iCore

Internet Connected Objects for Reconfigurable Ecosystem

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D1.5. Socio-Economic Evaluation

WP1 Socio-Economic, Technical Aspects and Evaluation

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Executive Summary:

This report contains the results of the work carried out in the WP1 iCore, more precisely Task 1.4 Socio-Economic evaluation. In that sense the business potential of the iCore use cases and trials have been evaluated by caring out several interviews with various stakeholders.

The iCore use cases and trials with proof of concept prototypes that have been evaluated are: Smart Tour in the City, Urban Security, Smart Hospital Asset Management, Smart Theme Park, Smart Home, Smart Office, Smart City Transportation and Smart Supply Chain Management and Logistics. For each prototype, two interviews have been carried out with relevant stakeholders, who provided details about: (a) stakeholder jobs, needs and wishes, (b) iCore value proposition, (c) iCore compliance with stakeholder's needs and wishes (d) iCore competing solutions.

In this deliverable are documented the methodology used during the stakeholders' interview and iCore added value derived from the interview results.

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1 Introduction

Nowadays, billions of tangible devices (like: smatphones, various sensors and actuators) are connected to the Internet, and in this way the Internet of Things (IoT) is created. As a result of that, the large amounts of live data generated by the devices creates new business opportunities.

The iCore project has developed an IoT platform that combines IoT technologies with cognitive capabilities. The project has provided the technological foundations for the IoT keeping complexity, generated by the huge number of the heterogeneous devices minimal for end-users. Cognitive technologies have been used to master this complexity of the IoT environment by providing means for handling the heterogeneity of the underlying infrastructure (in terms of devices and connected objects) as well as for considering user requirements in the dynamic creation of applications. More precisely, iCore is a generic platform, which has the capability to manage the various IoT devices, and the applications are dynamically created by exploiting composite virtual object (CVO) templates and service templates.

The work package 1 (WP1) of iCore serves as a junction between the technology development within the project and application of the technology in business by assessing economic feasibility, providing socio-economic requirements to the other project WPs by involving both stakeholders and end users. The two most important results of the various tasks of the WP1 are: the socio-economic requirements for the iCore technology (from four different domains) and an approach for Business Modelling specifically for multi-party IoT R&D projects. At the beginning of the project, several different domains have been considered to derive the iCore requirements. Then, at the end of the project, the proposed business methodology has been used to identify added value of the iCore technology. The last task of iCore WP1 (T1.4) completes the work by performing a socio-economic evaluation of the project. In that sense the business potential of the iCore use cases and trials have been evaluated by carrirng out several interviews with various stakeholders.

The iCore use cases and trials proof of concept prototypes that have been evaluated are: Smart Tour in the City, Urban security, Smart Hospital Asset Management, Smart Theme Park, Smart Home, Smart Office, Smart City Transportation and Smart Supply Chain Management and Logistics. For each prototype, two interviews have been carried out with relevant stakeholders, who provided details about: (a) stakeholder jobs, needs and wishes, (b) iCore value proposition, (c) iCore compliance with stakeholder's needs and wishes (d) iCore competing solutions.

In this deliverable are documented the methodology used during the stakeholders' interview and iCore added value derived from the interview results.

1.1 The iCore project

iCore[1] is a European FP7 project that addresses two key issues in the context of IoT: 1) how to abstract from the technological heterogeneity that derives from the vast amounts of different objects that will be connected in the IoT, while enhancing reliability, and 2) how to address the interests, needs and wishes of various stakeholders (users, hardware providers, software

[1] www.iot-icore.eu

providers, service providers) to ensure the proper provisioning and business integrity of iCore features and maximize exploitation opportunities.

The project aims to provide a cognitive framework for the IoT that enables the handling of diverse objects and the functions and services these objects provide. The proposed solution comprises of three levels of functionality, which are reusable for various and diverse applications. These levels are 1) virtual objects (VOs), 2) composite virtual objects (CVOs) and 3) functional blocks for representing the user/stakeholder perspectives. VOs are cognitive virtual representations of real-world objects, such as sensors, devices and other everyday objects, that hide the underlying technological heterogeneity. CVOs are cognitive mashups of semantically interoperable VOs, delivering services in accordance with the user/stakeholder requirements. The functional blocks in the third level comprise service templates and domain ontologies. Making use of these levels of functionality, the framework aims to generate and support, a wider IoT ecosystem in which many different parties across various application and usage domains can participate (see Figure 1).

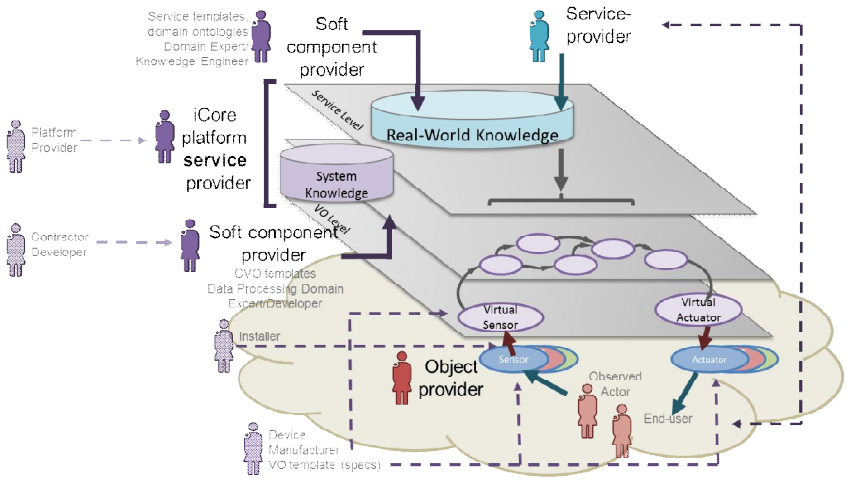


Figure 1 : iCore business ecosystem

While (real world or digital) objects may be owned (controlled) by a particular stakeholder, the virtual objects (i.e. the abstractions of real world or digital objects) can be owned (controlled) by particular service providers. And in turn, composite virtual objects may be owned (controlled) by yet another provider who adds value by combining different virtual objects and providing these combinations to users. This hierarchical structure will affect the structure of the ecosystem, but it opens new opportunities for all stakeholders, specifically since iCore integrates more or less existing technologies. Furthermore, the cognitive management system will ensure that the complexity of this ecosystem will be well hidden from the different players and stakeholders.

To validate the proposed solutions, iCore is implemented in the following use cases and trials: smart home, smart office, smart city transportation, smart supply chain management and logistics, smart tour in the city, urban security, smart hospital asset management, and smart theme park.

1.2 Objective

The iCore project proposed an IoT based architecture with cognitive features that has the potential to create an entirely new business ecosystem, which evolves from today's market spaces. Stakeholders (such as service providers, service developers, end users or others), that want to use an iCore based solution, have to create a fit between the proposed architecture and underlying concepts and the business ecosystem were they intends to operate in. In order to have a successful business model, the stakeholder must be aware about the business ecosystem rules, more precisely the actors, their relationships and the power balance that guarantees the ecosystem's existence.

Traditional business modelling methods do not seem to suffice to create IoT business models for increasingly entwined markets at the level of infrastructures, devices and content. Furthermore, no methodology or toolset exists to easily and quickly explore and evaluate the robustness, attractiveness and sustainability of the possible options and alternatives for a future business ecosystem in IoT. A new method, which is useful during the business modelling activities for IoT initiatives, had been developed within the iCore *Task 1.3 Value networks and business models*, and it is documented in the deliverables: D1.3[2] and D1.4[3].

The main objective of task *T1.4 Socio-economic evaluation* is to derive insights about the acceptability of iCore technology in different application contexts by applying the proposed business methodology. In that sense several interviews have been carried out with stakeholder from different domains. The interview results have been analyzed and the derived conclusions are documented in this report.

1.3 Socio-economic requirements

The deliverable *D1.2 Socio-Economic Requirements* provides an overview of the identified socio-economic requirements, and what are the implications for the iCore project. The requirements have been derived during the interaction with external stakeholders of iCore through three main activities: In Italy three focus groups sessions have been performed with real end users; in The Netherlands a business oriented panel discussion was organised; and across Europe a number of expert interviews have been carried out. Through a bottom-up approach, 12 overarching categories of requirements have been defined, based on which the main evidences and conclusions are presented in Figure 2.

The 12 categories of iCore requirements (more details can be found in D1.2) are briefly presented below:

- Scalability: the system should be capable of handling a very large number of underlying sources;
- System performance: the system should meet a number of performance criteria such as availability, energy efficiency, reliability and robustness;
- Interoperability: the system abstracts from a tremendously heterogeneous set of devices and data;

[2] D1.3 Vision on the future business ecosystem, new roles and models of acceptance. Available: http://www.iot-icore.eu/public-deliverables
[3] D1.4 Future business model methodology. Available: http://www.iot-icore.eu/public-deliverables

- Control: the system must have various forms of control, such as access and use rights, approval mechanisms and also to have transparency in usage;
- Governance: a number of organisational arrangements should be in place (e.g. distribution of responsibilities and liabilities, regulatory constraints, transparency in the value chain);
- Usability: under various forms (e.g.: user friendliness and a self-explanatory user interface, configuration of the platform and personalisation of services, functionalities ought to be traceable and searchable);
- Rapid application development: the quick development and deployment of new services based on the technology;
- Marketing: it must overcome the (end) user's reluctance to change, influence the audience's perception on security, privacy and trustworthiness and promotion of the technology;
- Value: iCore's novelty should be of clear value;
- Participation: participating with end-users and potential customers to further develop the technology and create awareness of the products.

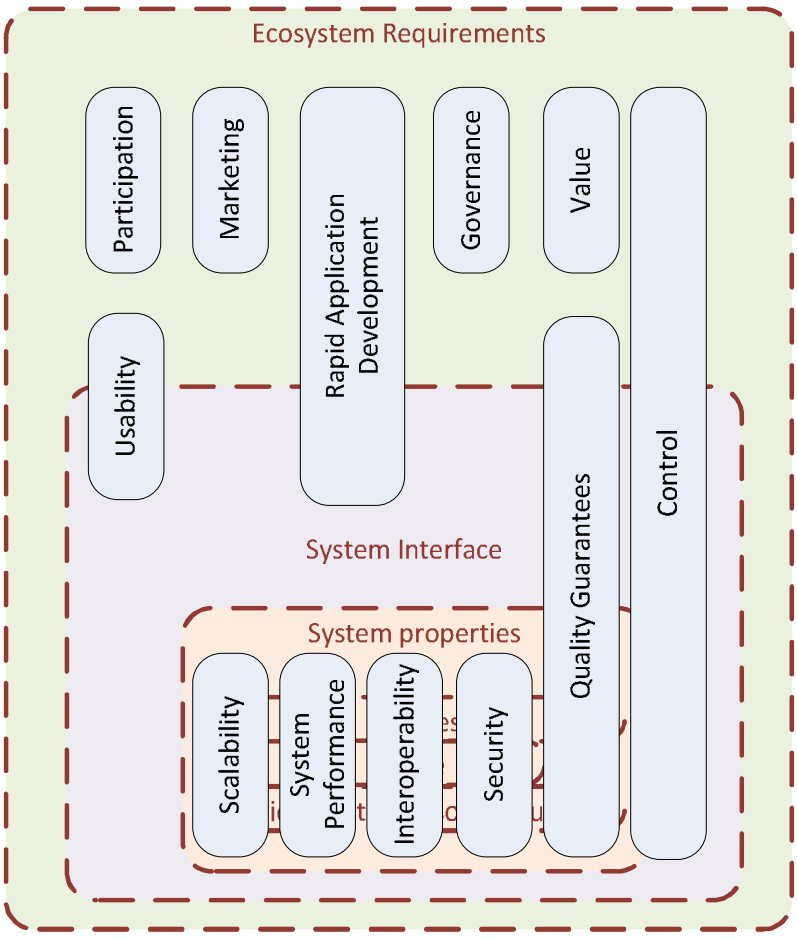


Figure 2: Categories of socio-economic requirements in the iCore context

1.4 Methodology

To gather the stakeholder needs and wishes with respect to IoT solutions and to validate the iCore value proposition, qualitative interviews using an interview guide were conducted with at least two stakeholders related to the iCore use cases and trials. This approach was chosen, because the iCore value proposition is dependent on the iCore implementation per trial/use cases. For example, the end user of the iCore smart hospital asset management application gains different benefits by using the iCore solution than the user of the iCore smart home application. Therefore a flexible and targeted research method is needed.

1.5 Report content

This deliverable reports on the methodology used during the stakeholders' interview and the iCore added value derived from the interview results. Section 2 Methodology provides details about the methodology used for assessing the potential of using the iCore technology in various domains. The main steps presented are: a) identification of stakeholders; b) setting the basis for exploitation and evaluation; c) development of iCore Value Proposition for this stakeholder in context of the use cases and trials; d) validate the value proposition and improve it with the stakeholder. Chapter 3 describes the evaluation conclusions and provide recommendations for implementing the iCore technology in different application contexts. The evaluation of the interview results for each use case and trial are synthesized in chapter 4. The report contains one appendix with the list of interviewed stakeholders.

The reports of the interviews itself are not public, but have been included in the project portal and can be made available to the European Commission on request.

2 Methodology

2.1 Interviews as a qualitative research method

In order to a) analyze the needs and wishes of iCore stakeholder, with respect to IoT solutions and to b) validate the iCore value proposition, 16 interviews were conducted with iCore stakeholders of eight different trials/ use cases. Interviews were selected as appropriate research method as iCore and the context of the trials/ demos are so specific that a flexible and targeted research method was needed.

Interviews are used to collect qualitative data by setting up a situation (the interview) that allows a respondent the time and scope to talk about their opinions on a particular subject. The focus of the interview is decided by the researcher. The objective is to understand the respondent's point of view rather than make generalizations about behavior. Frey and Oishi (1995)[4] define interviews as "a purposeful conversation in which one person asks prepared questions (interviewer) and another answers them (respondent)". Interviews are a very suitable research methods for situations were qualitative data, such as user requirements need to be collected, as the method provides an open-ended, flexible, and in-depth exploration of a topic on which the interviewee is a 'hands-on' expert.

