a year [18]. The upside for the product company is impressive, since the company can move beyond simple building components into providing innovative outsourcing services with improved margins.

Deregulation in the energy sector, along with a growing dependence on power supply, quality, and reliability has placed increasing stress on the entire energy grid. Both consumers and suppliers of energy are concerning themselves with managing how and when energy is used. While managing peak demand is nothing new, services like load shedding have been confined to high-usage, industrial, and heavy engineering customers. Now, similar services are addressing the home and commercial market, which often represent greater than 50% of a geographic area's total energy demand level. One of the simplest ways to help monitor and manage energy usage is through the meter.

The worldwide installed base of all types of utility meters is estimated at around 700 million meters. Less than 1% of the European meter base is currently "networked" but is growing rapidly. Remote metering has become an absolute necessity within the deregulated energy market, where costumers are moving in and out constantly thus requiring frequent, trusted meter reading with high accuracy suitable for billing purposes. Compared to the cost of manual metering, the remote value proposition is immense.

12.2.8 Summary of potential value propositions

As seen from the product company's viewpoint, the many value propositions can be grouped according to:

1) The potential for increasing revenues, because the customer is willing to pay extra money into the closed business systems
2) The potential for reducing costs, because the manufacturer or the supply chain is able to perform their activities more efficient
3) The potential for introducing new actors with new money into the system
4) The potential for reducing risks, monetary and non-monetary.

The results can be displayed in tabular form as shown here:

	Increasing revenues	Reducing costs	New actors	Reducing risks
Content, agents and personalisation	Increased volume and higher prices due to customisation and better customer focus.	Reduce cost due to misunderstandings and human errors	N/A	N/A
Usage monitoring and diagnostics	Better product utilisation attracts higher prices and new predictive maintenance schemes can be offered	Costs of warranty can be reduced	Compliance monitoring information can be exchanged with public authorities.	Early indications of breakdowns and failures reduce risk of down-time and producer liability.
Remote servicing and repair	New innovative services in predictive and preventive maintenance can be offered.	Predictive maintenance becomes more effective and eliminates many redundant service visits	External service organisations can join the network and pay towards its operation.	Losses on fixed priced maintenance contracts can be avoided.
Asset Tracking & Management	New tracking services can be offered. More high-value management responsibility can be assumed.	Minimising unforeseen costs in facility management	New services for facility managers, service providers, alarm firms, etc. can be offered.	Minimising risk of lost assets.
Automation and controls	Interoperable control systems can pave the way for new high-value services.	N/A	Other vendors of automation and control systems may see other potential and sign up.	N/A
Product training and upgrades	N/A	Huge savings in cost of installation and commissioning	N/A	N/A
Energy management and services	New service for energy management can attract high prices because of fast pay-back potential.	N/A	Remote metering can be a value proposition to other stakeholders.	N/A

Table 7 Potential value propositions (the product company's viewpoint)

12.3 The extended scenario

From at technical point of view, several e-Business services are easily envisioned based on the introduction of the eu-DOMAIN platform in Grundfos' Industrial Services segment. Already today, Grundfos has a portfolio of strong service offerings that can be extended with new product specific offerings such as remote asset management, remote monitoring, and remote servicing. However, Grundfos can also move to new types of services, which extends their business offerings either horizontally (extended products) or vertically (extended management). The choice is up to Grundfos. In this chapter, we will make a hypothetical choice based on the perceived needs and with a strong view to choosing services from a value perspective rather than a technology perspective.

The choice of service offerings - and the corresponding business model - will be based on the following strategic business priorities:

1. Offering new service products to existing customers
2. Clearly focusing on creating economic benefits for service customers
3. Enhancing customer retention through higher integration with service customers

Several additional services have already been indicated in the scenario "Serving your every need", which is described in D2.1 User validation framework plan and we will use this scenario to dress the service offerings and provide foundation for the subsequent validation of the business models.

12.3.1 The service model

12.3.1.1 Scenario, actors and value activities

Since the new business models will be closely related to the service business of Grundfos, we will need to extend the baseline model with the business system of service and support. It appears from the description in the baseline system that Grundfos offers service contracts directly from headquarter to its customers worldwide. The carrying out of the service work is subsequently performed by a network of local Service Partners acting on behalf of Grundfos (i.e. Grundfos Manufacturing in our model description). Service Partners are equivalents of Servizio Provinzia in the ESN scenario.

Grundfos Manufacturing offers service and maintenance contracts at three different levels: Basic, Extended and Total. The difference is mainly to be found in the coverage of the service work itself (reporting, status, assessment, etc.), the speed of delivery, and the additional costs (of spare parts). A detailed description of the different contracts is found the annex to deliverable D2.5 Societal User Requirements Specifications.

In the value model, the value object offered by Grundfos Manufacturing is thus the care free operation of the installation supported by proper preventive maintenance and service coverage in case of an unexpected malfunction. The value object requested in return is "Money".

However, if Grundfos Manufacturing cannot offer this value object at an acceptable price, there will be no value exchange. Since the cost of reaching out from a central location in most cases will make the price of the service too high, the value object is therefore complemented by a second value object, the "Localisation of service", which is offered by the Service Partner. In return, the Service Partner requests only the acceptance of the customer, i.e. his acknowledgement of the performed work. The Service partner has another value interface in which he exchanges the acknowledgement of the performed work ("Contract fulfilment") with the value object of "Money" and "Spare parts"

We have used the e^3value methodology to describe and model the Grundfos service business system in a way similar to the baseline scenario. In order to keep it simple, we abandon the global actor viewpoint and focus on value creation in the service systems only.

The partial value model is described in the following figure:

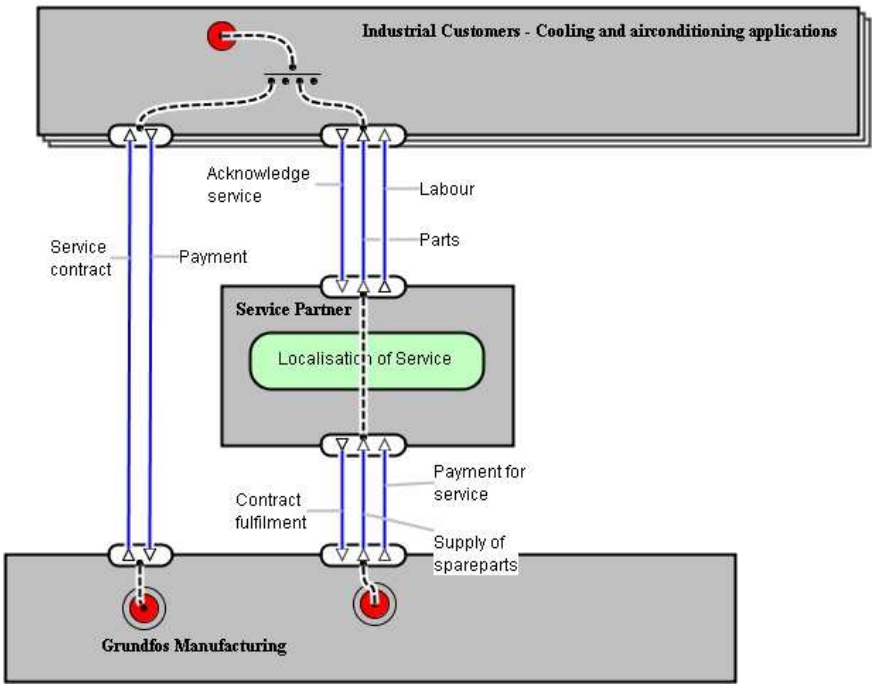

Figure 24 Model of an Industrial Service business system

The value exchanges between the actors are presented in the following table:

Actor / (€)	Value object in	Value in	Value object out	Value out
Industrial Customers - Cooling and air-conditioning applications				
Service Partner Grundfos Manufacturing	Localisation (parts & labour) Service contract		Acknowledge work Payment for service contract	 5,000
Service Partner				
Industrial Customers Grundfos Manufacturing	Acknowledgement of work Payment and spare parts	 2,000	Performing (parts & labour) Fulfilling service contract	
Grundfos Manufacturing				
Industrial Customers Service Partner	Payment for service contract Acknowledge work	5,000	Service contract Payment and spare parts	 2,000

Table 8 Value exchanges between different actors in the service model

In order to calculate actor profitability sheet, we assume that there are 1,200 service contracts in effect (20% of the installed base) and that each service contract requires two annual visits. The price of the service contract is assumed to be 5,000 € annually corresponding to 3% of the original installation costs.

Grundfos pays each installer 1,000€ per service visit and has additional costs for service and maintenance support of 1,440 k€ annually. The fixed costs and labour costs of the Service Partner have not been included in this model. The actor gross profitability now looks as follows:

Market segment / actor (k€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	6,000	-6,000
Service Partner	2,400	0	2,400
Grundfos Manufacturing	6,000	3,840	2,160

Table 9 Actor profitability in the simple service system

12.4 Extending the ESN business model

For the purpose of developing a new business model, we now introduce the *eu-DOMAIN Service Provider* with the aim of developing business cases, which have sustainable profitability for the new actor, and at the same time maintain the cost benefit ratio for all the other actors.

The Service Provider is an external firm that offers the functionality of the eu-DOMAIN infrastructure to Grundfos. The Service Provider has installed the eu-DOMAIN infrastructure on a server and provides communication accessibility and operational support to Grundfos, who in turn will use the eu-DOMAIN platform to develop and market a range of new e-Business services.

The Service Provider offers the service to Grundfos based on a fixed subscription fee plus a transaction fee depending on the volume of traffic. In addition, Grundfos must pay a one-time fee for installation and customisation of the service, but for simplicity, this investment is amortised over 36 month in our model. Hence, the cost for Grundfos of operating the eu-DOMAIN platform consist of a fixed part, which covers availability, operation and depreciation of the initial investment, and a variable part, which depends on the volume of traffic on the eu-DOMAIN platform.

12.4.1 Remote monitoring services

12.4.1.1 Scenario, actors and value activities

The first extension to the simple service business case involves the introduction of a new remote monitoring service. Customers, Facility Managers, and building owners with service contracts will be able to access the installation remotely and perform asset monitoring and control. They will be able to monitor early indications of breakdowns and thus reduce risk of down-time. They can also perform compliance monitoring and store the information for documentation to public authorities.

In order to be able to offer the service, Grundfos Manufacturing will engage an eu-DOMAIN Service Provider, who offers the value object of "eu-DOMAIN services" and request "Money" in return. The corresponding value model looks as follows:

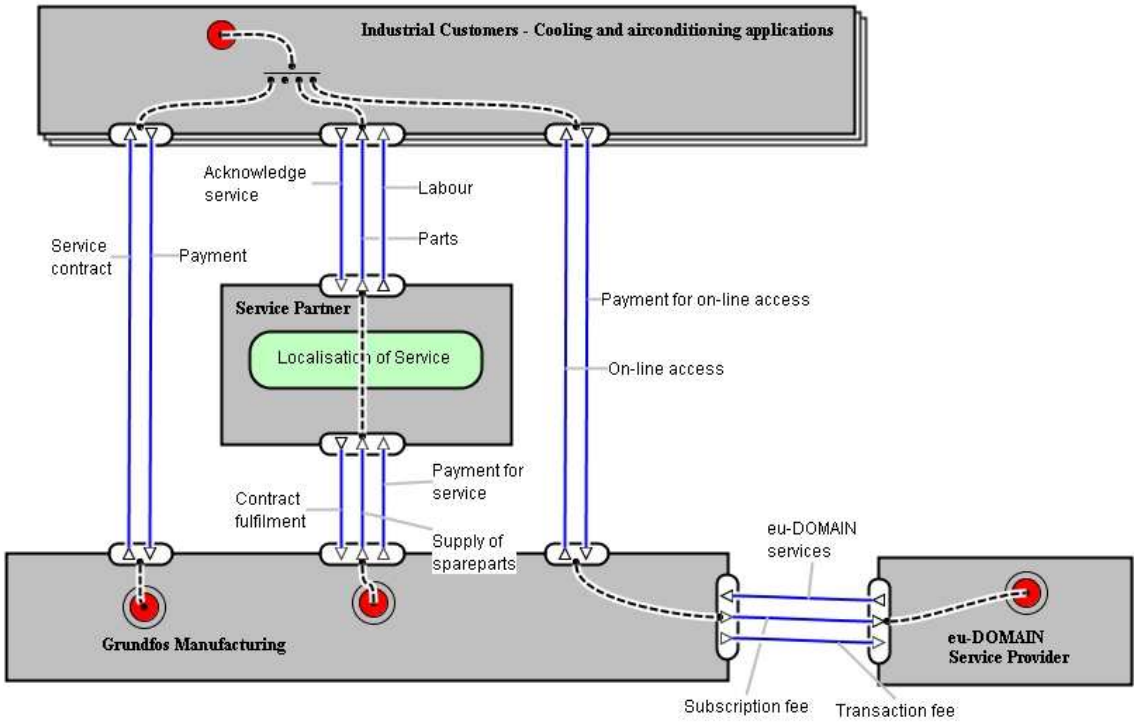

Figure 25 Extended value model for remote monitoring services

12.4.1.2 Value objects and value offerings

The new remote access service is offered as an addendum to the service contract. The value object of "eu-DOMAIN remote access" is thus closely related to the service contract itself and is therefore best offered by Grundfos directly to their customers. It further enhances customer loyalty and retention.

The price of the new service is initially set to a modest 200€ annually corresponding to a 4% increase in the price of the service contract. It is believed that most customers will find this price reasonable for the benefits offered. In the medium term, new services may be offered and the price may gradually be increased.

The price of the eu-DOMAIN service offered by the Service Provider is determined by the subscription fee (120€) including amortisation of the overall investment in the eu-DOMAIN platform, as discussed above. Further, the service provider has operational costs and usage costs based on the actual use of the services (80€).

In this first extension, we assume that the fee charged to the customers will be transferred directly to the Service Provider, i.e. the offering will be revenue-neutral for Grundfos.

The value object transaction appears from the following table:

Actor / (€)	Value object in	Value in	Value object out	Value out
Industrial Customers - Cooling and air-conditioning applications				
Service Partner	Localisation (parts & labour)		Acknowledge work	
Grundfos Manufacturing	Service contract		Payment for service contract	5,000
Grundfos Manufacturing	Provide on-line access		Payment for on-line access	200
Service Partner				
Industrial Customers	Acknowledgement of work		Performing (parts & labour)	
Grundfos Manufacturing	Payment and spare parts	1,000	Fulfilling service contract	
eu-DOMAIN service provider				
Grundfos Manufacturing	Payment subscription fee	120	eu-DOMAIN services	
Grundfos Manufacturing	Payment transaction fee	80	--	
Grundfos Manufacturing				
Industrial Customers	Payment for service contract	5,000	Service contract	
Service Partner	Acknowledge work		Payment and spare parts	1,000
Industrial Customers	Payment for on-line access	200	Provide on-line access	
eu-DOMAIN service provider	eu-DOMAIN services		Payment subscription fee	120
eu-DOMAIN service provider	--		Payment transaction fee	80

Table 10 Value exchanges between different actors in the remote monitoring model

12.4.1.3 Profitability sheets

Since we are aiming at developing entirely new business models for the eu-DOMAIN service provider in particular, we cannot just look at relative performance and incremental changes. We need to model not only the revenue stream, but the entire underlying cost model for this actor.

In the model we have assumed that setting-up costs, customisation costs and total operating costs amount to 457 k€ annually. Total transaction costs amount to app. 86 k€ per contract.

Using these figures, the actor gross profitability looks as follows:

Market segment / actor (k€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	6,240	-6,240
Service Partner	2,400	0	2,400
eu-DOMAIN service provider	240	543	-303
Grundfos Manufacturing	6,240	4,080	2,160

Table 11 Actor profitability in the remote monitoring model

The model shows that whereas the traditional service providers (Grundfos Manufacturing and the Service Partners) are unaffected by the introduction of the new service, the expected revenue stream is clearly insufficient, which makes the new eu-DOMAIN Service Provider highly unprofitable. The unprofitable situation has a number of ramifications that need to be addressed:

- The eu-DOMAIN Service Provider can try to obtain more contracts with other customers. Such other contracts would be contributing to the Service Provider's revenue stream and could lead to overall profitability.

- The eu-DOMAIN service provider can hope that prices can be increased as the service becomes more and more popular with customers and end users. This would require some kind of trusted expectation to market developments. In fact, the price has to be increased from 200€ to 492€ to create break-even.

- The eu-DOMAIN service provider can aim to increase the number of contracts, as the service gets increased awareness in the market. In fact, the break even point is around 4.000 contracts, which may not be unrealistic, considering the fact that the market segment of cooling systems is a rather narrow segment in the general market for pumping systems.

- Grundfos Manufacturing can decide to pay more for the service (at least initially) than what the users are actually paying. This would be the case if Grundfos Manufacturing has secondary strategic aims, such as brand awareness, customer loyalty, customer retention, etc., which can be supported by offering the service.

- Grundfos Manufacturing or the Service Partners may have internal benefits from the service, which could bring about substantial cost savings, which in turn could allow for a higher payment to the eu-DOMAIN service provider.

The latter case seems to have the highest potential and we will use it as basis for the further extensions to the business model.

12.4.2 Remote servicing and repair

During the first value model analysis it became clear that the value proposition offered to the Facility Managers or building owners were not sufficiently high in economic terms to justify the added cost of the eu-DOMAIN Service Provider. Further, we have assumed that the added benefit of the eu-DOMAIN service had to be revenue neutral to Grundfos Manufacturing. In other words, the value proposition to Grundfos Manufacturing is zero.

In order to further develop the business model, we will now ague that there actually is a sound value proposition to Grundfos Manufacturing, but we need to identify and quantify it, before the eu-DOMAIN Service Provider can negotiate a higher price for services rendered.

12.4.2.1 Scenario, actors and value activities

Theoretically, we use decomposition of value activities as a way to discover new profitable activities, for instance to identify alternative assignments of such activities to actors. Actors with many value interfaces are good places to start looking for decomposing potential. Grundfos Manufacturing thus has a total of four value interfaces to the following actors: Customers/end-users, Service Partners and eu-DOMAIN Service Provider. If we consider the value activities related to customers and Service Partners, we find that Grundfos undertakes several value activities to support these two actors.

One value activity is concerned with the offering and establishment of service contracts, including the involvement of Service Partners in performing the actual service work. We term this value activity "Contract service".