In order to minimize interview bias, often experienced with open-ended questions, we standardized and structured our questions with the help of an interview guide (Appendix B). The interview guideline consists of 24 concrete questions to be asked by the interviewer. While the questions are standardized, the answers were not predefined in order to allow for flexibility and be able to use the same questions in all interviews. Next to the interview guide an interview resources document was developed (Appendix C), containing all reference and background material needed for the interviewer to successfully conduct the interview.

2.2 The questions

The questions were structured according to the following structure:

- Introduction
- Part A: Stakeholder jobs, needs and wishes
- Part B: iCore value proposition
- Part C: Compliance with stakeholder's needs and wishes
- Part D: Competing solutions
- Part E: Acceptance
- Part F: Conclusion

During the introduction the interviewer explains the goal of iCore, the goal of the interview and the interview process.

The questions in Part A are used to collect background information about the interviewed stakeholder and to analyze how data is currently being used in practice by the stakeholder.

[4] Frey, J. H., & Oishi, S. M. (1995). *How To Conduct Interviews by Telephone and In Person. The Survey Kit, Volume 4*. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks, CA 91320.

Part B uses the Value Proposition Canvas, which is based on the Business Model Canvas from Osterwalder and Pigneur[5] as input to define the value proposition for each of the use case domains. The questions in this part are used to validate that the value proposition prepared by the interviewer beforehand is correct. This section further cross-checks that those non-technical socio-economic requirements identified in Deliverable 1.2 are indeed addressed by iCore. Specifying how iCore addresses these requirements helps to avoid that the stakeholders are distracted or concerned by non-clarity on these issues and can focus on the iCore Value Proposition.

Part C analyses to what extend the iCore solution provides value for interview participant. The first set of questions zooms in on the stakeholder needs and requirements for the iCore functionality. The second set of questions analyses the impact of iCore on the organization by setting up a business case (costs, benefits, risks/ difficulties).

In order to learn about competing solutions with similar functionality as iCore, three questions have been asked in Part D. These questions focus on the existence, success and added value of competing solutions. These questions require some preparation by the interviewer, such as a quick scan of domain specific and generic IoT solutions for the context of the trial/ demo.

For the questions on acceptance (Part E) the technical acceptance model[6] was consulted, however, those questions around perceived ease of use and perceived usefulness were considered to be too complex for the case at hand as most interviewed stakeholders have not used the iCore solution yet. Following, the research team decided to focus on two questions around the intention to use iCore.

2.3 Interviewer and Participant selection

In order to ensure high quality interviews, a few guidelines have been defined for the selection of interviewers. The most important requirement was that the interviewer had enough knowledge of the trial/demo in order to be able to position iCore in context of the interviewee (stakeholder). As the scope of the interview was on both general business and iCore in particular it was important that the interviewer did not dive into too many technical details.

For the selection of the interviewees it was most important that per demo/trial at least two stakeholders were interviewed of which one was a solution or service provider. The interviewees were expected to have very good knowledge of their demo/trial context. In-depth knowledge of iCore was not required.

[5] Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook For Visionaries, Game Changers, And Challengers

[6] Davis, F. D., (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly 13(3): 319-340.

3 Overall conclusions and further recommendations

The good news is that overall the iCore proposition is valued positively by all consulted stakeholders. All selected applications proved to benefit from the values that iCore technology offers. The most important valuable aspects identified during the interviews are listed in Table 1. For almost all the use cases and trials, one can identify (by analyzing the inputs from the table) that there is a clear link between the iCore architecture valuable aspects and the attractive features of the iCore prototypes.

Table 1. iCore valuable aspects identified during the interviews.

iCore trial/use case	Valuable aspects
Smart tour in the city	**iCore architecture**: Dynamic service provisioning; Personalized services; Cognitive capabilities (adaptation to changes); No human intervention; Abstraction of heterogeneity; Increased Quality of Experience QoE; Availability of IoT services; Self-management features; Autonomic management and control of devices; dynamic on demand creation of IoT Apps; Semi-dynamic / Semi-automatic software deployment for VOs and CVOs. **iCore Prototype**: personalized services to the tourists; real-time adaptability to context and the immediate autonomous responsiveness of the new solution.
Urban security	**iCore architecture**: Services Requests; Service Templates; RWK Model; System Knowledge; Situation Observers; RWK-based predictors; CVO Level infrastructure functions; CVO Level infrastructure functions; VO registration, querying and data stream control. **iCore prototype**: Multi viewpoints situation awareness for decision support through video and CBRNE sensors; Urban security operational procedures (VIP protection) validation through bio-inspired simulated urban environment; Cognitive overload for the service user is reduced to the most relevant, over-seeable information, as an optimized decision support; Wireless network resources are devoted to the highest priority, high-quality-requiring streams, with best effort support for additional streams (as far as battery autonomy requirements allow).
Smart Hospital Asset Management	**iCore architecture**: Cognitive capabilities (adaptation to changes); No human intervention; Abstraction of heterogeneity. **iCore prototype**: direct measure of the real utilization of a specific hospital devices (mobile incubators); collecting additional data on the hospital device usage**.**
Smart Theme Park	**iCore architecture**: scalability; Abstraction of heterogeneity. **iCore prototype**: new services to the customers (such as: automatic multimedia composition and editing); automatically label subjects in

	the video and avoid the manual selection of customers
Smart Home	**iCore architecture**: the interoperability and scalability of the system; learning mechanisms; Self-management mechanisms; Creation and provisioning of new added value services for disabled individuals through iCore platform; Simplification of management of IoT infrastructure for smart home/assisted living reducing the need for human intervention which leads to lower OPEX; Increased re-usability of objects which can lead to reduced CAPEX. **iCore prototype**: improve quality of life of elderly/impaired/patients in general; improve doctors daily-life procedures; reduce the time needed for collecting simple vital data of the patients; the doctors are informed in case of any error internally or on transmitted data; decrease in energy expenditure
Smart Office	**iCore architecture**: Abstraction of heterogeneity; resource - devices utilization, easy reusability of them at different contexts; easier way to handle privacy and security considerations; virtualization **iCore prototype**: can be integrated with Blue Kiki; smart recording and smart wrap-up; be independent on recording devices from the room;
Smart City Transportation	**iCore architecture**: creation and the easy deployment of components; a higher standardization level, able to grant compatibility between components; cognitive capability and the simplification of interfaces; allows to build enhanced services with a short time to market; **iCore prototype**: Telematics Features and Services Manager
Smart Business	**iCore architecture**: interoperability between multiple vendors; combination of different data sources based on generic templates; repository of devices which can be used for management and maintenance tasks, especially with self-organizing capabilities; system knowledge which be exploited; learning capabilities; provides standardized way of accessing the data; CVO templates execution; generic characteristic of the platform. **iCore prototype**: shift the focus from integrator toward analyzing supply chains; reduce time to market for new services; change their focus to analyses where the business is more valuable; get rid of vendor lock in and time consuming integration with different data sources; allow for more scalability in terms as number of devices as well as business-wise; continuously monitoring the devices and the predictive capabilities.

Most, if not all, of the applications are positioned in the context of a single business, but seem to provide a stepping stone towards extension. Such extensions will by cross the boundaries of single businesses, e.g. from one hospital department to another or from one retail store in a mall to another (or from one smart city application to the next). This will give challenges in the

collaboration with and acceptance of multiple organizations. This extension is definitely adding value to the iCore proposition, since the cognitive aspect in IoT reinforces the network effect that IoT platforms already have. We call this the 'smaller waist'. Achieving these values thus imply extending the application context. In one domain for the other, the level of vested interests and stovepipe solutions will be higher and seriously affect the acceptability. After all, superior propositions do not always win. If we combine this observation with the work in D1.4 we see that the iCore proposition in theory and once accepted broadly is expected to de-verticalize ecosystems, which is expressed as a benefit by the stakeholders, because it promotes a potential change in role (e.g. from solution integrator towards data analytics based advisory). However, we also see that currently the 'compete or perish' paradigm is reflected in verticalisation rather than the complementarity/ecosystem view that characterizes successful IoT applications. Still, the stakeholders see a barrier in the need to persuade many device and sensor vendors in 'icore-ifying', which means letting go of some of their control points. One of the mentioned barriers for acceptation of iCore is the fact that the cognitive aspect of iCore will need some operational time to prove its value, which is required for validation (certification or regulation). Also many corporate ICT managers are investing only in 'proven technology'. In order to address this, iCore should develop an approach to speed-up and estimate the time and effort required to the point where the cognitive models add value. A related identified barrier is the lack of specific domain knowledge, which competing, stovepipe solutions do exhibit.

On top of that, the Cognitive IoT solutions, such as the iCore proposition are essentially an integration of data, and data processing technologies and the IoT-real world interaction. In both situation applications may exist. In the data side you will find the typical planning and current web-applications (e.g. airline planning, tourist applications, logistic, etc) which are merely digitized pieces of information and on the other end you will find the typical control-loop systems of sensors and systems. Thus the ecosystem complexity and ICT maturity levels in a given application domain are definitely of influence to the acceptance levels.

Another mentioned barrier is the perceived complexity of the iCore solution. Its architecture is complex, but also the outputs of the cognitive processes will at some point be hard to follow or mentally predict. In critical applications (e.g. security), that will run into resistance and the requirement to offer the possibility of overruling. Associated with the complexity and the relatively immature stage of development of the iCore technology, the consulted stakeholders identified the need for organizational change, training but also high uncertainty with respect to the required effort and cost of the solution.

Supported by the appreciation of the stakeholders and applicability of the iCore solution in multiple domains described above, we suggest the following approach for gradually building the acceptation of the iCore solution. The first phase is to further develop a footprint in applications areas that allow for some level of experimentation, since the cognitive technologies require some learning and development. Typically, critical applications such security are excluded by this, but smart meeting or the smart tour in the city probably allow for some 'shadow running' and gradual real-life implementation of the technology. In these applications the 'dial-in' time of cognitive applications should become manageable, because that is one of the identified specific barriers. If the first application context is chosen well, such as a hospital, mall, smart city or industrial cluster, so to include a context that is shared by other companies (such as a building or area), some of the cognitive aspects can be reused. This should serve as a basis for replication and extension to other businesses and domains. The horizontization patterns of D1.3 should provide reference for further continuation.

All in all, the cognitive IoT solution that iCore provides is confirmed to be promising and unique in its kind. On top of the technological challenge, full-fledge business acceptation will lead to or require paradigm shift, of which moving from a competitive mind-set towards an complementary and ecosystem mind-set is definitely very challenging.

4 Socio-economic evaluation

This chapter presents the value propositions and the results of the evaluation for all iCore use cases and trials. Each section is dedicated to a use case or trial and has the following structure: 1) short description of the use case/trial; 2) the value proposition (containing the value proposition canvas); 3) stakeholders requirements evaluation 4) conclusions and further recommendations.

4.1 Smart tour in the city

The Smart tour in the city trial offers information on traffic, points of interest and weather to tourists, dynamically suggesting optimal routes to reach desired destinations, based on user preferences and situation (e.g. location).

In particular the objective is to showcase aspects of cognitive management for IoT self-management in the scope of a Smart tour in the city application, particularly addressing scalability issues (in terms of VOs, real world information data, numbers of users).

Part of the trial has focused on Athens addressing tourists visiting different sites around the city. Another major part of the trial concerns the exploitation of the SmartSantander infrastructure for conducting experiments for the large scale evaluation and validation of the integrated iCore architecture and concepts.

The stakeholders addressed in this use trial are IoT application developers, travel agencies and tourists. Further stakeholders, which were not addressed but could be targeted include municipalities (e.g. the City of Athens or other cities), tourism related open communities (e.g. http://opentourism.gr).

A detailed description of the trial, its storyboard and evidences are in the D 6.6[7]. In this place this high level description is functional to the objective of this document that is to present the interview results to the external stakeholders aimed to gather their opinion on iCore smart tour in the city value proposition.

4.1.1. Smart tour in the city value proposition

The value and novelty of the Smart tour in the city trial does not come so much from the services offered to users (tourists) but rather to stakeholders such as IoT application providers and travel agencies that can exploit the features of the iCore architecture for facilitating the development of services/applications that can be provided to tourists.

Considering the perspective of these stakeholders the iCore value proposition lies particularly in the following features :

- **Dynamic (on demand) service provisioning:** Travel agencies request an application from IoT application providers.
- **Automated analysis of user requirements:** A tourist registers himself (prior to the utilization of the service) and gives information about his/her profile. Based on this input, user requirements are derived.
- **Service personalization:** The service takes into account user preferences.

[7] D 6.6 Report on the validation of the final iCore prototypes. Available: http://www.iot-icore.eu/public-deliverables

- **Cognitive capabilities:** Through exploitation of real world knowledge, cognitive management mechanisms allow the dynamic reaction (or proactive action) corresponding to changes in the application context.
- **Minimum human intervention:** No intervention from the tourist is needed for the creation of a service that respects his preferences.
- **Abstraction of heterogeneity:** Exploitation of virtual objects that correspond to heterogeneous sources of information.

However to give evidence to the stakeholders not only of the technical point of view but also of the real value and advantages for their job in their daily activities provided by the smart tour in the city solution, a CANVAS model has been used to rationalize and visualize the components of the value proposition from a business point of view. The CANVAS model output is reported in Figure 3, that shows how needs and wishes of the stakeholders, elicited in the right side of model, are satisfied by the overall set of functionalities provided by the smart tour in the city solution listed in the left side of the model.

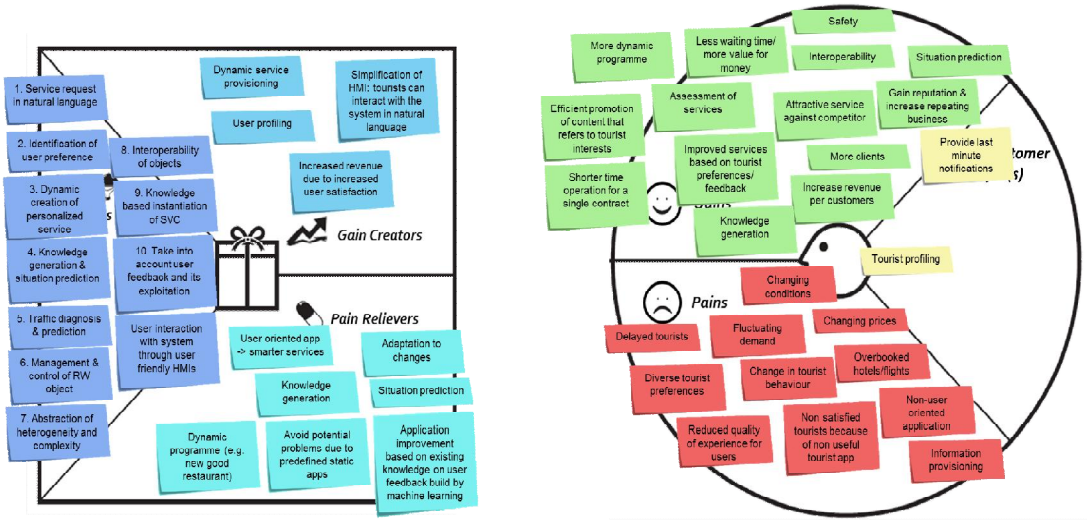


Figure 3. Value proposition canvas for smart tour in the city trial

4.1.2. Stakeholder requirements evaluation

The stakeholders involved are the "Clipper Travel" agency and WINGS ICT Solutions as an ICT Service solution provider. Their opinions have to be considered relevant for our purposes because, with respect to the iCore framework, they play relevant roles. In the following a brief report of the results of two interviews and a table summarizing the interviews outputs are provided.

4.1.2.1. The CLIPPER TRAVEL interview report

The first part of the interview was dedicated to clarify the stakeholder job, needs and wishes in order to better understand how iCore could meet these requirements.

CLIPPER TRAVEL, interviewed in the person of Eleftheria Bramou, as a travel agency, has, as main job, to provide tourists the necessary arrangements for their convenience. For example, hotel rooms reservations, airport tickets, city tours. Apart from these, it also aims at facilitating their vacation in any possible way resolving any issue that might occur.

In particular it aims at supporting its clients with personalized services, which should be flexible by exploiting on demand information from various heterogeneous sources that cannot be predefined. Moreover, tourists' needs cannot be considered as fixed; therefore adaptation to changes in their behavior should also be accommodated by the services that a travel agency offers.

This flexibility and customization and generally speaking the continuous improving of the quality of the offered services, requires the control of their activities in terms of measuring, monitoring, predicting, correcting travel offers by using data collected from many sources of information.

The data sources are any entity involved in their activities. For example, the tourists through their feedback are a fundamental source of information, hotels (rooms) and so on (with respect the iCore framework all these entities are considered as real world objects that produce data).

In particular they focus their attention in collecting and analyzing:

i) Data regarding the status of hotels (rooms' availability, prices) either current values or predicted.

ii) Ratings from the tourists (feedback reflecting their satisfaction)

Usually they gather these information via demanding the direct communication with the sources of data. For example, they contact the hotels that they work with, asking for their availability and prices in order to proceed with the necessary reservations. Furthermore, they discuss with clients about their preferences and opinions. However, trying to have a global view, they also exploit information that can be acquired from the web.

This activity is performed directly by employees of the CLIPPER Travel agency that are responsible to gather the data from their clients, partners or the web, to solve issues immediately, without disturbing the clients. For this purpose, an updated view of the conditions helps them to take the right decisions.

Another opportunity in exploiting data is the derivation of useful statistics, after filtering unreliable sources of information. Actually, data can be found quite easily through the web. However, their reliability is the main concern for using them.

Compliance of the iCore framework with stakeholder's needs and wishes

After the emphasis on the on needs of the stakeholder, this part of the interview aims to elicit their perception and willingness to accept the iCore solution, and the conditions for acceptance.

Looking at the features characterizing the iCore solution Clipper travel think that their use could have a positive impact on their product/services, their organization and competitiveness especially regarding:

i) Dynamic service provisioning

ii) Personalized services

iii) Cognitive capabilities (adaptation to changes)

iv) No human intervention

v) Abstraction of heterogeneity

vi) Increased QoE

vii) Availability of IoT services

These features satisfy the two most important business requirements to increase quality/performance and perception of quality by customers: the first one is the offering of personalized services to the tourists: with this solution, each tourist can be considered individually, taking into account his own preferences and trying to satisfy his needs. Currently, this is something difficult to achieve. The second one is the real-time adaptability to context and the immediate autonomous responsiveness of the new solution: they think that the iCore solution could provide a very added value because it provides the real-time adaptability they wish.

They also see a positive impact in organization due to the fact that iCore solution could make their job easier and possibly more efficient. Easier, as it can resolve issues autonomous and more efficient, as it will be possible to exploit various heterogeneous sources of data.

Their overall feelings is that the iCore solution could help them in competitiveness improving the perceived quality in addition to safety, privacy, security from the customer: these are crucial aspects for the acceptance of the application from the tourists and therefore for its use. Moreover, security problems will affect the trust of our clients and will impact negatively their reputation.

Comparison with competing solution:

According to Clipper Travel in their domain, there is not an alternative solution that offers what iCore does: they see iCore as an holistic solution that covers all possible issues related to the IoT. However, solutions for individual services may be found.

The strength of iCore is its ability to cover a wide range of personalized services on demand and its adaptability to changes. Also, the exploitation and seamless integration of heterogeneous sources of data is an added value, since the information collection and combination process can be really complex.

Perceived Barriers:

- Technical barriers : The availability and exploitation of all the data needed to support the iCore features raise a lot of security issues. Especially, for the privacy of the tourists in our case.
- Development of applicable applications

Condition for acceptance

They see two main conditions: affordable costs for the development of applications and corresponding costs for maintenance, support and updates.

Customers' approval and willingness to use the offered service: they are not sure about the willingness of the tourists to use these IoT services. For example, if customers are not familiar with the technology (e.g. smart phones).

The results are synthesized in the table Table 2 and Table 3.

Table 2. CLIPPER TRAVEL interview results for smart tour in the city Trial (willingness to accept iCore).

Perceived utility and usability	Perceived advantages respect competing solutions	Perceived costs/barriers
they think that the iCore solution could provide a very as added value in increasing quality/performance of services and perception of quality by customers due to: -the better capabilities to customize and the real-time adaptability to context and the immediate autonomous responsiveness of the new solution: Their overall feelings is that the iCore solution could help them in Competitiveness improving the perceived quality in addition to safety, privacy, security from the customer: these are crucial aspects for the acceptance of the application from the tourists and therefore for its use	According Clipper Travel in their domain, there isn't an alternative solution that offers what iCore does: they see iCore as an holistic solution that covers all possible issues related to the IoT	Costs for the development of the application and corresponding costs for maintenance, support and updates

Table 3. CLIPPER TRAVEL interview results for smart tour in the city Trial (conditions for acceptance).

Ecosystem	iCore architecture
no particular condition for acceptance	Customers' approval and willingness to use the offered service: They are not sure about the willingness of the tourists to use these IoT services. For example, if they are not familiar with the technology (e.g. smartphones).

4.1.2.2. The WINGS ICT Solutions interview report

WINGS ICT Solutions, interviewed in the person of the CTO, Dr Konstantinos Tsagkaris, pursues research and prototyping achievements in diverse areas such as smart wireless access, device management, IoT-cloud-wearables, software networks/ NFV/ management & orchestration, big data & predictive analytics and development of applications and services.

In the area of IoT the customers targeted are individual/corporate consumers for Smart Home/Smart Building applications and organizations, such as public authorities/municipalities for Smart City services. Food production companies are a potential target. Further market segments being investigated are energy and water management.

Since they operate in the Self-management/automation in homes, offices, cities, networks, energy and resource management fields, data do represent a strong component for their activities. They collect data by a lot of various real word objects like sensors, actuators, mobile devices, cameras, but also people as well as public authority policies play a role. Real world objects can both produce or process data.

The data categories they usually collect and analyze to fulfil their job are related to temperature, luminosity, humidity, motion, traffic, user preferences, ratings of services, points of interest.

For smart home/smart building services/applications the data is collected from sensors installed for the particular purpose. For smart city services data is collected via the mobile device of users (pertaining to their location), sensors installed in a city (e.g. traffic sensors) and other sources of information (e.g. traffic police website). Currently they don't remark a lack of information/data in their job, but they believe that the availability of additional information could enhance context-awareness of developed services/applications.

The data gathering represent a crucial aspect for WINGS and sometimes they encounter problems because installing sensors on a large scale, e.g. at various sites in a city requires the collaboration of several authorities. So there is not a technological barrier but a sort of organizational barrier.

Compliance of the iCore framework with stakeholder's needs and wishes

Due to the nature of a stakeholder such as WINGS ICT Solutions (mainly Platform Service Provider) the value of iCore is not tightly linked to the Use Case. The value is the iCore platform itself being used for the development and delivery of IoT applications/services in a variety of domains, exploiting virtualization, dynamic/programmable service composition, dynamic resource optimization, self-x.

WINGS considers the iCore Value proposition interesting especially regarding the features of:

- Self-management features (configuration, healing, optimization, protection).
- Autonomic management and control of devices in the smart home.
- The potential for dynamic on demand creation of IoT Apps, taking into account user preferences and context.
- Semi-dynamic / Semi-automatic software deployment for VOs and CVOs.

They believe that, due to these features the iCore could give them an added value with positive impact on products/services creation and delivery and on organization:

- Easier creation of new services through use of the iCore platform and re-use of objects and applications. Allowing the offering of new types of services with increased context-awareness and degree of personalization due to cognitive features.
- Simplification of management of IoT infrastructure reducing the need for human intervention due to self-management. Potential facilitation of integration of devices (sensors, actuators, etc.) /data-sources.
- Applications and services on top of the iCore platform could potentially be developed faster.
- Reliability of solutions would improve due to self-management and cognitive features.

As far as potential barriers in the iCore adoption, they pointed out at easiness of programmability of the platform. In fact, sometime it will be required for developers to get accustomed to the use and exploitation of the iCore platform. The do not perceive major problems on the customer acceptance side given that customers (e.g. residential consumers or

other organizations exploiting IoT applications in a smart home and smart city context) don't care about the details of the technical solution. They will only care that it works in the way they expect to.

Currently other commercial solutions are on the market like: Evrythng, Xively, ThingWorx. According to WINGS that have already taken those solutions into account and , for this reason, is aware of their value propositions, iCore offers more automation: the potential for dynamic on demand creation and deployment of IoT applications with cognitive features.

For these reasons they see in a positive way the use of the iCore platform with no particular condition for acceptance.

The results are synthetized in the Table 4 and Table 5.

Table 4. WINGS ICT Solutions interview results for smart tour in the city Trial (willingness to accept iCore).

Perceived utility and usability	Perceived advantages respect competing solutions	Perceived costs/barriers
- easier creation of new services with increased context-awareness and degree of personalization due to cognitive features. - Simplification of management of IoT infrastructure reducing the need for human intervention due to self-management. - Potential facilitation of integration of devices (sensors, actuators, etc.) /data-sources. - Applications and services on top of the iCore platform could potentially be developed faster. - Reliability of solutions would improve due to self-management and cognitive features	iCore offers More automation: the potential for dynamic on demand creation and deployment of IoT applications. Cognitive features.	as potential barriers in the iCore adoption, some time will be required for developers to get accustomed to the use and exploitation of the iCore platform

Table 5. WINGS ICT Solutions interview results for smart tour in the city Trial (conditions for acceptance).

Ecosystem	iCore architecture
no particular condition for acceptance	No problem on the customer acceptance side given that customers (e.g. residential consumers or other organizations exploiting IoT applications in a smart home and smart city context) don't care about the details of the technical solution

4.1.3. Conclusions and implication

Considering the value proposition of the Smart Tour in the City scenario, iCore could be a means to exploit existing infrastructure (sensors networks and databases) for the development and deployment of smart solutions for visitors and tourists and the personalization of Travel Agencies services. In addition, it could exploit the current deployments of Smart City solutions around several cities in the world. iCore could allow the mashup and integration of several resources and the provision of highly valuable services if access is granted on Smart City resources. It would be extremely important to harmonize the different views on data captured by the different city infrastructures. In addition iCore could allow the integration of infrastructural resources with those made available by end users (such as smartphone). In this context a crowd source based approach could be implemented and personalized services offered to users.

The stakeholders' evaluation of iCore is twofold. Not surprisingly the view of a technology provider (WINGS) is focussing on the platform functionalities. In this case iCore is promising more functions and capabilities that the current major competitors. The approach of the technology providers will be very simple, they'll we choose the best platform in terms of functions, programmability and manageability up front to its costs. iCore seems to have good opportunities on the technical ground. From the standpoint of a customer (the travel agency), it is important to guarantee that iCore is capable to deliver new appealing services. As said this is not totally up to iCore, there are also infrastructural considerations to be taken into account.

4.2 Smart Urban security

The overall context of the use case is about national and urban security concerns and is addressing more specifically research and development for smart cities to support these concerns. Terrorism events, industrial disasters, environmental disasters tend to be more and more common; in the same time large amount of population worldwide is now living in cities and the trend is progressing very fast. So the social impact of urban, national or even international crisis is often dramatic at any level (societal, economic and so on); e.g. Fukushima Accident 2011, Vietnam typhoon/flood, Haiti Earthquake Disaster, 2011 Norway attacks.

In this context, the main goals of surveillance system customers are first to minimize the number of people impacted/injured and second to control information. Crisis management is typically performed through an OODA (Observe Orient Decide and Act) close-control loop where local and even national centre manage the crisis response coordination. So the organization is extremely hierarchical with first responders acting on field using available information from coordination centre and local information possibly from sensors.