Another value activity is concerned with internal support for the field service technicians. Due to increased complexity of the installations, there is a strong need for service training and upgrade of the knowledge of the service personnel, in particular the service personnel employed by the independent Service Partners. Not only the cost of education, but also the costs of supporting the

service technicians during installation and commissioning and during actual service work are very high and steadily increasing. We term this value activity "Installation and service support".

Having established remote accessibility to all installations in the market segments, this facility can now be considered for improving the value activity of "Installation and service support". Instead of using expensive field assets to support the service organisation, Grundfos Manufacturing will be able to remotely diagnose and provide fixes without having to make visits to customers' sites. Such facilities could mean a substantial saving on service support costs. If one estimates that support costs can be decreased by up to 20%, the total savings amount to 300 k€ annually for the market segment in question, corresponding to a reduction in the average support costs from 600€ to 475€ per contract.

In the resulting business model shown in the figure below, we have introduced the two value activities and analysed the resulting value propositions.

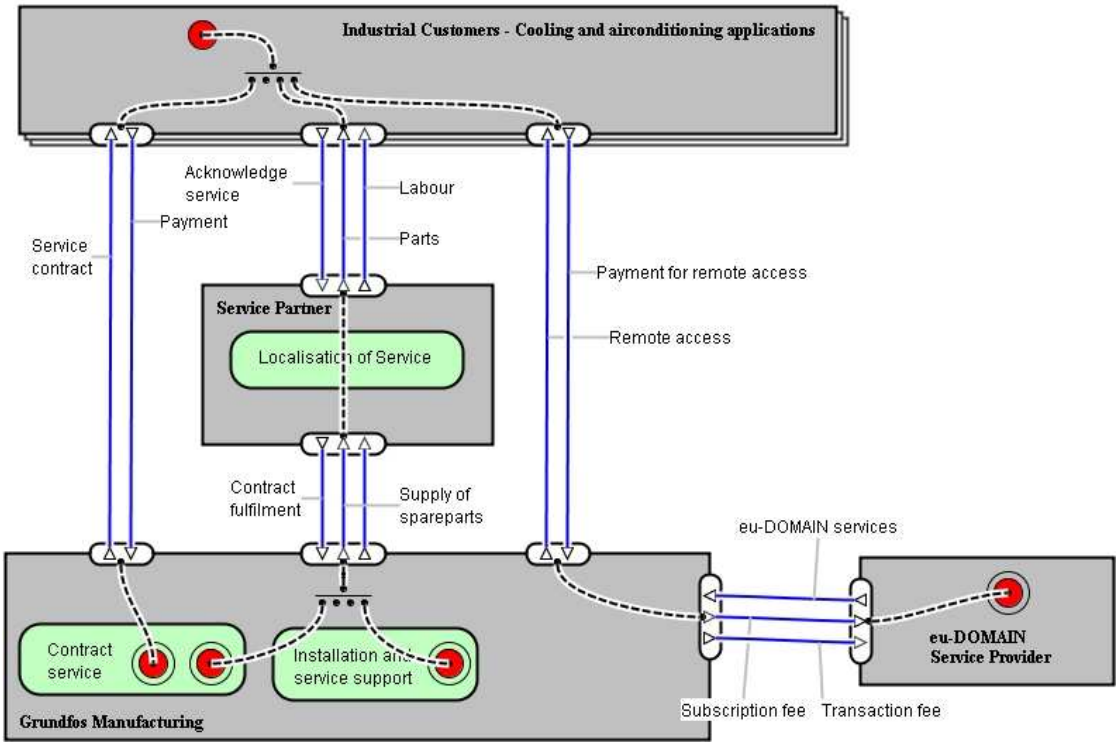

Figure 26 Extended value model for remote monitoring and remote service

12.4.2.2 Value objects and value offerings

The value proposition offered by the eu-DOMAIN service provider is now of much higher value to Grundfos Manufacturing due to the potential for costs savings. We have assumed that the prices for providing the eu-DOMAIN services to Grundfos can be increased to 270€ for subscription fee and 170€ for transaction fee. All other transaction costs remain the same.

The associated transactions are as follows:

Actor / (€)	Value object in	Value in	Value object out	Value out
Industrial Customers - Cooling and air-conditioning applications				
Service Partner	Localisation (parts & labour)		Acknowledge work	
Grundfos Manufacturing	Service contract		Payment for service contract	5,000
Grundfos Manufacturing	Provide on-line access		Payment for on-line access	200
Service Partner				
Industrial Customers	Acknowledgement of work		Performing (parts & labour)	
Grundfos Manufacturing	Payment and spare parts	1,000	Fulfilling service contract	
eu-DOMAIN service provider				
Grundfos Manufacturing	Payment subscription fee	270	eu-DOMAIN services	
Grundfos Manufacturing	Payment transaction fee	170	--	
Grundfos Manufacturing				
Industrial Customers	Payment for service contract	5,000	Service contract	
Service Partner	Acknowledge work		Payment and spare parts	1,000
Industrial Customers	Payment for on-line access	200	Provide on-line access	
eu-DOMAIN service provider	eu-DOMAIN services		Payment subscription fee	270
eu-DOMAIN service provider	--		Payment transaction fee	170

Table 12 Value exchanges between different actors in the remote monitoring and remote service model

12.4.2.3 Profitability sheets

The higher value proposition to Grundfos Manufacturing has dramatically increased the profitability of the eu-DOMAIN Service Provider as can be seen from the profitability calculations.

Market segment / actor (k€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	6,240	-6,240
Service Partner	2,400	0	2,400
eu-DOMAIN service provider	528	543	-15
Grundfos Manufacturing	6,240	4,068	2,172

Table 13 Actor profitability in the remote monitoring and remote service model

For Grundfos Manufacturing, the model now shows a marginally higher profitability, because not all of the savings have been passed on to the eu-DOMAIN Service Provider. The Service Provider, in turn, is still unprofitable, albeit at very much reduced level. However, this is the highest price that can be obtained from Grundfos Manufacturing under the given conditions.

The unprofitable situation still has a number of consequences that need to be addressed:

- The eu-DOMAIN Service Provider can accept the non-profitability situation for a transitional period, assuming that it can be corrected either by increased usage by customers/end-users or by additional customers/end-users opting to have the service.

- Since there is still not sufficient value to any of the present actors to make the eu-DOMAIN offering profitable for the Service Provider, a new actor can be brought into the model.

Since the latter case seems to have the highest potential we will discuss it and use it as basis for the last extension to the business model.

12.4.3 Remote metering

Since the "Remote access" value object is already being requested by all of the present actors in the scenario, we now look at the possibility of introducing new actors with a similar value proposition. In the last extension to the business model, we will look to decompose the value object of "Remote access".

12.4.3.1 Scenario, actors and value activities

It became clear from the discussion above that the remote connectivity technically could be used to collect crucial data and gain insight into other areas, such as energy consumption.

In today's world of deregulated energy companies, customers move between suppliers in a competitive environment. Every change of supplier or change of product requires high accuracy reading of energy consumptions such as electricity, gas, water, etc. Remote meter reading, now increasingly being referred to as Automatic Meter Reading (AMR), has thus become an important contributor to success in all utilities. The latest industry figures indicate that the market for AMR is growing at 15% annually.

The remote access already established by the Grundfos installation can be used for high accuracy temporal data about energy supply and consumption for the use, such as usage patterns over the day, week and month and many other useful information. The Grundfos installation becomes a component in the information network; the information becomes a commodity and Grundfos Management now has a value object that is of interest to a completely new actor in the scenario: The utility company.

Our final business model will thus be based on the introduction of a utility company, with whom we assume that Grundfos Manufacturing and the industrial customer has entered into a strategic cooperation agreement with.

In the final business model shown in the figure below, we have introduced the new value activity and analysed the resulting value proposition.

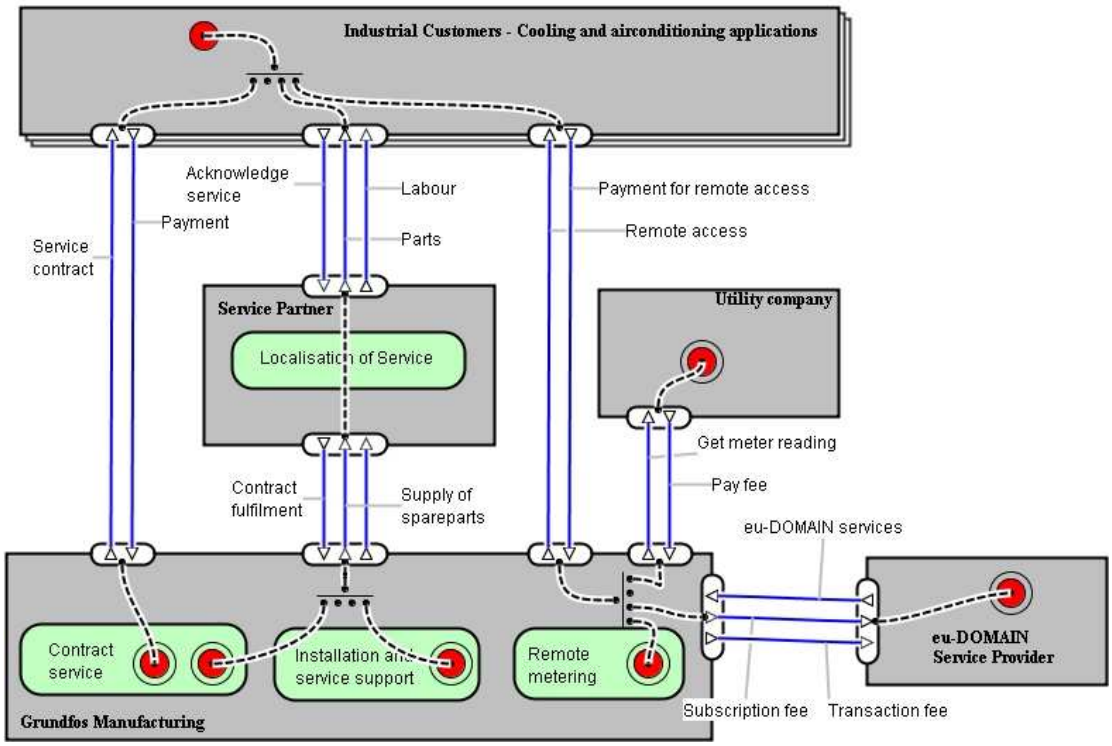

Figure 27 Extended value model for remote monitoring, remote service and remote meter reading