A strong constraint exists also for reliable and flexible communication / interoperation between all stakeholders, which include local government agencies managing city services, third-party companies offering additional services on top of public city services (e.g. car parks), agencies dealing with crisis operations at every level of control and command, and citizens themselves. Other important stakeholders are all system providers, typically supplying applications such as video analysis, crisis management with geographic information system, alerting software, supplying various sensors, supplying networks but also systems integrators or even terrorists in our case. Last but not least standardization bodies (ETSI, IEEE, IETF, ISO, etc.) are key players in this area since interoperability is gaining more importance and attention every day.

One of the key opportunities of this Urban Security ecosystem of interdependent people, services and objects is to leverage the potential of a city-wide infrastructure to enhance public services, but also private services and in our case emergency prevention and management. Technically this requires mechanisms to ensure secure resource sharing and coordination between applications with different constraints in terms of criticality and data privacy and integrity protection.

The prototype demonstrated in this use case is very close to the operational surveillance system that could be used in the near future. Through a realistic Very Important Person (VIP) evacuation scenario, a representative set of software and hardware components is demonstrated:

- Control and Command (aka C2) end users applications providing dedicated Common Operational Picture (COP) to the police forces with multiple points of view,
- A software framework with built-in cognitive based functions, i.e. an iCore service platform, managing automated operational situation awareness enhancement and automated network management for superior wireless sensors network performance and availability,
- A software providing a simulation of thousands of people in a big area with realistic behaviour (decision and navigation)

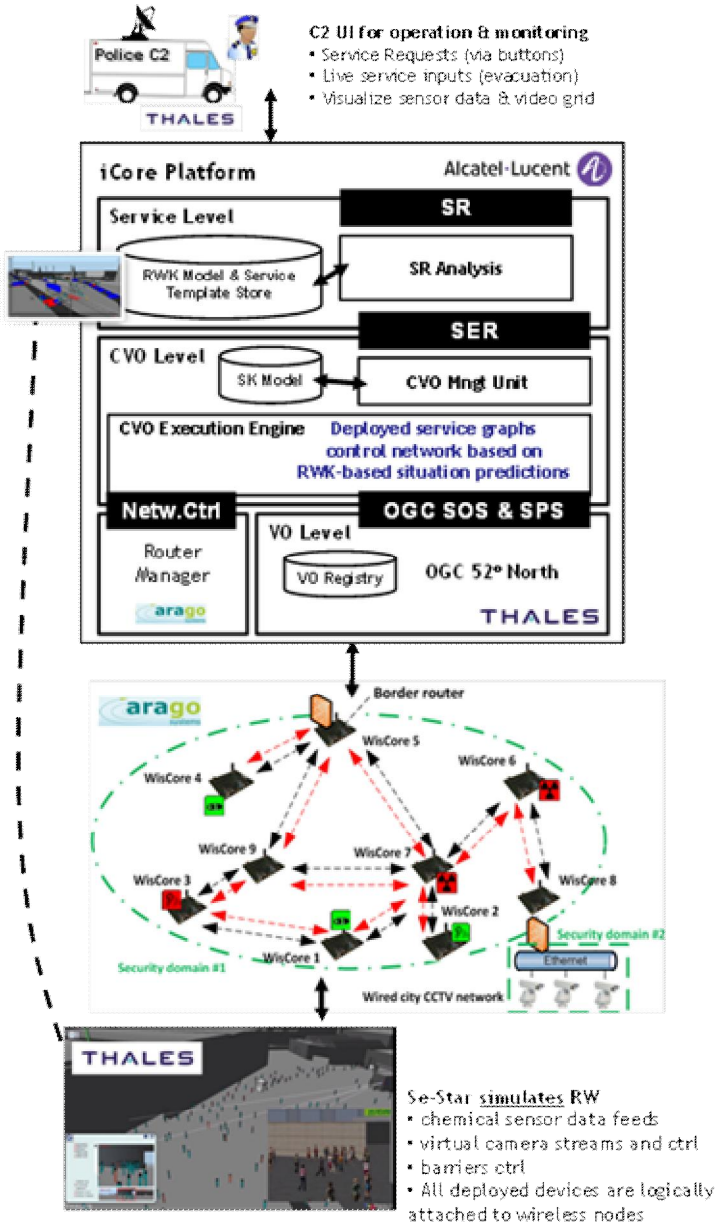


Figure 4. Overview of Urban Security setup

4.2.1. Smart Urban security value proposition

Two interviews have been conducted for this trial, one based on the application of iCore in the context of critical infrastructures protection, the other based on the application of iCore for delivering new services and collaborative applications in the context of airport. Both value propositions are elaborated below.

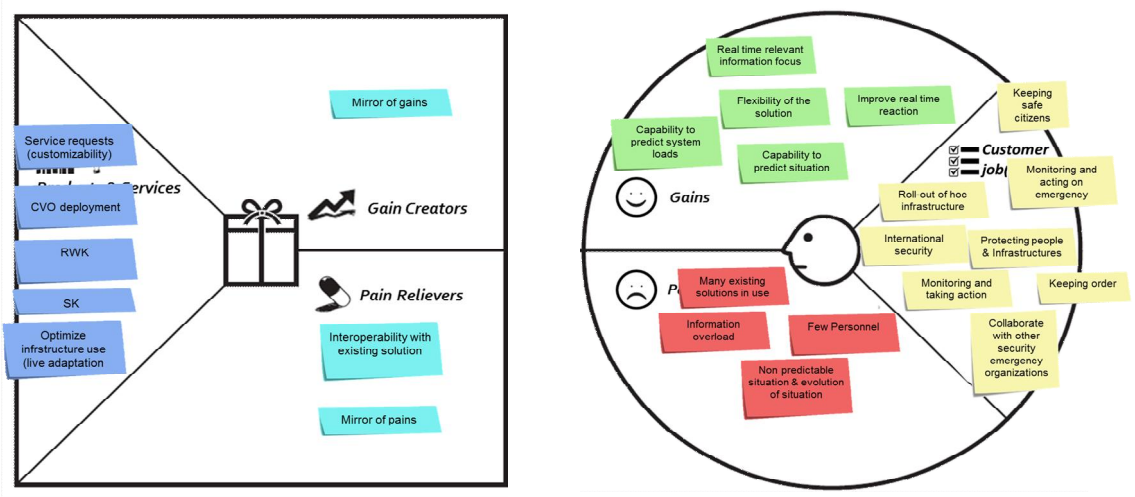


Figure 5 Value proposition canvas for police force stakeholders

Value proposition presented in the first interview

In the context of VIP protection, the first value of iCore platform is focused on *situation awareness and decision support enhancement* through the deployment of various sensors and modelling of Real World Knowledge (RWK) and System Knowledge (SK). On one hand, prediction of crowds, prediction about toxic cloud dispersal, knowledge about coverage area of camera, chemical detections, and knowledge about VIP waypoints, enable optimization to video streaming selection and finally a reduced operator's cognitive load with finer situation awareness. On the other hand, based on the optimization of video streaming selection and system performance (network and sensors) modelling, system availability and usage is also optimized according to the most relevant sensors data.

A second value introduced above is related to *system validation with end-users operational procedures*, then end-users support before and after operational missions. First, system behaviour validation during development, thus before first delivery to end-users, can benefit from simulated sensors, simulated urban environment and simulated operational procedures because it enables early experience and feedback about exceptional situations that are difficult or even impossible to set-up physically. Here the iCore platform knowledge models and machine learning techniques can be tuned and improved according to these situations. Second, initial drill / learning and training are two important features for end-users during system acquisition and missions return of experience processes to support overall efficiency with C2 operators that could even update their own behaviour according to system decisions (for real-time decisions in stressful environment, machines may be more efficient than humans). Again, iCore platform knowledge models and machine learning techniques can be tuned and improved to deal with urban security situations because it is coupled to built-in simulation tool.

Finally, business ecology could make sense through the reuse of iCore platform solution for other businesses such as urban pollution tracking, traffic control with green waves in case of accident, etc.

Value proposition presented in the second interview

According to the first interview the potential intrinsic value of iCore is on situation awareness and decision support enhancement based on modelling (of Real World Knowledge and System Knowledge) and predictions through cognitive techniques.

iCore can be an enabler also for developing new collaborative applications and services, enhancing HubOne customers business processes because a better situation awareness and decision support; for instance rush at boarding gates prediction based on sensors data about traffic outside the airport, meteorological conditions, type of passengers within the terminals, and so on can help airlines companies to dimension correctly people required to boarding gates.

Because the iCore platform could process massive set of data in real-time, it is also something that can justify and accelerate the collection, use and correlation of more and new data than it has been done in the past. iCore here creates opportunities of new services and new uses for current customers but also to serve new customers.

Similarly to the first interview, simulation tooling natively included in the smart urban security proof of concept brings knowledge models and predictions enhancement by continuous validation that is a strong business differentiator. For urban security it was mainly related to safety, for collaborative applications and services development to the mass it is about reliability and economic efficiency for the customers because operational procedures can be tested without perturbation on the airports activity.

To sum-up, HubOne's strategy here is to make use and collect even more data within and around airports; the goal is to develop added values with these valorised data then to create new services, applications that enhance current business processes and address new customers and uses. Also, collecting data from various sensors and organizations within the airports enables multiple situation points of views and more efficient decision processes.

Cognitive techniques with knowledge models that are coupled to simulation tools that can tune and enhance the models is a strong business differentiator because operational procedures can be tested without perturbation on the airports activity.

4.2.2. Stakeholder evaluation

For the evaluation of this trial, two solution providers have been interviewed: Marc Dehondt, the communication and security international business development manager protection systems (PRS) of Thales and Eric Pivot, the innovation manager of HubOne, a telecom operator. The interview reports are included below.

4.2.2.1. Interview report Thales communication and security international business development manager protection systems

The interview participant is a services provider and system integrator and also provides the end-users point of contact. Services hosted by the iCore platform may be enhanced and customized for specific end-users by this stakeholder. Services can be sub-contracted, and cooperation schemes can be applicable, which is typically the case for iCore with ALU developing the video streaming based decision making. The department targets the protection of VIPs, so end-users for the developed services are security forces, infrastructure protection teams, G20 exhibition site teams, etc. An important common characteristic of this environment is the massive set of people on site (crowds).

The main activity of PRS is about system integration with development on specific added value. PRS is about massive complex (sensors and humans) data processing according to OODA (Observe Orient Decide and Act) loop. Real World Objects here are sensors and humans on the

field and actuators (most are lethal) on the field; obviously sensors produce data that are processed to deliver situation awareness.

The main customer segments for the PRS include (not exhaustive):

- C4I for battlefield decision support and processes; Ministries Of Defence (MoD)
- Protection of MoD headquarters and Forward Operation Bases, protection of airports, train stations, etc.; Ministries Of Defence, all critical / sensitive infrastructure operators;
- Industrial sites (Extractions fields, pipelines, refinery, storage, LNG plants) protection; Oil / Gas industry
- Land and Maritime border protection; Ministries Of Defence, Home Land agencies
- Chemical Biological Radiological Nuclear (CBRN) surveillance; CBRN military special forces
- Urban Security; large cities

All of these activities share the same protection goal but the means are different because the contexts are manifold.

To explore the use and opportunities of data, information, knowledge in this domain the interviewee presents two examples of opportunities: oil and gas infrastructure protection and airport security.

Example 1: Airport security

In this case the customer is the airport operator that can be a public or private company. Airport security should be taken with a large meaning tackling accidental threats, cyber-attacks and all kind of physical crimes.

Smartphones of passengers within the airports are more and more used as sensors that enable new businesses and commercial services to passengers: to provide flight information, to localize and guide within the airport, to optimize passengers' flows, etc. The "connection" between airport and passengers maybe based on cellular networks but also on Wifi, because of purchasing in shops, etc. To enhance airport security, in addition to traditional protection systems such as CCTV delivering a first set of data, we can gather some passengers' data provided by the airport public and private "network operators" then process and correlate all the data to achieve protection missions, either in a better way or even new missions for instance more focused (terrorists tracking).

So, the question and trend are to take benefits of new "sensors" such as smartphones, but also to relate data from already deployed sensors; currently sensors are deployed according to a given business and process and overall inter-connection and correlation of data is not yet there. Note that sensors can be physical but also logical, typically for used for IT monitoring and cyber-security.

The main barrier is first organizational; also exploiting data from passengers' smartphones is constrained by citizens' privacy protection; for instance privacy concerns control is under the supervision of CNIL public administration in France. In the case here, probably use of anonym data is required.

To sum-up, currently airport security is poorly automated mainly achieved by several specialized protection teams either police forces or private companies. Taking into account in a

more global way new sensors or even sensors already deployed then multiple sources of data enable correlation and prediction then strong protection enhancement.

Example 2: Oil and Gas infrastructure protection

Here, sensors already deployed within infrastructures are related to the industrial processes such as oil refinement; many of them could be also exploited and reused to enhance infrastructures protection again in addition to traditional protection systems (CCTV, access control, etc.). Typically, abnormal behaviour of the industrial processes can be the result of an act of sabotage (whatever physical or cyber); its detection can increase the reactiveness and root cause analysis.

Like in the previous case for airport security, sensors from communication means of workers on-site such as their professional smartphones can be used to increase situation awareness. Like in the previous case, even if workers use professional smartphones provided by the companies themselves, using sensors data (e.g. tracking people) can be subject to legal barriers according to contexts, countries, etc.

Other opportunities regarding use of sensors data is related to validation, training and learning based on built-in simulation tool. Here simulated sensors data are used at various stages during the system life-cycle to improve protection system usage and effectiveness.