12.4.3.2 Value objects and value offerings

The value object of "Remote meter reading" provides data on usage and is being offered by Grundfos Manufacturing to the Utility Company against a fee. We have not investigated the market for remote metering or AMR in detail. For simplicity we have assumed that an annual fee of 30€ would be interesting to all parties. We have also assumed that Grundfos Manufacturing passes the fee on to eu-DOMAIN in the form of accepting a higher subscription fee from the eu-DOMAIN Service Provider.

The associated transactions are as follows:

Actor / (€)	Value object in	Value in	Value object out	Value out
Industrial Customers - Cooling and air conditioning applications				
Service Partner	Localisation (parts & labour)		Acknowledge work	
Grundfos Manufacturing	Service contract		Payment for service contract	5,000
Grundfos Manufacturing	Provide on-line access		Payment for on-line access	200
Service Partner				
Industrial Customers	Acknowledgement of work		Performing (parts & labour)	
Grundfos Manufacturing	Payment and spare parts	1,000	Fulfilling service contract	
eu-DOMAIN service provider				
Grundfos Manufacturing	Payment subscription fee	300	eu-DOMAIN services	
Grundfos Manufacturing	Payment transaction fee	170	--	
Utility company				
Grundfos Manufacturing	Meter readings		Pay fee	30
Grundfos Manufacturing				
Industrial Customers	Payment for service contract	5,000	Service contract	
Service Partner	Acknowledge work		Payment and spare parts	1,000
Industrial Customers	Payment for on-line access	200	Provide on-line access	
Utility company	Fee for meter reading	30	Provide meter reading	
eu-DOMAIN service provider	eu-DOMAIN services		Payment subscription fee	300
eu-DOMAIN service provider	--		Payment transaction fee	170

Table 14 Value exchanges between different actors in the remote monitoring, remote service and remote metering model

12.4.3.3 Profitability sheets

Although the contribution to the overall economic system is small, the contribution from the utility company just raises the profitability of the eu-DOMAIN Service Provider into profitability as seen from the following profitability sheet:

Market segment / actor (k€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	6,240	-6,240
Service Partner	2,400	0	2,400
eu-DOMAIN service provider	564	543	21
Utility company	0	36	-36
Grundfos Manufacturing	6,276	4,104	2,172

Table 15 Actor profitability in the remote monitoring and remote service model

We have now demonstrated that a sustainable business model can be developed by the value modelling methodology. The resulting business model will be submitted to user validation as part of the overall validation framework to be used in eu-DOMAIN. The business model will further be used in the exploitation plans to be described in greater detail in D9.6 Exploitation plan.

For the sake of future reference, we will now describe again the final business model in the following chapter.

12.5 A sustainable business model for the Industrial Services sector

The business model has been developed based on the industrial market segment comprising customers, owners and users of Grundfos circulation pumps for cooling and HVAC applications. In this hypothetical market, the number of new installations and replacements annually is 6.000, of which 1,200 customers have opted for a service agreement with annual service calls and free spare parts.

12.5.1 Market segments, actors and value activities

The service contract is entered into by the *Industrial Customer*, but the service is performed by a *Service Partner* in the local area. *Grundfos Manufacturing* is the main actor in providing high quality service to the customers, which is part of the company's overall strategy. In addition to providing the basic service and maintenance, Grundfos Manufacturing has introduced network communication components allowing users as well as Service Partners and Grundfos' own staff to remotely access the installations. Grundfos is basing the remote services on the eu-DOMAIN platform and has outsourced the operation to a *eu-DOMAIN Service Provider*. As a by-product of the communication network, Grundfos Manufacturing is now able to enter into new partnerships with e.g. utility companies, offering them remote access to energy consumption at the customer's installation.

In this way, the Grundfos Manufacturing undertakes three value activities supporting the business model: Contract service, installation and service support, and remote metering.

12.5.2 Value objects, value offerings and value exchanges

The business model is based on an accurate identification of value objects, value offerings and value exchanges.

The first value object consists of remote access to important pump and other relevant data. This value offering is requested by the Industrial Customer, Facility Manager or building owner, because it provides up to date information about the status of the installed assets, early warning of malfunctions and specific information on consumptions and other operational parameters. They will also be able to perform compliance monitoring and store the information as documentation.

The same value object is requested internally in the Grundfos Manufacturing support organisation. It allows key technical support personnel to remotely diagnose and support field service workers directly from Grundfos Manufacturing, without having to make visits to customers' sites.

Finally, the remote accessibility provides Grundfos Manufacturing with remote or automatic meter reading capabilities, a new commodity (or value object) which is being requested by various utility companies. Offering this information against a fee provides new influx of money into the business system.

The underlying service platform providing the remote accessibility is provided by the eu-DOMAIN Service Provider, who receives compensation in the form of subscription and transaction fees.

Most value objects are being exchanged via the Grundfos Manufacturing actor. We have chosen this approach because it conforms with the desire of Grundfos Manufacturing to be intimately linked with their customers and to provide world class services to them. This also implies that Grundfos will not allow other service providers to get in direct contact with their customers. By being engaged in all exchanges of value objects, Grundfos retains total customer control and supports customer satisfaction, brand recognition and a high level of customer retention.

12.5.3 Value model

The resulting value model is shown in the figure below.

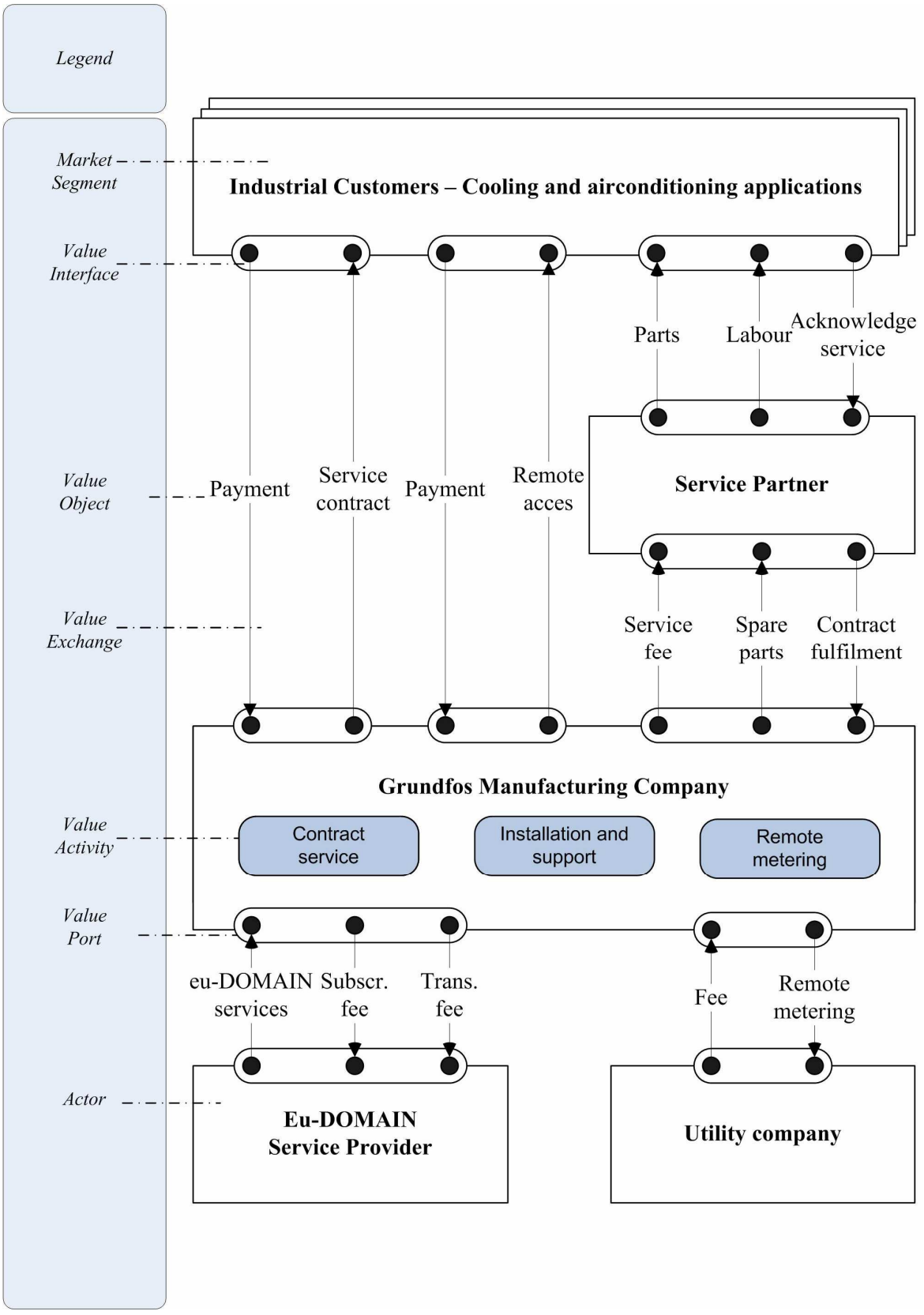

Figure 28 Final value model for remote monitoring, remote service and remote meter reading

12.5.4 Profitability analysis

An overall profitability analysis has been carried out based on the value model above and using the e^{3}value tool. The profitability sheet below shows the result of the analysis.

Market segment / actor (k€)	Revenues	Expenditures	Gross profit/deficit
Industrial Customers	0	6,240	-6,240
Service Partner	2,400	0	2,400
eu-DOMAIN service provider	564	543	21
Utility company	0	36	-36
Grundfos Manufacturing	6,276	4,104	2,172

Table 16 Actor profitability in the remote monitoring and remote service model

The business system is overall profitable and each actor is profitable, which indicates a high chance of the business model being sustainable over time.

The profitability sheet does not claim to be accurate in absolute terms, but indicates that sustainability can be achieved by carefully focusing on the value objects, decomposing actor activities into relevant value activities and by introducing new actors into the business system to achieve additional funds.

13. New business models in the healthcare sector

13.1 Business opportunities

In order to create new e-Business models for the healthcare sector, it is important to take the current trends – policy and demographic trends – into consideration. We have already analysed these in the previous chapters. Here, we will use this analysis to analyse new sustainable business models for new e-Business services based on the eu-DOMAIN platform. We will propose one business model for validation in the UK market, but the model can be extended to other markets, with the some adaptations.

In relation to the extensive ICT developments within the healthcare system in the UK, there is a fertile environment for the introduction of yet more comprehensive services such as those offered by eu-DOMAIN. Also, the increased public spending on healthcare suggests that the government see ICT investments as a priority in order to ensure an efficient and cost-effective healthcare system in the future.

Healthcare is generally accepted as being one of the new areas of Internet based applications and there is a growing impetus to develop e-Business solutions for this field. A result of the increasingly widespread deployment of information technology as a core component running across broadband communication infrastructures facilitates the delivery of ubiquitously and enhanced health care services to patients in professional clinics and in their homes.

The current situation in the healthcare domain is affected by the fields of medical and technological improvement, increasing patient's requirements and the inversion of the age pyramid (leading to more chronic and degenerative diseases) as well as an increased cost pressure. Another important issue is the impact of technological developments of medical equipment. We have identified the following drivers for deployment of new eu-DOMAIN based services:

- The increasing trend in miniaturization and the mutual networking of medical devices allows a seamless and permanent monitoring of the patient, even in their home and when they are mobile.
- From an economic point of view, the competition between health care providers on different levels, new but expensive medical technologies and the aging population puts a high pressure on costs.
- On the customer side, a movement from pure treatment of diseases to wellness and self-management can be observed.
- The utilisation of health services is going to be a regular service available anywhere and at anytime. The patient is mobile and healthcare services should be available pervasively, integrated into the patient's environment.
- Better use of existing knowledge or faster update of and access to knowledge for all participants like doctors, nurses or patients is increasingly needed for proper clinical practice.
- Citizen-centred services are increasing being used with success. Self-management programs, educated patients, family assisted and palliative care are examples of increased integration between technology and clinical practice.

Healthcare providers are now looking to use the new e-Business and e-Health technologies to provide efficient, cost-effective health services and care to citizens.

In order to define new business opportunities for the healthcare domain, we refer to our extended PaC Scenario "Patients as Customers". In this scenario, diabetic patients are encouraged to apply "self-management" of their disease by using remote monitoring realised by the eu-DOMAIN Service Provider.

13.2 Identification of value offerings

Networked products and devices is about enabling certain environments to be connected and operating together in an efficient manner. Services and products will utilise the embedded intelligence that resides in the networked devices in combination with the ambient intelligence provided by the eu-DOMAIN infrastructure to support completely new value added services. In line with the PaC Scenario "Patients as Customers", remote monitoring in connection with self-management programmes provide added value to patients in terms of better disease control and better quality of life.

13.2.1 Remote monitoring in self-management

In the healthcare domain, enabling patients with chronic diseases to manage and monitor their condition from home or away, thus avoiding spending hours in the doctor's office for regular check-ups, will not only mean that patients are more mobile and less dependent on their GP or the surgery's opening hours, it will also enable patients to take control of their disease. Studies have shown that when patients are more involved in their own health care, they monitor and manage their chronic disease more efficiently, for example by taking their medicine as appropriate. This is particularly crucial for diabetic patients who must follow a strict diet, monitor their glucose level and take injections. eu-DOMAIN will allow patients to self-manage their disease through the use of home testing devices and two-way remote communication with their GP, nurses and the hospital.

Improving chronic patients' condition and lives will be a major challenge for EBPCT in the future as more and more patients develop chronic diseases like diabetes. Providing remote monitoring will enable EBPCT to meet this challenge; patients' lives will be improved, the monitoring of the disease will improve and at the same time, EBPCT will be able to save money on commissioning fees as patients will need less consultation time with GPs. Moreover, EBPCT will be able to cut down on hospital costs as unnecessary admissions may be avoided and as the length of hospital stay can be cut down as patients will be able to be dismissed earlier and instead monitored closely at home.

In the PaC Scenario "Patients as Customer", which we use as our starting point for creating a new, extended, value model, we learn that remote monitoring not only benefits the patient's health condition by the improved monitoring of the disease, thus keeping it in check, but it also makes life with diabetes easier and more mobile and involves relatives in family-oriented assisted care.

13.2.2 Value creation

In order to analyse the value creation of a new business model introducing the eu-DOMAIN service provider, we must first of all define the number of patients who will be using the services, i.e. remote monitoring. We estimate that the first year (which our model represents), 10% of diabetic patients (576) in EBPCT will use eu-DOMAIN services.

Secondly, in order to define the value creation in our extended model, we next need to consider the following stakeholders/actors because they must all be able to benefit from the services the service provider providing eu-DOMAIN offers:

- EBPCT
- Hospitals
- GPs
- Service Provider
- Patients (end-users)

EBPCT: This is the main stakeholder (the service provider's main customer) who will buy the services offered by the service provider directly. EBPCT will be motivated to buy these services by the promise of cutting overall costs of healthcare for patients with diabetes. These savings will mainly be found in commissioning fees to hospitals and GPs, but also in improving co-ordination and communication between district nursing teams, case managers and patients. This will lead to a more efficient use of time (saving time) and improved care for patients, which will improve preventative measures and care.

The savings in commissioning fees to hospital will probably be the most significant saving. People with long-term health problems are significantly more likely to be admitted to hospital as an inpatient (on average about twice as likely, given a particular problem) and stay in hospital for longer. Treating the different complications caused by diabetes is very expensive and patients with diabetes account for 5% of the NHS budget and up to 10% of hospital budgets.

Currently, EBPCT pay approximately 217M€ to hospitals (secondary care) a year and 10% (21.7M€) of this goes towards healthcare treatment of diabetic patients.

With eu-DOMAIN hospital costs of diabetes treatment would be reduced because remote monitoring and self-management would reduce the number of hospital days and length of hospital stay. Moreover, because effective self-management and remote monitoring will improve preventative and care efforts, the need for inpatient hospital treatment of complications could be reduced. For example, a recent telemedicine project in Carlisle showed that remote and self-management of chronic respiratory diseases reduced hospital stay for some patients from 10 days to 5.5 days.

If we consider that 10% of diabetic patients use remote monitoring, we estimate that half of this group of patients will not need to go to hospital once a year. Subsequently, there will be a reduction of 2.5% in hospital admittances/bed stays or a cost reduction of 5% for diabetes treatment.

In relation to GPs, we assume that EBPCT will pay the same sum per patient; GPs will have the same number of patient whether they use remote monitoring or not and therefore EBPCT will not be able to cut in costs to GPs.

Hospitals: As described above, hospitals will be able to reduce the number and length of hospital stays, both due to remote monitoring itself and to the preventative care enabled – and made easier – due to remote monitoring and self-management of the disease. The total spending on treatment to diabetic patients will therefore, as mentioned above, be reduced with 5%.

GPs: GPs will witness a reduction in consultation time when 10% of diabetic patients use remote monitoring. GPs will therefore be able to reduce the average costs per consultation with approximately 5%.