Compliance of the iCore framework with stakeholder's needs and wishes

Overall the iCore approach is OK but regarding urban security, cognition techniques are a plus only if:

1. the models have been intensively validated according to exceptional and hard situations and demonstrate their theoretical efficiency during validation process with end-users and initial learning also with end-users,
2. the models can be enhanced easily after missions based on feedbacks and experience,
3. the models and overall behaviour of the iCore platform decision process can be summarized to the operators at run-time during missions: human in the loop with possible automated decision process switch off.

Nevertheless, the iCore platform has not a native knowledge models built-in improvement feature specifically tackling exceptional situations.

With this coupling iCore brings differentiators against the competition that enhance profits. Also supporting customers and end-users through the entire life-cycle is more a long term vision with long term customers' relationships; it means that probably the business target is more the exhibition areas than VIPs.

Four features are selected to rate on attractiveness (5 = very attractive, 1 = not attractive): System self-adaptation, data format and data sources unification/abstraction, situation prediction, easy update/introduction of services.

Self-adaptation (protection, reparation, configuration) and autonomous system are rated as 1 (not attractive), because the interviewee deemed this a basic and mandatory feature.

Data & sources unification is also rated 1 (not attractive), because it does not add value at the business level, but is mandatory at the technical level.

Machine learning with growing RWK/SK and situation prediction is deemed very attractive (5), as is the update of services or new services.

When asked about the missing features, the interviewee stresses the point made above: the iCore solution's main lack is a native knowledge models built-in improvement feature that specifically tackles exceptional situations. It lacks the coupling of decision making support with simulation to support in an effective way validation, operation, learning and training. Also, the iCore solution is missing a clear technical built-in support with criteria to demonstrate value and performance level of the used models (e.g. optimal evacuation).

The interviewee expects higher marketing costs when implementing the iCore solution, because it introduces a major shift and new way of doing things to customers and end-users. Therefore it requires costly explanation and training.

Barriers to the introduction of iCore will come from customers, because major evolutions have a high cost to manage, reduction of end-users has a social cost, etc. Also some hard requirements are expected from customers, such as typically the provision of indicators to validate the benefits and effectiveness; so there is a need for assessment criteria in the iCore solution. Furthermore, the maturity level of the iCore solution is clearly still not there, so industrialization process from proof of concept to product is required without being sure the solution will pass all the gates.

The interviewee also expects changes to the services of Thales: probably product lines have to be reorganized, the iCore solution being included in a Package Modular Solution. In general, no internal modification in the organization would be foreseen.

When asked about competing and complementing solutions the interviewee did not want to disclose any information, because that is business confidential.

For the interviewee (active in business development) to accept the iCore solution is firstly a question of acceptance by end-users and demonstrated reliability of the solution.

The results are synthetized in Table 6 and Table 9.

Table 6. Thales communication and security international business development manager protection systems results for Smart Urban security Trial (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
Overall iCore approach is OK, but cognition techniques are only a plus if several conditions are fulfilled (see column with conditions). iCore does not offer a knowledge model built-in improvement feature through simulation. Adding this could be a clear business differentiator. Machine learning with growing RWK/SK, situation prediction and the easy update of	No specific comments	The iCore solution will substantially change the current practice of end-users, which requires high costs for marketing, explanation and training. Customers will set high requirements regarding the benefits and effectiveness of the iCore solution in the security domain. They require the provisioning of performance indicators. iCore solution still needs to mature, there is uncertainty

services/introduction of new services are deemed very attractive features of iCore.		if the solution will pass all gates in the industrialization process

Table 7. Thales communication and security international business development manager protection systems results for Smart Urban security Trial (conditions for acceptance).

Ecosystem	iCore architecture
End-users need to accept the iCore solution in order for Thales to further develop a solution based on iCore.	The solution should be reliable. Cognition techniques are acceptable under the following conditions: Intensive validation of models according to demanding security domain situations with end-users Easy enhancement of models based on real-life feedback/experience Human in the decision-making loop through summary of system's behaviour with possibility to switch-off automated decision process

4.2.2.2. Interview report innovator manager HubOne

Related to IoT business and iCore, HubOne can be considered to be a service provider and system integrator; also it is an end-users point of contact. Services hosted by the iCore platform would be dedicated to *professional/commercial collaborative applications* within airport infrastructures, such as terminals, but also malls, aircraft runways, aircraft hangars, etc.

HubOne is a telecom operator part of the ADP company that operates airports in France and worldwide. HubOne is a private company. The activities of HubOne are that of a telecom operator, so its activities include, but are not limited to, network services, along with IT services and system integration dedicated to collaborative applications within airports. A typical service can be a tracking application developed by third parties and/or customers, integrated on smartphones and provided to airports maintenance teams by HubOne.

Right now, data are private to end-users / customers. These data are possibly saved and processed by trusted third parties, but not by HubOne. So data by themselves have no role in the activity but rather correspond to development and integration constraints; the main goal being to provide communication means end-to-end.

The main customers of HubOne are either ADP itself or other airports operators, but also organizations working within the airports or similar environments such as airlines companies, first responders (police, firemen, etc.), shops and other various private companies supporting security, energy production, etc.

The goal of ADP is the management of secured and optimized passengers departure, transit and arrival. The business process is based on 14 well-known steps (e.g. check-in) that have to be optimized according to security and time constraints. Depending on the situation, different operational procedures are set-up and applied to take into account accidents or even malicious events. There is also a geographical dimension because an airport is a border between countries with customs, etc.

Also, HubOne is addressing other customers and business environments outside airports, but it has to be noticed that airports today are more and more extending their commercial activities so a big airport is very like a small city.

For first responders, such as police, telecom services provided by HubOne are free of charge, because of their public services missions dedicated to public protection.

HubOne manages many deployed networks within airports; for instance Wifi networks within terminals anonymously collect passengers' geo-location through smartphones. But currently these data are only saved and not yet used. Like all telecom operators, HubOne collects data related to network management to support quality-of-service supervision of the networks it deploys and operates. Other network such as the one supporting CCTV system for surveillance is also operated by HubOne.

The goal of HubOne is more and more to provide commercial services on top of the networks it deploys and manages. Typically for its customer ADP, the use of passengers' smartphones sensors and various other deployed sensors could enable the delivery of new services with clear added value such as the provision of flight information specific to each passenger, overall optimization of passengers' flows, passengers' guidance with personalized advices, etc.; all of these can be made context aware depending of the passenger (e.g. frequent flyer or not), but also depending of prediction about traffic around the airport, meteorological conditions, etc.

The data collected by HubOne can also serve other customers such as shops to support efficient advertisement for instance.

All of these data collected by HubOne may be useful to predict and dimension at the right time the network resources required both IT systems and supervision teams according to rush hour, uncommon events, etc.

To sum-up, because of its role, HubOne actually collects or can collect more and more data transmitted to the networks it operates, so using/processing these data, for instance through analysis and correlation, creates opportunities for new commercial and professional services. In addition to the exploitation of data from sensors network deployed, interconnecting organizations within the airports can also create new synergies and opportunities to collect data then to offer another set of new services.

Except in the specific case for network management, the first main barrier preventing exploitation of data from (already) deployed networks is a legal one: citizens' privacy protection under the supervision of CNIL public administration in France. Therefore anonymous data are used in this case. A second barrier exists for new networks that could be deployed typically to interconnect organizations with the airports. This barrier is organizational, because strong security requirements are obvious and hard to tackle.

Compliance of the iCore framework with stakeholder's needs and wishes[8]

In general, the second interviewee touched upon most of the points outlined in the first interview, with a few differences due to the different domain HubOne operates in.

[8] *It is important to note that work achieved to address urban security can be derived somehow and applied to collaborative applications and services within airports and vice versa, in the sense that both are based on massive data collection and processing to achieve useful predictions.*

Also this interviewee liked the iCore approach, but in the case of collaborative applications and services, cognition techniques are only valuable if again 1) the used models have been thoroughly validated with end-users and demonstrate their efficiency in operation; 2) the models can be easily enhanced based on real-life feedback and experience; and 3) the behavior of the iCore decision making process can be presented to the decision makers at run-time in operation, with the option to switch of the automated decision making process by the human decision maker.

However, the benefit of adding simulation (also mentioned by the Thales interviewee) has not been included in the initial iCore proposal, but could provide a clear business differentiator in this case, because it allows HubOne to test operational procedures without stopping airport activity. This is different than in the protection systems enhancement case (first interview), where the benefit of simulation is related to run-time optimization during real missions with the aim to more easily tackle exceptional situations. In the HubOne case it would therefore also be beneficial if iCore can support easy enhancement of models based on operational feedback and experience through the entire service life-cycle.

Also in this interview, the participant is asked to rate the following four iCore features on attractiveness (5=very attractive, 1=not attractive): System self-adaptation, data format and data sources unification/abstraction, situation prediction, easy update/introduction of services.

Self-adaptation (protection, reparation, configuration) and autonomous system is rated with a 2, because it is a basic and mandatory feature given the security context.

Data & sources unification, is scored with a 3, because the interviewee perceives this a an enabler for new usages, so it offers a clear added value at the business level and is mandatory at the technical level.

Like in the previous interview, this interviewee scored both the machine learning feature and the easy uptake/introduction of new services with a 5, indicating them to be clear benefits of the iCore system.

Next to the missing simulation feature (which was mentioned earlier), specifically tackling continuous enhancement of predictions without perturbing airport operations, the interviewee also misses a built-in feature with criteria to evaluate performance and added value. It is expected that customers in the security domain will pose strict requirements regarding the performance of the system. So there is a need for assessment criteria.

Furthermore, a feature to follow the behaviour of prediction algorithms in real-time is missing according to the interviewee. This is important since it can offer a strong supporting tool for the marketing department that tries to convince customers and end-users about the solution's reliability. A tool like this can tackle the human way of thinking: "I prefer what I understand". During operation is can offer a means to track the consistency of predictions and related advice provided to end-users.

Also this interviewee expects that a system like iCore would introduce a major change to the current practice of customers and end-users. It will require more marketing budget to make customers and users aware of, explain and train them to use the new system. But as the iCore solution currently is immature, there is still much uncertainty if the iCore solution will survive the process from proof of concept to product.

Because delivering new collaborative applications and services within airports is on-going, iCore would not have a critical impact on the services of HubOne, but would be more integrated as part as the overall business strategy.

Adding to this, iCore could accelerate the new business strategy if it efficiently supports all these new data processing. Business strategy about collaborative applications within airports could evolve in 2 steps from integration and sales only, to overall operation delegation additionally then to fully packaged all-in service including applications. The innovation manager job could evolve towards more relationships with academics and subcontractors addressing IoT and big data management.

Like in the previous interview, acceptance by business development is a question of acceptance by end-users and reliability of the solution. Also, providing the iCore platform manager ways to switch off or influence predictions would be a plus, particularly during critical situations.

The results are synthetized in Table 8 and Table 5.

Table 8. HubOne results for Smart Urban security Trial (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
Overall iCore approach is OK, but cognition techniques are only a plus if several conditions are fulfilled (see column with conditions). The addition of simulation could increase the value of the proposition, because it allows to test operational procedures without stopping airport activity. Machine learning with growing RWK/SK, situation prediction and the easy update of services/introduction of new services are deemed very attractive features of iCore.	No specific comments	The iCore solution will substantially change the current practice of end-users, which requires high costs for marketing, explanation and training. Customers will set high requirements regarding the benefits and effectiveness of the iCore solution in the security domain. They require the provisioning of performance indicators. iCore solution still needs to mature, there is uncertainty if the solution will pass all gates in the industrialization process

Table 9. HubOne results for Smart Urban security Trial (willingness to accept iCore).

Ecosystem	iCore architecture
End-users need to accept the iCore solution in order for HubOne to further develop a solution based on iCore.	The solution should be reliable. Cognition techniques are acceptable under the following conditions: Intensive validation of models according to demanding security domain situations with end-users Easy enhancement of models based on real-

	life feedback/experience Human in the decision-making loop through summary of system's behaviour with possibility to switch-off automated decision process Customers need to understand what the algorithms do, a feature to follow this behaviour is currently missing.

4.2.3. Conclusions and implications

The interviewees for the Smart Urban Security use case like the iCore approach in general, but they miss some features that would be helpful in this specific use case, such as adding simulation features to test operational procedures without actually perturbing the real-life operation or to improve decision making support in exceptional situations such as the attack on a VIP.

While the interviewees see merit in the cognitive features of iCore, such as the easy update and introduction of services, the interviewees also mention several conditions concerning the use of cognition techniques, such as the validation and easy enhancement of used models based on real-life feedback. Also it seems important that humans maintain their autonomy while using a cognitive system like iCore. Humans should be able to understand the actions the system performs based on the used algorithms and they should be able to overrule automated decision processes.

Based on the responses it seems that the iCore system needs to further mature before it can be of actual value in the urban security domain, due to high customer requirements regarding the benefits and effectiveness of the solution. In a critical situation where you only have one chance to save the lives of people involved room for error will not be tolerated.

As the iCore system is expected to have a large impact on the current practices of customers, it is expected that to reduce the barriers for adoption a large amount of money needs to be spend on marketing, explaining and training customers with the solution. As the urban security domain is not an easy domain to enter for companies without a proven track record, introduction of iCore to this domain would be most viable either through existing programs (e.g. Thales Protection of Citizens) or through specific initiatives with customers where early experimentation is possible and makes sense (available airport dedicated experimentation area).

4.3 Smart Hospital Trial

Modern hospitals are complex logistics systems composed of a number of departments and rooms, medical equipment (asset) including portable ones and personnel. The assets are often migrate from one department to another or are misplaced. Accurate positioning of assets ensures their quick localization in the case of emergency and makes them available for periodic maintenance.

The Smart Hospital trial is done at the Santa Chiara Hospital in Trento, Italy, in the Newborn (Neonatologia) department. There are many medical devices in the department to guarantee the daily work and ensure high-quality medical service. Currently roughly 240 devices are present inside the department and have to be monitored. The list of these devices includes monitor, personal computer, medical equipment and all the electronics devices available inside the department. In order to guarantee good healthcare services, it is also necessary to ensure a well-managed environment, able to track, monitor and maintain all the available technologies and devices that are present inside the department

4.3.1. Smart Hospital Trial value proposition

The value proposition canvas for the Smart Hospital Asset Management Trial is presented in Figure 6.