Patients: While the first four stakeholders have direct financial interests and must benefit directly financially, patients do not have direct financial interests involved. Patients will benefit in terms of receiving more efficient and convenient care, more self-management and independence and overall better health. Patients will, however, benefit financially more indirectly in terms of saving time (i.e. they do not have to go to their GP as often) and possibly medicine costs and loss of work time due to better control and management of the disease, thus preventing serious complications.

13.3 The extended scenario

Based on the value creation analysis above, we will now develop a realistic business case for each actor based on the technical capabilities of the eu-DOMAIN platform. From at technical point of view, the user requirements are easily described. We have mainly taken inspiration from the developed scenario "Patients as Customer", which is described in D2.1 User validation framework plan.

The value model of the proposed extended scenario for the healthcare domain was performed in a similar way as the baseline scenario, but with additional actors. First we have extended the baseline business model with the eu-DOMAIN service provider offer its value object to EBPCT. We name this value object "eu-DOMAIN services". It enables EBPCT to offer remote monitoring to diabetic patients. This new service will involve GPs and hospitals also. They will be able to improve the quality and capacity of the healthcare services they provide to patients, as well as to EBPCT as the commissioning body.

We can now create a new extended value model that includes the eu-DOMAIN Service Provider:

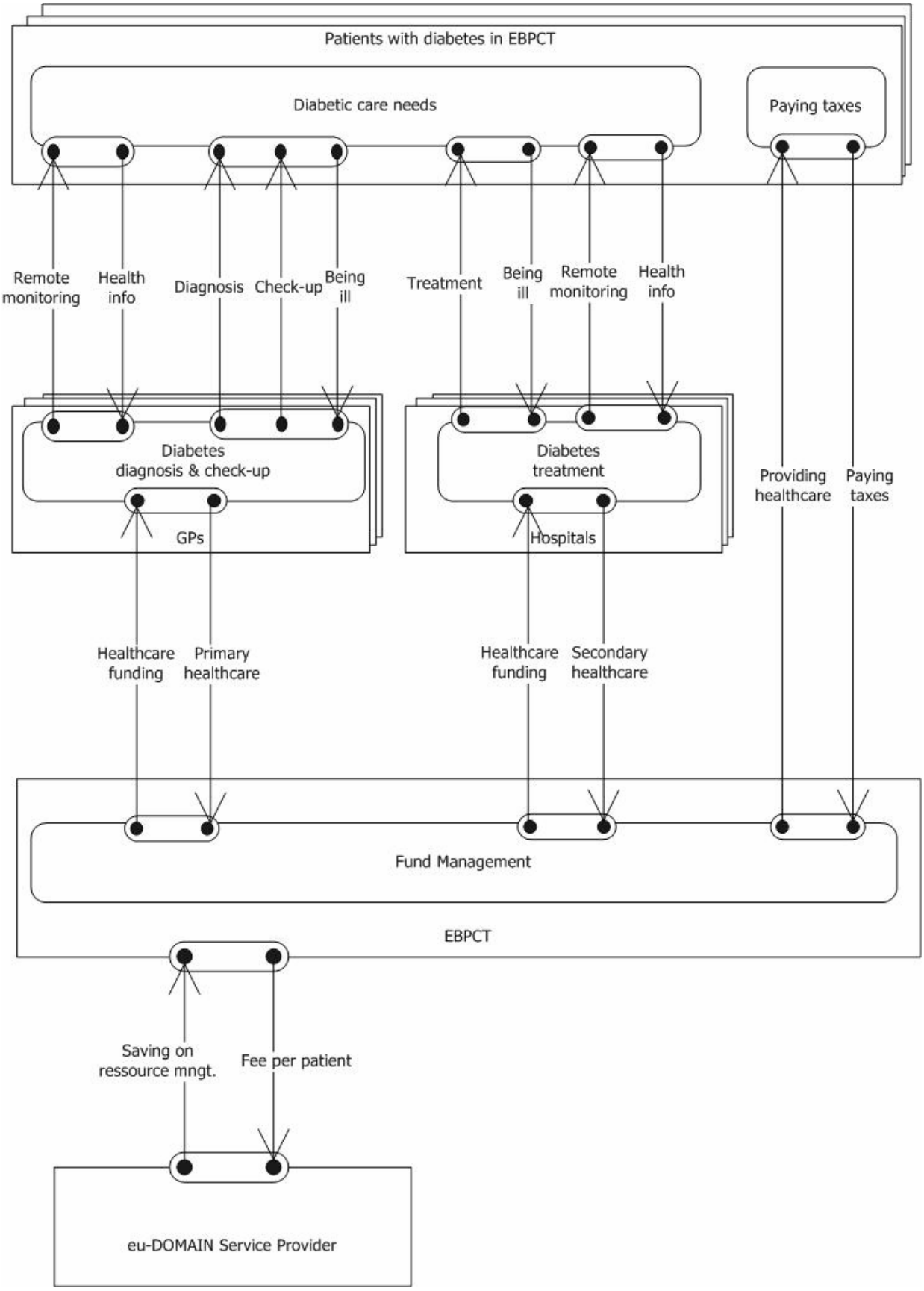

Figure 29 Value model for remote monitoring and self management of diabetes patients

13.3.1.1 Scenario, actors and value activities

Market segment 1: This market segment comprises all patients with diagnosed diabetes in the geographical area served by the EBPCT, i.e. that group of people EBPCT provide healthcare services to.

Diabetic patients: The market segment consists of individual actors (diabetic patients), who perform a value activity called "Need of diabetes care". This value activity triggers two paths; patients go to their GP and to hospital. Each path triggers a choice of direct consultation or remote monitoring. We estimate that 10% of diabetic patients will use the services provided for remote monitoring.

Diabetic patients also perform a value activity called "Paying taxes". This activity is essential as it ensures the money flow via tax revenues to the NHS, thus funding EBPCT's healthcare commissioning services.

Market segment 2: This market segment comprises all GPs commissioned by the EBPCT. There is a total of 140 GPs in EBPCT.

GPs: These actors are individual GPs, commissioned by the EBPCT. GPs are responsible for providing NHS primary care to patients covered by EBPCT. GPs have a value activity called "Diabetes Diagnosis & Check-up" which includes the remote monitoring of that group of diabetic patients who have chosen to use this option.

Market segment 3: This market segment comprises all hospitals commissioned by EBPCT to deliver secondary healthcare in EBPCT.

Hospitals: The hospitals in EBPCT are responsible for providing secondary healthcare treatment to residents belonging to the EBPCT. There are three main hospitals used by EBPCT.

Here, we are only concerned with diabetic patients who need hospital treatment as a consequence of their disease. Hospitals thus have one value activity called "Diabetes Treatment" which includes remote monitoring for 10% of all patients.

The EBPCT: This actor has a value activity called "Fund management and healthcare provision". EBPCT commissions primary healthcare from GPs and secondary healthcare from hospitals.

EBPCT's funding is generated by general tax revenues. The model is designed on basis of the yearly funding EBPCT receives via general tax revenues.

eu-DOMAIN Service Provider: This actor offers the services of eu-DOMAIN to EBPCT.

13.3.1.2 Value objects and value offerings

Diabetic Patients: Diabetic patients have a total of five value interfaces with three different actors/market segments.

Via the first value interface with GPs, diabetic patients offer the value object of "Being ill" to their GP. In return, diabetic patients request two value objects from their GP: "Diagnosis" and "Check-up". This value interface with GPs thus has one outgoing value port and two ingoing value ports.

Patients also have a second value interface with GPs where they offer the value object "Health information" and request "Remote monitoring" in return.

Diabetic patients also have two value interfaces with hospitals. Patients offer the value object "Being ill" to hospitals and request the value object "Diabetic treatment" via one value interface. Via the other value interface with hospitals, patients offer "Health information" and request "Remote monitoring".

Finally, diabetic patients offer the value object "Paying taxes" and request "NHS healthcare" via the value interface with EBPCT.

GPs: GPs exchanges value objects with two different actors via three separate value interfaces.

Via the first value interfaces with diabetic patients, GPs have two outgoing value ports offering "Diagnosis" and "Check-up". In return, GPs request "Diabetic patients". Via the second value interface with patients, GPs offer "Remote monitoring" and request "Health information".

In the second value interface with EBPCT, GPs request the value object "Funding" and offer "Primary healthcare delivery" in return. The value object "Funding" has a monetary value of 80€ per patient.

Hospitals: Hospitals have two interfaces with diabetic patients. In the first interface hospitals offer the value object "Diabetic treatment" and request the value object "Receiving diabetic patient". In the second value interface, hospitals offer "Remote monitoring" and request "Health information".

Hospitals also offer the value object "Secondary healthcare delivery" and request "Healthcare funding" via the value interface with EBPCT.

EBPCT: Requests and offers eight value objects in four different exchanges via four different value interfaces.

Via the value interface with diabetic patients, EBPCT offers the value object "NHS healthcare" and requests in return "Taxes".

Via the value interface with hospitals, EBPCT offer the value object "Funding". In return, EBPCT request the value object "Secondary healthcare delivery.

In the value interface with the GPs, EBPCT offers "Funding" which has a monetary value of 80€ per patient. EBPCT request "Primary healthcare delivery" in return.

Via the final value interface with the eu-DOMAIN Service Provider, EPBCT requests the value object "Savings on resource management" and offer "Fee per patient" in return.

eu-DOMAIN Service Provider: This actor offer the value object "eu-DOMAIN services" and request in return "Fee per patient" via the value interface with EBPCT.

13.3.1.3 Value model

We can now create a new business model using the e3value tool. The model is based on the baseline model but extended with the introduction of the eu-DOMAIN Service Provider and the value activities, value object and value offerings defined above.

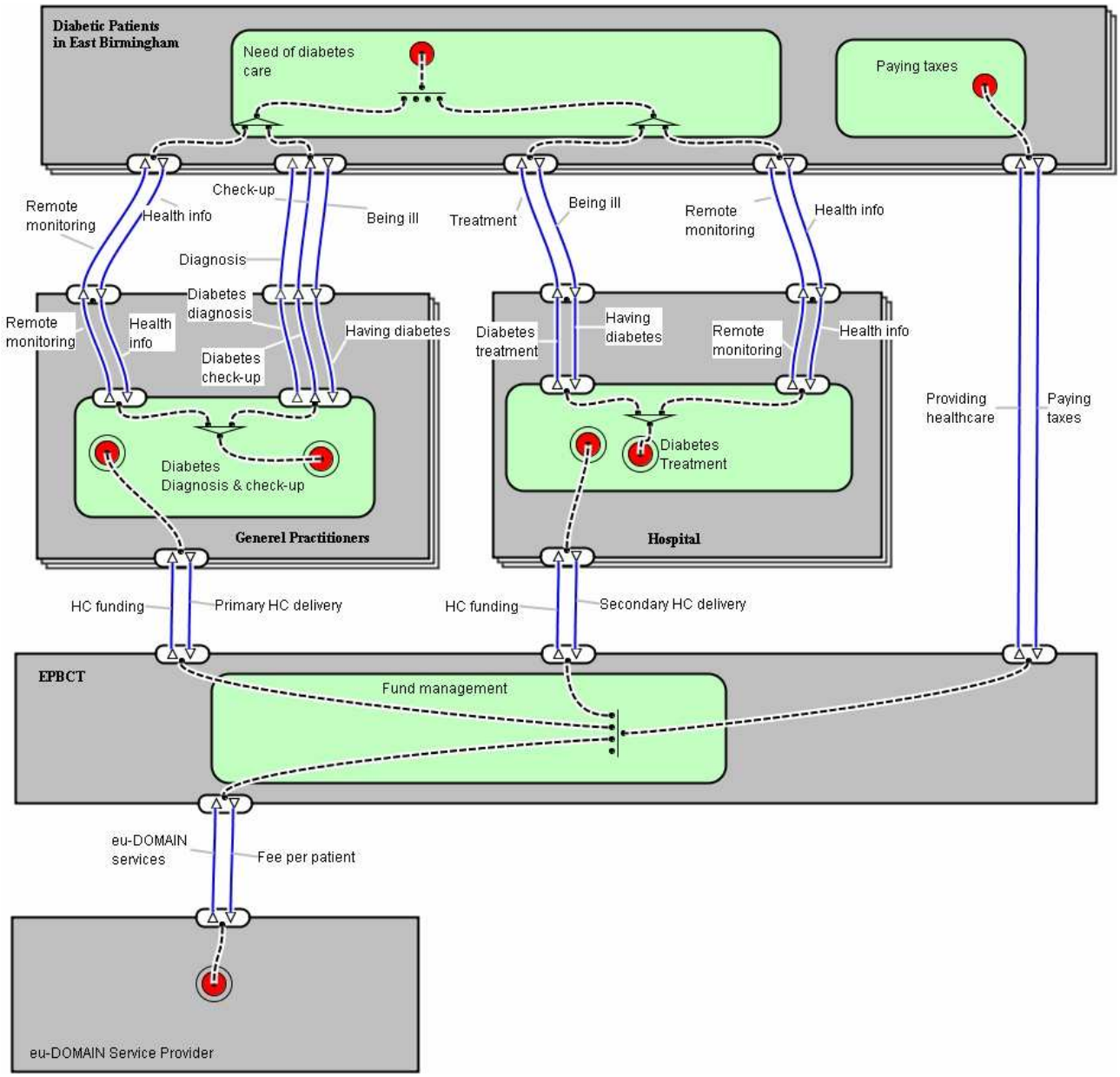

Figure 30 Extended PaC model

13.3.1.4 Profitability sheets

Considering the above value objects and value offerings/transactions and their assigned value, our model can now create profitability sheets.

The model is based on the following propositions:

EBPCT is paying the eu-DOMAIN Service Provider with the savings made possible by using eu-DOMIAN services, i.e. the money flow generated from tax revenues is reorganised. This model proposes that EBPCT will have the necessary funds due to the savings on commissioning fees to hospitals. We estimate that with 10% of diabetic patients using remote monitoring, thus improving the management of their diabetes, EBPCT will be able to save 5% in hospital costs annually.

GPs will also be able to reduce their expenses as they will have 10% less direct consultations per patient. We may estimate that GPs will actually be able to reduce their expenses with up to 5% per patient annually.

The annual expenses for the eu-DOMAIN Service Provider is 550K€ (please refer to section 10.3). We have estimated the fee charged per potential patient to 110€. We assume that EBPCT has to pay

the total number of diabetic patients since the service is made available to all patients, although we estimate that only 10% will actually use remote monitoring initially.

Table 16 below shows the value transactions between each actor in the model and the value assigned to each value object.

Actor / (€)	Value object in	Value in	Value object out	Value out
		Diabetic Patient		
General Practitioner	Diagnosis		Being ill	
General Practitioner	Check-up		Being ill	
Hospital	Treatment		Being ill	
EBPCT	Providing healthcare	0	Paying taxes	2,500
		General Practitioner		
Diabetic Patient	Ill patient		Diagnosis	
Diabetic Patient	Ill patient		Check-up	
EBPCT	HC funding	80	Primary HC delivery	
		Hospital		
Diabetic Patient	Being ill		Treatment	
EBPCT	HC funding	2,755	Secondary HC delivery	
		EBPCT		
General Practitioner	Primary HC delivery		HC funding	80
Hospital	Secondary HC delivery		HC funding	2,755
Diabetic Patient	Paying taxes	2,500	Providing healthcare	
eu-DOMAIN Service Provider	eu-DOMAIN services		Service fee	110
		eu-DOMAIN Service Provider		
EBPCT	Service fee	110		

Table 17 Value exchanges between different actors participating in the scenario

As we can see here, EBPCT has now been able to reduce the cost to hospitals to 2,755€ per patient. The eu-DOMAIN Service Provider charges EBPCT a service fee of 110€ per patient. Considering these value exchanges between each actor, we can calculate the overall costs/profits for each market segment/actor and compare these to the costs/benefits arrived at in our baseline value model. The values are shown in the table below:

	Baseline model			Extended model		
Market segment / actor (M€)	**Revenues**	**Expenditures**	**Gross profit/deficit**	**Revenues**	**Expenditures**	**Gross profit/deficit**
Diabetic patient (7560)	0	19.0	-19.0	0	19.0	-19.0
GP (140)	0.6	0.35	0.25	0.605	0.330	0.274
Hospital (3)	22.0	0	22.0	21.00	0	21.00
EBPCT	19.0	22.5	-3.5	19.00	22.26	-3.36
eu-DOMAIN Service Provider	-	-	-	0.832	0.550	0.282

Table 18 Total revenue and expenditure for each market segment and actor participating in the scenario (baseline and extended value model)

We can now see that EBPCT's gross deficit has been reduced from 3.63M€ to 3.36M€, thus a saving of 265K€; a saving made possible by the introduction of eu-DOMAIN services offering remote monitoring to diabetic patients (10% of which use the service).

The eu-DOMAIN Service Provider collects a total fee of 832K€ from EBPCT which covers all diabetic patients in East Birmingham. GPs expenses have dropped to 330K€ (from 348K€) annually, thus increasing the total profit for GPs with 17K€ a year. Hospitals' revenues have dropped to 21M€ which relates to the reduced cost of treatment to diabetic patients.

From our viewpoint, and the viewpoint of EBPCT, this reduction in hospital costs is positive because it represents a reduction of the total costs of hospital treatment to diabetic patients. In our business modelling work, we have not been interested in showing any cost/revenue for hospitals. Instead we assume (due to the financial structures of the healthcare system) that hospitals are not interested in make a profit in line with a commercial actor, but rather to reduce costs of treatment to a specific group of patients.

The profitability sheet does not claim to be accurate in absolute terms, but indicates that sustainability can be achieved by carefully focusing on value objects.

13.4 A sustainable business model for the healthcare sector

The new business model we illustrated above is based on an extension of our baseline model for healthcare and on the PaC Scenario "Patients as Customers". The model has allowed us to reorganise the financial structures within EBPCT because our eu-DOMAIN Service Provider enables EBPCT to reduce the costs of healthcare to diabetic patients. Remote monitoring of diabetic patients secures a reduction in the number of patients who are admitted to hospital each year and thus a reduction in hospital costs of diabetic patients.

13.4.1 Market segments, actors and value activities

The eu-DOMAIN Service Provider is introduced into our business model as a new actor.

The Service Provider enters into contract with EBPCT who pays a fixed fee per diabetic patient the remote monitoring service is made available to. EBPCT can only offer this service to patients, not force them to use it as some patients will still prefer to see their GP in person. However, we estimate that 10% of the patients will want to use the service and thereby improve their self-management of their diabetes, leading in turn to a better control of the disease, keeping it in check.