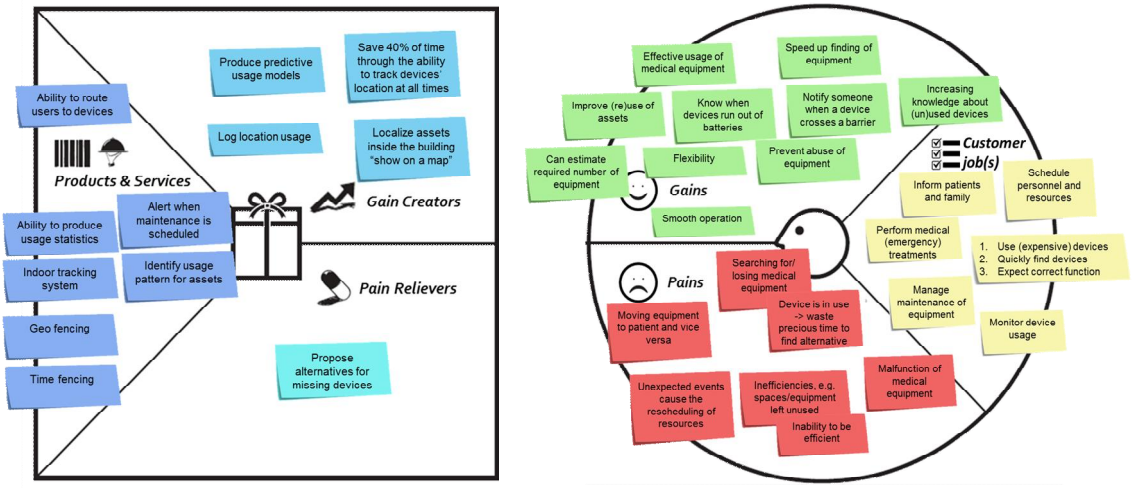


Figure 6: Value proposition canvas for hospital stakeholder.

The proposed iCore solution is able to monitor the location of the various devices (devices tracking), set fencing areas and generate an alert when the device exits a specific defined area (geo-fencing). In general, the idea of using this iCore solution is designed to monitor how many times a specific device is used (and where). Information about the usage time is not provided directly for now. For this reason we correlate the movement of the object with the fact that it is used.

4.3.2. Stakeholder requirements evaluation

This trial is done at the Santa Chiara Hospital in Trento, in the Neonatology (Newborn) department. The people involved in the interview for the department were staff of the hospital, who are expected to benefit from the asset management solution:

- Dr. Massimo Soffiati (Department Director)

- Dr. Annalisa Cuccu
- Marina Cologna (nurses coordinator)

The indirect "customers" of the Neonatology department are, first of all, the newborn babies who receive the care and attention of the medical staff. It is therefore important to relieve the medical staff from having to dedicate too much time to non-core activities. Many medical devices at this department, like at other hospital departments, are present to guarantee the daily work. In order to achieve the above objective and guarantee good healthcare services, it is necessary to ensure a well-managed environment by being able to track, monitor and maintain all the available technologies that should be present inside the department in a correct way.

Identifying which medical devices are inside the department and which are temporary outside, which devices are in the correct room / place and which have been misplaced, which ones are used more often than others etc., could generate a lot of inferred information that can improve the quality of the service the department supplies to its customers. Currently this type of data is not collected and there are no means to acquire this type of information. Thus, all the information used is generally not structured and based on the experience of the people who work in the department.

Furthermore, a recent Italian legislation (law 81/08) requires to have a device book that contains all the history of the devices of a given type. For the moment, this type of documentation is created and managed in hardcopy. For every object typology there is a folder containing sheets with the history of the various devices (the information collected inside this folder relates to maintenance mostly). For each device there is ordinary maintenance (periodic) and extra-ordinary maintenance (based on usage/faults) that needs to be carried out. The routine maintenance is managed by the a separate clinical engineering unit/company (Ingegneria Clinica) and the records of this type of operations are managed directly by this separate organisation. Currently roughly 240 "technologies/devices" are present inside the department (medical and non-medical but electrical/electronic devices) and have to be monitored. The list of these devices includes monitor, personal computer, medical equipment and all the electronics devices available inside the department.

After a discussion about the various medical objects available inside the department, a series of different type of mobile devices, with different characteristics have been identified and a specific integration with the iCore platform has been defined to keep track of these object location/usage/maintenance. This list of various devices is the result of the definition of the iCore capability (tag, track, geo-fence objects movement) and the possible integration into the medical department.

The identified devices types were:

- **Infusion pumps:** Around 40 devices are available in the department. 10 of those at fixed locations. This implies that we could reduce to 30 the number of infusion pumps that we need to monitor and keep track of. After use, these devices are placed in charge in a sort of rack where they can be stacked up. For now, when a nurse needs one of the devices, there are no rules for which one of the available pumps she/he has to use. The choice of which pump depends on immediate availability and on status. The idea of tracking the pumps, assuming a tight association between device location / movement and use, is a useful information to collect. Ideally, the goal would be to use all the pumps equally, for example to avoid reaching the point of extra-ordinary maintenance on some while others were never used. The application of historical

knowledge about the position for every device (device tracking) is the starting point to have a better control of how the different pumps are used. Useful information to define a new organization strategy can also be derived from retrieving trends and patterns from the collected data.

Figure 7. Infusion pumps used in Smart Hospital Trial.

- **Mobile incubators:** 2 device of this type are available. They are usually used outside the department and the usage is requested in transfers to/from other hospital departments or in the ambulance/helicopter for first aid and ER purposes. The medical staff members that had been interviewed agreed, that tracking this type of device and, recording the time used outside the department, would be useful.

- **The respiratory system (or ventilatory system)**: 3 of these devices are available in the department. It will be useful to know and monitor how many times they are used and for how long and where. This data has also been judged useful by the medical staff.

- **Medical ultrasound machine**: One unit is available in the department. It is a fairly used device, both inside and outside the department. Could be useful to monitor its whereabouts and to collect information of where the device is more used.

During the interview, we have identified the objects that need to be monitored: 36 in total. At the same time we have defined, with the contribution of the stakeholders, the areas where tracking will take place. We have identified two gates/doors to monitor for entrance/exit of objects. These gates are the only two ones that can be used to access the department (the two gates in the image are visible in red). The area inside the department where to monitor and track devices is composed by 8 rooms (the border of the area to be monitored is highlighted by the green border in Fig 1.2) and with a surface of 190 m2.

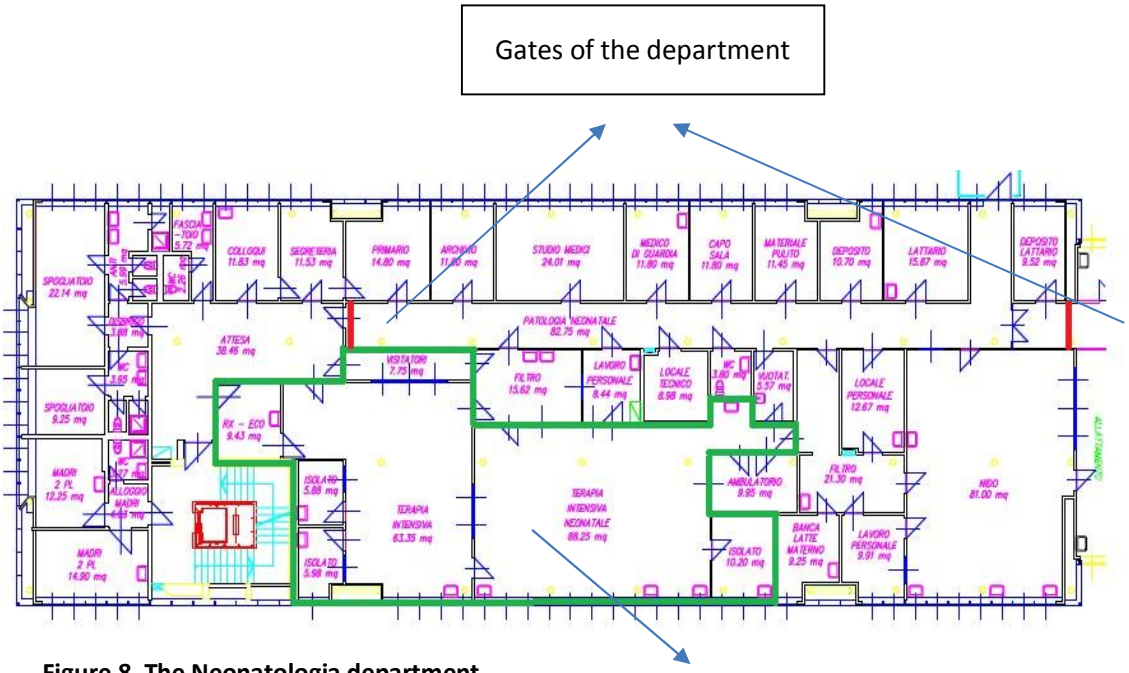


Figure 8. The Neonatologia department.

4.3.2.1. Compliance of the iCore framework with stakeholder's needs and wishes

Perceived utility and usability – According to the interview, the stakeholders' principal need and wish is to be able to have a collection of additional data available. Having these data enables the stakeholders to have more information for taking some decisions concerning an efficient usage and procurement of devices. Observing the object movements and aggregating these data we can also create models that help derive usage trends and patterns that help medical staff assess the overall situation in the department. For example in the department there are two mobile incubators. The two devices are different in terms of functionality and during the interview it has emerged that one of these incubators is preferred with respect to the other. This is caused by the intrinsic features of the two different devices. In a case like this one, a system able to monitor the usage of the devices could be useful to give a concrete measurement of which of the two is more used and to what extent this is so. This information is relevant for any decision on updating the department equipment, both for dismissing or purchasing. At the same time it is possible have a real measurement of the usability of a device and know better if indeed it is needed or not.

One of the points that the stakeholders consider a possible improvement, after the interview and the explanation of the system features, is getting a direct measure of the real utilization of a specific device. The collected information helps build the tracking history of the devices but it is not a direct measure of the device utilization. Device usage information however, for many of the tracked objects, can be inferred from interpreting the moving history of an object.

Perceived advantages with respect to competing solutions – None other similar solution is known to the interviewed stakeholders. The willingness to try the iCore solution is strong and

tied to the effective usefulness. The stakeholders relate the presence of a Wi-Fi network inside the department.

Conditions for acceptance **–** The idea of trying the iCore solution inside the department has been accepted and the department is considering to use this type of solution in the future. This is tied to the real improvement that the application of this solution could generate inside the specific hospital structure.

The stakeholders only had some reservations with regards to the usage of tracking tags close to medical devices. The doubt expressed by the stakeholder was related to any possible electromagnetic field interference generated by the tags and by the performance of the tagged devices. These questions have been addressed by explaining the stakeholders that iCore technology complies with the official requirements for medical equipment and their radiofrequencies. The policies that regulate this situation are described in Appendix D.

After the interview with the stakeholders and the installation of the positioning tags into the trial premises, the impression is that the acceptance of the system will not be an issue. The stakeholders and the others people involved in this trial shared the understanding that the use of a system like the iCore Medical Asset Management can produce a better management of the medical devices than what currently available. The advantages of using the iCore-based solution for the management of their medical assets, compared to the costs can only be evaluated after the period of trial. While the stakeholders shared the positive perception of the trial outcome, the real benefits introduced by the management system are not likely to have an immediate impact but it will be some time (a few months of collecting and interpreting data) before these can be better articulated. In this regard, the stakeholders have expressed their availability to continue using of the ICore Management System currently installed also after the end of the official duration of the iCore project ensuring sustainability of results and reuse in other project context (local and international).

The results are synthetized in Table 10 and Table 11.

Table 10. Santa Chiara Hospital evaluation results for Smart Hospital Trial (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
Collecting additional data on device usage is expected to aid the decision making process concerning the efficient use and procurement of medical devices.	No similar solutions are known. Strong willingness to try the iCore solution and commitment to keep using the solution after the official duration of the iCore project	The advantages of the iCore solution compared to its costs can only be evaluated after the trial. The real benefits of the system are not likely to have an immediate impact, but will become clear after a few months of collecting and interpreting data.

Table 11. Santa Chiara Hospital evaluation results for Smart Hospital Trial (conditions for acceptance).

Ecosystem	iCore solution
No requirements regarding the business ecosystem are stated	The iCore solution needs to be safe in a hospital environment: tracking tags cannot interfere with crucial medical equipment

4.3.3. Conclusions and implications

The proposed iCore solution in the Smart Hospital Asset Management trial could provide a clear benefit regarding the monitoring the location and amount of usage of medical devices. In Italy the uptake of this solution could also benefit from the introduction of legislation that requires hospitals to keep a record on all medical devices of a given type.

End-users (i.e. medical personnel) involved in the interview, responded positively to the iCore trial. They expect that the additional data, which the system allows them to collect, can aid the decision making process regarding the efficient use and procurement of medical devices.

However, they also expect that the first benefits of using the system will only reveal itself after a few months of collecting and interpreting data on device locations and use frequencies. The effects of using iCore are not immediate, the system requires time to learn. This requires a strong commitment of the end user, which in this specific case has been acquired, because the hospital wants to continue with the trial after the official duration of the iCore project. This learning curve, however, might result in a slow uptake of iCore in general, because it requires a large upfront investment (time and/or money) of users, while the benefits at the moment of initiating use of the iCore system are uncertain.

In the hospital environment it is very important that new technological solutions do not interfere with the performance of crucial medical equipment. This is not only a technical requirement. Concerns raised by the interview participants about compliance with hospital standards show that this issue should also be well-addressed when marketing iCore to the hospital market.