Remote monitoring of patients is now included in both GPs' and hospitals' value activities.

13.4.2 Value objects, value offerings and value exchanges

We now have three new value objects, made possible by the inclusion of eu-DOMAIN Service Provider in our model. The first value object "eu-DOMAIN services" is offered to EBPCT by the Service Provider. This value object enables a second value object "Remote monitoring" to be offered to patients by GPs and hospitals in return for our third value object "Health information".

As noted above, we estimate that 10% of all diabetic patients will request the value object "Remote monitoring". This will in turn allow some patients, we assume here half of patients, to avoid hospitalisation. Keeping in mind, that we have to calculate with average numbers, and that in average each diabetic patient spend one day in hospital a year, we can therefore assume that half of the 10% (378 patients) will not need to go to hospital once a year. This means, at the same time, that total hospital admittances are reduced by 2.5%, corresponding to a 5% reduction of total expenditure on treatment for diabetes in hospitals.

13.4.3 Profitability analysis

The profitability sheet demonstrates that all actors in the model are able to profit. EBPCT will see savings in expenditure on commissioning costs to diabetic healthcare and GPs will be able to reduce their average expenditure per consultation because they will have a smaller number of direct consultations. The eu-DOMAIN Service Provider also has a good profitability chance and overall we may conclude that there is a high chance of the business model to be sustainable over time.

14. Validation of the business models

The aim of this chapter is to briefly introduce the validation activities in eu-Domain. To this purpose it could be useful to clarify first of all the difference that exists between different types of validation.

Even if "**validation**" in general terms can be defined as the testing and assessment of a system with the goal to prove that it realises the benefits expected by the stakeholders (i.e. added value of the services, increase of job satisfaction of end-users, new methods of collaborative working, etc.), it should be borne in mind that validation activities in eu-DOMAIN include two different types of validation:

- a "technical validation" of the platform
- a "socio-economic validation" of the business models

In general terms it could be said that, while "technical validation" investigates and assures the quality of the "hard core" of the platform, the "socio-economic validation" takes into consideration its "soft" part.

To be more precise, the "**technical validation**" of the prototype eu-DOMAIN platform in the two user scenarios will involve user testing of the prototypes, which means letting the users execute the user scenarios on location. In this sense, "usability testing" is the assessment of the quality of use of the eu-DOMAIN applications and "verification" tests if the software is free of bugs.

A user validation plan with appropriate criteria for user testing will be produced in task 7.4, derived from critical success factors of stakeholders and from the identified user needs. Appropriate methods for user testing will be selected and usability inspection methods will be applied to assess the quality of use of the testing platforms. The purpose of this "technical validation" is also to validate the technical performance of the platform to ensure that it fully supports the identified business needs at acceptable performance levels.

Anyway, for the eu-DOMAIN project a particular challenge is to test the added value of the services and the sustainability of its business models, which means to perform also the previously mentioned "**socio-economic validation**". This kind of validation will test if the eu-DOMAIN services meet the expectations and requirements of its intended users from the healthcare domain (EBPCT) and from the industrial service domain (GRUNDFOS). The purpose of this kind of validation is to secure that the services reflect the identified business priorities and to validate them in reference to user priorities, i.e. functionality, security and user acceptance and therefore implies also the validation of the economic feasibility of the services in the users business environment, including a cost/benefit analysis.

As a consequence, it can be said that a relevant part of the validation endeavour will be especially focused on the socio-economic aspects and impacts of the eu-DOMAIN platform in the two selected scenarios: The European Service Network and *e*Health services. The proposed and chosen method to conduct this kind of validation is the so-called "**European Awareness Scenario Workshop**" (**EASW**®): for a wider description of how an EASW® works, please refer to deliverable D2.1 – User Validation Framework Plan, chapter 8.

The idea underlying EASW® is to involve different participants' profiles and let them discuss these in two separate phases. In the first phase, homogeneous groups are created to develop a common vision on a so called scenario zero, while in the second phase participants are divided into heterogeneous groups in order to reach a wider perspective and scenario.

In this sense, the EASW® methodology will be used in the eu-DOMAIN project since it allows the definition and validation of the eu-DOMAIN functionality and business models with a wider audience than just the project's users and it will help to identify new exploitation opportunities.

Indeed, it is interesting to note that the EASW® methodology has been developed as an instrument for participatory planning, based on dialogue and collaboration among groups of local actors to create a balanced relationship between social and technological interests.

Actually, the application of EASW® method allows the exchange of knowledge, experience, opinions and ideas about existing barriers and possible solutions to the central topic among different "stakeholders" (technology experts, potential end users, etc.) and it helps to identify and discuss the similarities and differences in the perception of problems and their possible solutions among the different social and professional categories involved.

This leads, therefore, not only to the development of new knowledge, new ideas and proposals, but also, above all during the "vision making phase", EASW® allows to achieve consensus among workshop participants and to identify a preferable scenario.

Finally, it should be noted that the purpose of the EASW® technique will not only be to assess and validate the socio-economic aspects of the eu-DOMAIN platform but also to get input for the exploitation phase. In other words, by applying this method it would be possible to gather elements and ideas on how to present eu-DOMAIN platform to future users and potential buyers.

The results of the workshops can therefore serve as valuable input for the exploitation phase.

On the basis of what has been stated in the previous paragraph, it can be said that the scope and the objectives of the eu-DOMAIN validation by means of the EASW® are the following:

A) **to validate** and refine the eu-DOMAIN business model and business cases: on the basis of the participants' feedback, the refining of the eu-DOMAIN business model and business cases described in deliverable D6.1 will be done, for example, by introducing or removing value actors or value activities from the model, by modifying the value assigned to some value objects, by suggesting new configurations for the proposed value constellations and so on.

B) **to validate** the eu-DOMAIN functionalities and the achievement of the Functional, Social and Trust & Security user requirements. In other words, the purpose is to assure that the result of the development project - i.e. the implemented result - is in agreement with the needs and requirements of customers and users and that it is socially acceptable. Drivers to be taken into account could be, for instance:

   - Usability
   - Social attitude and acceptance
   - Trust and security achievements
   - Cost and business effectiveness

C) **to search for new exploitation opportunities for eu-DOMAIN platform,** for instance:

   - finding of new application fields for eu-DOMAIN
   - suggestion of additional functionalities to be added to the platform

It should be pointed out, however, that validation through EASW® will not concern technical or technological issues related to the platform functionalities: the investigation will be focused on the potential socio-economic impact of eu-DOMAIN service development in terms of social acceptance and economic benefits achievable by the local stakeholders by means of this new way of service delivery.

The approach and the action plans for the EASW® to be performed in order to validate the two selected scenarios will be described in the following chapters.

14.1 Industrial Services business models

A purely commercial approach will be taken instead towards the ESN scenario and the workshop will cover European-wide interest.

Also in this case, a preliminary study has been conducted (in the annex to D2.5 – Societal user requirements) on the specific business model related to the industrial service delivery and facility management sector, investigating both the legal/regulatory framework for e-business and the business contractual framework (service level agreement etc.).

The definition of the specific business model and the investigation on legal/regulatory and business/contractual frameworks will provide valuable inputs to be added to the scenario zero described in D2.1 – User Validation Framework Plan, chapter 5.8.1.

As concerns the action plan for the ESN scenario and business model validation through EASW, it has been planned to perform this workshop on 19th and 20th April 2006 in Bjerringbro (DK). To this workshop at least 4-5 representatives for each of the following profiles should be invited:

- Technicians for buildings and facilities maintenance
- Facility managers and other types of clients
- SW and technology providers

14.2 Healthcare business models

The identified approach for the healthcare business models' validation through the EASW® consists in starting from scenario zero (PaC scenario) described in D2.1 – User Validation Framework Plan, chapter 6.7.1 and from the baseline business model (see chapter 9) that was designed according to the PaC scenario and to the data collected with the stakeholders and end-users.

Moreover, the state-of-the-art analysis that has been performed in Annex to D2.5 – Societal user requirements will be taken into account and eventually integrated with the feedback arising from the discussion with the EASW® participants.

In addition to this, different extended business models of the PaC scenario will be presented in order to trigger discussion and reach the above mentioned goals. In particular, the aim is to verify if the presented business models are relevant for the different stakeholders involved in the EASW® and to refine them in regards to the activities and the values taken into consideration.

As concerns the action plan for the PaC scenario and business model validation through EASW, it has been planned to perform this workshop in Birmingham (UK). To this workshop at least 4-5 representatives for each of the following profiles should be invited:

- General Practitioners
- Expert patients (possibly, from different cultural origins to investigate e-Inclusion)
- Representatives from the insurance companies
- Nurses
- Health divisions managers
- IT experts in EBPCT

14.3 Validation results

At the end of each EASW®, which constitutes the deliverable D6.2- Organised EASW®, a detailed report will be produced and included in deliverable D6.3 – Public reports from EASW®.

The aim of these reports will be to describe in detail the procedure followed to organize and to perform the EASW®, as well as to collect all the material used for this project's activity (letters of invitation, leaflets, agenda, scenario zero, etc.) and to present the results emerged from the two workshops.

In addition to this, the results emerged from the EASW® discussion will be used to develop new business models that will be included in deliverable D6.4 – Validated business models and business cases.

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16. Table of figures and tables