4.4 Smart Theme Park

The iCore smart amusement parks trial focuses on recording the valuable moments and experiences of people in the format of digital multimedia when they are seeking fun in entertainment attractions like amusement parks. By fusing various sensing technologies, identity, time and location information are sensed and combined in this trial to generate a personalized digital souvenir for consumers (tourists), which is semantically much more rich and vivid than words and can be later enjoyed and shared with family members and friends.

To this end, the service provider (theme parks), device producer (thrilling rides producer) and tourists are involved as stakeholders in this trial. On one hand, the trial cooperates with specific service providers and device producers to provide a personalized product for tourists, on this other hand, when large amounts of consumers are attracted, the trial could act as a platform of marketing and promotion for all kinds of amusement parks. This trial creates a new business channel to connect consumers and amusement parks from a novel anchor point where the social and emotional needs are satisfied.

4.4.1. Smart theme park value proposition

The value proposition canvas for Smart Theme Park Trial is presented in Figure 9.

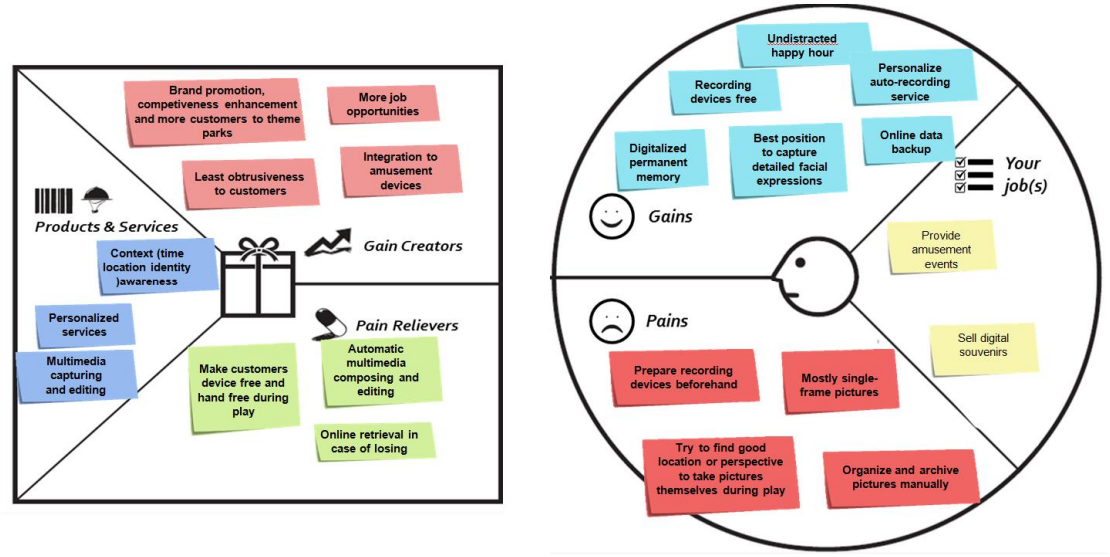


Figure 9: Value proposition canvas for Smart Theme Park Trial.

The following value proposition statements have been used during the interview:

- By iCore's capabilities of providing situation awareness (time location identity) and personalized services the amusement park operator can offer a range of new services to the tourists such as: personalized auto-recording service, undistracted happy hour, best position to capture (containing detailed facial expression). The new services are meant to free the tourist of the following painful and boring activities: prepare recording devices beforehand, try to find good location or perspective to take pictures themselves during play and organize / archive pictures manually. In this way, in addition to the ticket revenue, the new services represent a new source for income for park operators.

- Using iCore features of optimized resource management and of virtualizing the resources (video cameras, location sensors) the amusements park operators can add new sensor technology without modification of existing infrastructure.

4.4.2. Stakeholder evaluation

In order to evaluate value proposition for the iCore in a Theme Park trial one interview have been carried out with an event organizer stakeholder. For privacy reasons the person interviewed decided to remain anonymous.

The event organizer is in charge of organizing thrill rides in the amusement park and is responsible for the following types of activities: customer reception, security check, ride operation, gift selling, etc. The main service is to provide a thrilling experience to customers. In addition, some souvenirs are presented in the gift shop at the exit.

During their activities the event organizers collect mechanical and electrical data with the scope of securing and having the real-time status of the ride system. Data collection and analysis is accomplished by the support systems offered by the ride provider.

For the event organizer, the iCore based solutions are attractive because of scalability a feature, which makes it possible to deploy the system over similar events and attractions in the park. In addition to that iCore solutions allows them to provide new services to the customers (such as: automatic multimedia composition and editing), which will increase considerable the incomes for the park. From their opinion, in addition to the devices and sensors necessitated by the iCore theme park solution, specialized manpower is also need, including system operators, device maintainers, etc.

The interviewee thought that difficulties in implementing the iCore solution lie in the corporation with the ride provider at the stage of system deployment. As the iCore solution is totally based on the ride system, the deployment of devices and sensors must be conducted with the permission and guidance of the ride providers. Besides, the customer privacy should also be considered and handled carefully.

Nevertheless, iCore solution can provide to the event organizer both single photos and video/audio content of customers exciting experience, which are more attractive, second, with existing solution, customers have to manually select their photos from the preview interface, which cause much inconveniences, while the iCore smart theme park solution could automatically label subjects in the video and avoid the manual selection of customers. The interviewee heard about an image generation system which could capture photos for customers when they take the rides. Customers can browse and choose to buy their own photos when they finish their rides.

The results are synthetized in Table 12 and Table 13.

Table 12. Stakeholder evaluation results for Smart Theme Park Trial (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
scalability makes it possible to deploy the system over similar events and attractions in the park	iCore smart theme park solution could automatically label subjects in the video and avoid the manual selection of	the deployment of devices and sensors must be conducted with the permission and guidance of

	customers	the ride providers; the customer privacy should also be considered and handled carefully.

Table 13. Stakeholder evaluation results for Smart Theme Park Trial (conditions for acceptance).

Ecosystem	iCore solution
No requirements regarding the business ecosystem are stated	the incorporation with iCore solution must not cause any potential risk of safety to current ride system; make sure the system is technically feasible and could capture the excellent memories of customers.

4.4.3. Conclusions and implications

The proposed iCore solution in the Smart Theme Park trial could provide a clear benefit regarding the monitoring of riding installations on one hand and can simplify the manual work done for photos sorting/classification on the other hand.

The event organiser involved in the interview has responded positively to the iCore trial and the most attractive feature is the scalability of iCore, which makes it possible to deploy the system over similar events and attractions in the park.

A potential barrier for applying iCore in the theme park environment is the fact that the meeting organiser hast to collaborate with the ride installation providers. On one hand the ride providers should permit the access to and the virtualisation of the existing sensors (mechanical and electromechanical) and on the other hand they must allow the event organiser to deploy new sensors (video/photo cameras) on the riding installations.

4.5 Smart Home

The smart home application scenario is a wide umbrella that includes in its boundaries several applications in the domestic environment. For this reason the smart home use case focus on two sub use cases: a) remote monitoring of the patient health status where the iCore functionalities are used to provide patients, doctors, nurses, and family members with an easy-to-use medical care, and b) a home automatic system, which uses available sensors/actuators as well as smart devices inside the Smart Home to help the users to carry on typical home functionalities.

Many patients, often elderly people, have to trade off their freedom when living in retirement homes with full time medical care. Instead of abandoning their independent life in their own flat, the iCore smart home system goal is to offer personalised, context-aware services that can support, enhance and improve everyday life, increasing autonomy and thus enabling independent living with home automation systems and remote medical care attendance. Next to freedom, users would also like to get support in health care. Therefore a smart home could be used to care about the medicine and automatically place a repeated order to a pharmacy for purchase of the proper medicine. The vital functions could be monitored automatically and alarm signals could be sent to hospitals and doctors nearby in case of emergency. Thus the patients will have an independent life without losing the possibility to be assisted in case of emergency, like heart attack.

The iCore solution also offers home automation features like the remote controlling of appliances (remotely open and close the door, the lights, turn-on/off the heater, light, air conditioning) and so on. Specific attention is given to measuring energy or water consumption. These features meet the needs both of users like elderly people or people with bad health conditions that can experience a more autonomous living, and the needs of people that want to be aware of their consumption, by optimizing the usage of many electrical devices (fridge, washing machine and others) and minimizing the related energy costs.

This (sub) use case is widely detailed in WP6. The short description reported in this document has the main objective to clarify the value proposition that stakeholders are asked to give their opinion through the interviews.

Looking to more specific fields covered by the use case, and considering that several users categories are involved, the iCore smart home value proposition has to be outlined per category:

i. **Elderly People/Patient**: lives in a smart home or has opted for an assisted living service either at home or in elderly care station. From an end-users point of view, the iCore solution value proposition makes patient possible to gain the assistance in healthcare and everyday life and also allows the elder to keep his independence as much as possible. This type of users would also benefit from an iCore system to control the home appliance, light, heating and submit an order to purchase a medicine, etc.
ii. **Nurse and doctor in medical care stations or hospitals**: Nurses/doctors have many patients in their medical care station or hospital wards and are eager to take care for every patient's health. Therefore it is needed to check vital functions as well as conditions during short intervals. There is less time to be left to communication and intensive patient care so an automated inspection of vital functions and an automated signal/alarm in case of emergency will relieve everyday work of a nurse. ICore System enables them to remotely monitor the patient condition and to provide remote treatment.

iii. **Day care assistant or family member**: Many day care assistants provide a service for patients helping elderly people with their everyday life trying not to disturb patient's privacy and daily routine. They attend in duties and responsibilities like ingesting pills, washing, assistance in indoor work or checking vital functions. Depending on the situation, whether a patient lives in a home then a family member, potentially, will assist the patient or in an alternative case if the person lives in a day care center then a member of the staff, a day care assistant, will support the patient.

iv. **Pharmacy**: A patient can submit/send to a pharmacy a medical prescription or alternatively the physician/nurse can submit, directly to the pharmacy, a medical prescription on behalf of the patient. The pharmacy in turn will take over to deliver the drugs to the patient.

In order to make the iCore smart home value proposition, more understandable to the involved stakeholders, the Business Model Canvas from Osterwalder has been used to rationalize and visualize the components of the value proposition from a business point of view. The CANVAS model aim is to outline the real advantages provided from the iCore solution in the daily life of the users. The CANVAS model has been developed taking in mind in particular the medical centers perspective due to the following assumptions:

- Most of the functionalities provided by iCore are used by doctors and nurses but are not visible to patients that only perceive more efficiency and timeliness: a real advantages in medical centers daily activities automatically produces advantages for patients.
- Medical care centers and doctors are the decision maker in adopting or not a telemonitoring solutions and an important factor in this decision is the patients' satisfaction. We can say that Medical centres and doctor satisfaction leans on the patients satisfaction.

The CANVAS model output is reported in Figure 10, that shows how needs and wishes of the stakeholders, elicited in the right side of model, are satisfied by the overall set of functionalities provided by the smart home solution listed in the left side of the model.

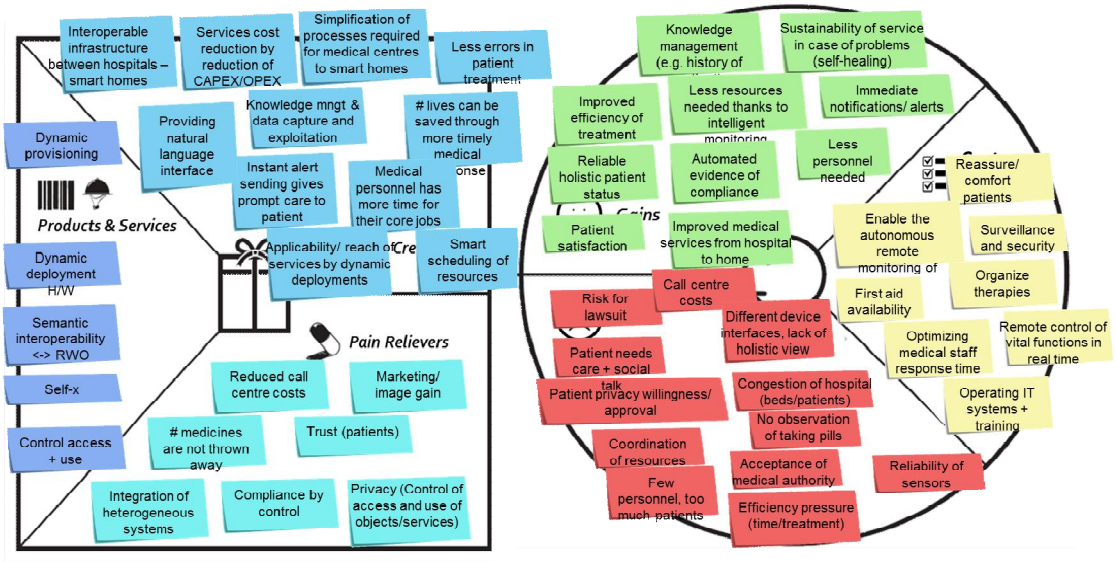


Figure 10. Value proposition canvas for Smart Home use case.

4.5.1. Stakeholder evaluation

Two stakeholders have been selected for an interview, which represent different points of view with respect to services and the platform.

The first stakeholder is strictly related to the use case since he is a doctor leading a doctor praxis within a consortium formed with other doctors and a pharmacy. He was identified as an iCore stakeholder in terms of the Smart Home service, because he represents an average German medical praxis inside a collection of praxis's and pharmacies in an shared environment. Also he has a strong requirement for openness to new technologies that can be used to extend the existing services.

The second stakeholder is not related to the telemonitoring solution, but to the smart home solutions in a wider perspective: he is a man is living in a 1920 building with his family that comprises two parents and three kids. He is a final user, the real person that will interact with the smart home and its services and it is the entity that is using and paying for the service. So its functionalities represents directly the value for money. If this kind of stakeholders are not satisfied by the services, the platform will lose importance and relevance.

4.5.1.1. The service provider interview report

The first stakeholder described in here is a doctor leading a doctor praxis (internal medicine) within a consortium formed with other doctors and a pharmacy. The consortium consists of 10 different praxis each specialized in different areas of expertise. Services are splitted in consulting hours and home visits.

The first part of the interview, aimed to understand the stakeholder needs and wishes, outlined as crucial the availability of as much as possible data about patients: information helps increasing the correct full-blown clinical picture. Every time a patient is visited they need to distinguish between well-known patterns and new symptoms. Every change in intake of medicine or happening in their lives results to new deviations, which makes important to collect as much information as possible. Next to the data collected directly by the patient checked during the visit , they also try to get information from colleagues or hospitals in case patients had been hospitalized (the most important data of a patient for understanding their health status are vital functions like blood pressure, pulse, blood values, EKG, Cardio vascular, body temperature etc. Known diseases and the list of all medicines is needed as well). The more availability of values makes it easier to discover abnormalities.

They also need to be aware of information in real time: daily business and different medications running in parallel make it difficult to identify various medications having effects at the same time. It occurs that more than one medication is running in parallel with different doctor´s caring of the patient (e.g. an orthopaedic specialist can prescribe pain reliever while a general practitioner gives antihypertensive drugs to a patient). This could lead to interdependencies that stay unknown due to the missing communication between the doctors or the doctor and the patient .

All data collected and stored should simply be used to help the patients and to enhance the recognition/identification of diseases. Comparing the data (anonymized) with well-established patterns and use cases can help to detect symptoms and indications geographically based or age-related. Many diseases staying undetected as it is difficult to inherit all interdependencies

with various medicine and the distinctive reaction of each patient. The availability of all these data makes it easier to detect the current health status of a patient saving time and also to define a more precise scheduling of the visit.

In this context, it is seen as very useful if data could be obtained according to different schedule and programming, e.g. if the patients are able to measure the values their selves at home based on their clinical scenario. In addition, general knowledge of a patient are helpful, such as forgotten intake of pills, wrong intake or simply comparison of daily routines (e.g. recognition of high change in daily pattern like immediately change of usual travel paths) what is not traceable and mostly recognized upon mutual trust.

Another critical issue is storage of data: data are mainly collected manually. In some case upon request hospitals shares via post office, the discharge summary that is often a handwritten document. Nowadays not even every doctor's office is connected to the internet. Almost all documents are stored handwritten. Information is usually stored in two-ways: hardcopies and scanned documents (or internally digital created).

Considering the current picture he sees great opportunities for improvement in the data collection, elaboration and storage and in his perception new technologies can give a relevant support and expand services to the patients. Of course technology innovation will not be able to automate process as the direct communication will stay most important in handling with the patients.

Compliance of the iCore framework with stakeholder's needs and wishes

In the stakeholder opinion iCore value proposition looks really promising: "If I understand correctly iCore is a system that is able to connect various daily-life objects together (thanks for IoT explanation, I am now a bit more aware of some technical details) and can provide services that would help me in my daily-life procedures. In addition, the system is able to learn from experts or can exploit already collected data to increase the services I am expecting"

The use of the iCore functionalities will reduce the time needed for collecting simple vital data of the patients that will lead to an enhanced service for the patients and will make easier the handling of the assets in a more effective way saving real money.

In particular he sees as most attractive the interoperability and scalability of the system: these two features will, while running his services, enhance functionalities with any kind of sensor, actuator or service available. Thus being lock-in free of any vendor.

Furthermore he also sees as very useful the learning mechanism. He expects also to get informed in case of any error internally or on transmitted data, so that he does not have to keep track about all data as long as he gets informed or met the patient personally.

Next to the automation in data collection or gathering and exchanging information, he gives value to automated procedures that will lead to higher safety due to errors in human being (non readable writings, forgotten measurements, missed documents etc.). Thus is important and should be used in accordance with the patients.

Also one can simplify follow-up care as long as vital functions can be gathered by the patients on their own.

The overall perceived added value of iCore is an enhanced service to patients by increasing the performance of doctors (due to the availability of reliable and real time data to define the

clinical picture) and improving the life quality of patients (e.g. they don´t need to come to the doctor often if they are able to collect and provide their data from home and feel good). These conditions also allow saving of time that can be better employed in the relationship with patients.

Overall the stakeholder declared a positive willingness to accept a solution like iCore because he believes it can enhance the quality of services for patients. As conditions of acceptance he sees the easiness of installation of the solution (provided he is not familiar with technologies) and a reasonable initial costs.

As far as competing solutions providing similar functionality as iCore the stakeholder wasn't completely aware so he can't provide a correct picture of the iCore advantages.

The results are synthesized in the Table 14 and Table 15.

Table 14. Service provider evaluation results for Smart Home use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
Perceived utility and usability: The overall perceived value added of iCore is an enhancing of services to patients by increasing the performance of doctors (due to the availability of reliable and real time to define the clinical picture) and improving the life quality of patients (e.g. they don´t need to come to the doctor often if they are able to provide collect their data alone at home and feel good). These better conditions also allow saving of time that can be better employed in the relationship with patients.	Perceived advantages respect competing solutions The competing solution known by the stakeholder are available between the experts and not valid for sensor data coming from the patient their selves. .	Perceived costs/barriers No particular barriers

Table 15. Service provider evaluation results for Smart Home use case (conditions for acceptance).

Ecosystem	iCore architecture
No specific comments	As conditions of acceptance he sees the easy installations of the solution (provided he is not familiar with technologies) and a reasonable initial costs

4.5.1.2. The end user interview report

The chosen user is living in a 1920 building with no modern isolation in the walls or roof, and 20 years old heating systems. In this building there are a total of four families. The chosen family comprises of two parents and three kids.

The goal of this family is to optimize the usage of many electrical devices (fridge, washing machine and others) while minimizing the related energy costs. The home has a few devices that can provide data about their consumption.

The family uses data and would like to use more in order to understand the consumption pattern with respect to their actual needs. The family already perform an analysis of their data once a month hoping to improve their energy footprint.

They are interested in some services within the home, in particular the family wants to increase convenience and save heating, water and electrical energy costs. Several services could be of interest such as: a) adjust dynamically all thermostats according to their typical use pattern, outside temperature, but also take into account exceptions b) give warnings, if somebody family member is taking a shower for too long time (adjustable threshold for amount of water); c) automatic open/close window protections to avoid deep cooling at night but allow sun heating at day; d) make sure light switches off, if room has been left (at least after a while) and the night light switches on, if children are waking up and start moving; e) recognize, if some unforeseen event takes place and send alarms.

Collecting and analyzing data is seen as a compelling task outside of the interest of the family. A service that can take care of this and report daily use or weekly statistics is considered very useful. In addition the user is interested to deploy more sensors but he is not interested in any technical or management activity. With respect to barriers in the use of data, the customers sees none of them essentially because he has the assumption that collected data are his own and stays in the home.

Compliance of the iCore framework with stakeholder's needs and wishes

The perceived value of iCore is relevant. In the user's own words: "It seems, that iCore would be something like an ever growing, modular expert/help system allowing me to use existing infrastructure but also giving hints to me how to extend infrastructure for getting better results in terms of savings and higher convenience. It would offload me from taking care myself all these adjustments and would be much more efficient. It may even display in an easy way the results/recommendations."

With respect to the value proposition of iCore the user, the family would be interested to achieve a decrease of 20% in energy expenditure and they would be interested to invest part of that saving in services that automatically optimize and suggest the energy pattern consumption. Quantitatively, considering that they spend 500 euro per month for the heating/water and some minor house keeping costs they calculate a saving of around 1000 euro per year. They associate to this saving also the possibility to totally demand boring tasks to the system.

The user also expressed some concern on the availability of data (who can read the data and infer what they can do) and they also miss an AppStore in which to look for appealing applications. On a brighter side, the user, not being an expert, is confident that the platform is easily extensible and programmable and that it could also be used in different application domains.

With respect to competing solutions for iCore, the user was trying to use some of them (an open source one and proprietary product). The customer was dissatisfied in one case for the complexity of the solution and in the other case for the ratio between costs and functionalities provided.

One added value recognized by the user is the cognitive aspects of iCore, He said that it should be possible to increase the level of intelligence of the whole system making it fit more his own requirements.
He would definitively use iCore for a right price and if it comes with a set of applications and extension module that allow a good customization of functionalities.

The results are synthetized in the Table 16 and Table 17.

Table 16. End user evaluation results for Smart Home use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
Perceived utility and usability: iCore allows to use existing infrastructure for getting better results in terms of savings and higher convenience offloading the end user from taking care himself all these adjustments and would be much more efficient. It may even display in an easy way the results/recommendations One added value recognized by the user is the cognitive aspects of iCore, He said that it should be possible to increase the level of intelligence of the whole system making it fit more his own requirements.	Perceived advantages respect competing solutions iCore solution is preferable in the stakeholder perception compared to the competing solution they tried : in one case for the complexity of the solution and in the other case for the ratio between costs and functionalities provided.	Perceived costs/barriers Potential barriers may be The price And availability of app to customize the service

Table 17. End user evaluation results for Smart Home use case (conditions for acceptance).

Ecosystem	iCore architecture
No specific comments	He would definitively use iCore for a right price and if it comes with a set of applications and extension module that allow a good customization of functionalities.

4.1.3. Conclusions and implications

The interviews' results seem to be favorable to iCore smart home solution whose value proposition is positively perceived from the stakeholders:

- It satisfies needs of end users both in the case of features related to the remote control of appliances and in the case of remote health monitoring
- It is compliant with the job needs of phyisicians and doctors that play the role of service provider to the patients/end users.

The concurrent satisfaction of both these conditions is of great importance in the case of services, such as telemonitoring, where those who decide to buy and therefore pay for the service, are not the end users but the service providers (hospitals, medical centers). At the same time, the service provider will never buy the services and the platform if the end user does not perceive real advantages.

The positive stakeholders' opinion on the iCore solution makes the iCore platform an appealing technological asset for a player that would act as platform provider or service provider in the smarthome environment.

But , especially for the e-health field, from a business point of view, as outlined in D1.3 from the ecosystem scenarios' analysis, the positioning as service provider seems more difficult for a new entrant considering the strong barrier due to the specific relationships with sanitary structures and national systems: the mechanisms of healthcare are very different from country to country and a strong effort should be spent to understand and build up the relationship with the sanitary structures.

For these reasons, it seems that the best probability for iCore smart home solution to succeed is as a platform solution rather than as a set of services.

The smart home use case seems also to be a highly valuable deployment scenario for iCore because it needs a minimal deployment of infrastructural resources (sensors and local networks in the home) and through a cloud implementation it can allow to serve several houses. This means that iCore could be economically implemented and deployed by Service Providers in order to provide this type of functions. In addition, also the possibility to integrate data collected from several homes is envisaged in order to provide general information to the neighborhood.

For a broader analysis of the opportunity for a profitable positioning of the iCore smart home solution, business models and related barriers see the Smart Home ecosystem analysis developed in D1.3.

4.6 Smart Office

The Smart Office environment (iCore prototype) aims to offer a seamless meeting experience to meeting participants and the meeting organizers with added capabilities of control. The prototype has the following features:

- Smart Meeting Organization: The meeting organizer is capable of creating a meeting, specifying the date, time and location and indicate the invited visitors. The system sends the invitations attaching a QR-Code, providing information related to the participant and the meeting itself;
- Smart Meeting Guidance: The participants are able to find their way to a meeting venue by using a preinstalled system and the QR-Code received at the meeting organization phase.
- Smart Meeting Break: The meeting organiser, using the application, asks the meeting's attendants for their desire to have a break without interrupting the flow of the ongoing meeting. After a given period of time, the system analyses all the gathered data and sends the feedback result back to the organiser.
- Smart Meeting Recording: The system records the ongoing meeting through the attendants' mobile devices.
- Smart Meeting Wrap-Up: The system gathers all the data generated and provided by the participants and make them available for them but also for the rest of the attendants who for some reason could not be physically present.

Current commercial solutions providing support for meeting automation are segmented. The meeting ecosystem contains mainly the following applications: real-time video observation and control systems; access management, energy settings, security monitoring; access code and password distribution, etc. The number of players participating in smart meeting ecosystem is quite large. From big companies – producers of solutions for messaging, calendaring and scheduling, developers of solutions for navigation usable as standalone devices or implemented into the smart phone, producers of systems providing 2D (QR) code based access control and ticketing, wireless solution and application providers, building automation and access control systems and producers of smart hardware able to provide basic level of integration based on appliances connected to smart building systems.

The smart meeting ecosystem is influenced by trends in different domains. In this process all participants providing services and delivery are affected. From building infrastructure, office equipment, software and application developers, telecommunications operators and appliance producers, all subjects are working on solutions oriented to improvements.

Next dimension having impact on ecosystem are methodologies defining strategy in area of meeting management, like Strategic Meeting Management Program (SMMP) which defines disciplined approach to managing enterprise-wide meeting and event related processes, activities, metrics, standards and supplier strategies to achieve business objectives, quantitative cost savings, risk mitigation and optimal service levels. Producers of solutions offer companies and organizations platforms from which an SMMP should be launched or managed while offering planners an efficient way to manage meetings and attendees.

4.6.1. Smart office value proposition

By iCore's capabilities of providing situation awareness, personalized services and optimized resource management the event organizer can automatically invite the participants and arrange the facilities for a meeting. In addition to that the application prevents mingling the participants to parallel sessions.

Using iCore's features of context and location awareness the event organizer is able to offer a better service to the meeting participants, by guiding them to the meeting location using the preinstalled infrastructure and the QR-code received at the meeting organization phase.

The optimized resource management feature of the iCore allows the event organizer to record the ongoing meeting through the attendants' mobile devices and to select the most appropriate device to do the recording also gathering the recordings and uploading them to a designated area so they become available for consultation or even further offline processing.

The situation awareness feature of the iCore allows the event organizer to identify the potential need of a break and select the most appropriate moment for having a break, without interrupting the flow of the ongoing meeting.

The value proposition canvas for Smart Office use case is presented in Figure 11: Value proposition canvas for Smart Office use case.Figure 11.

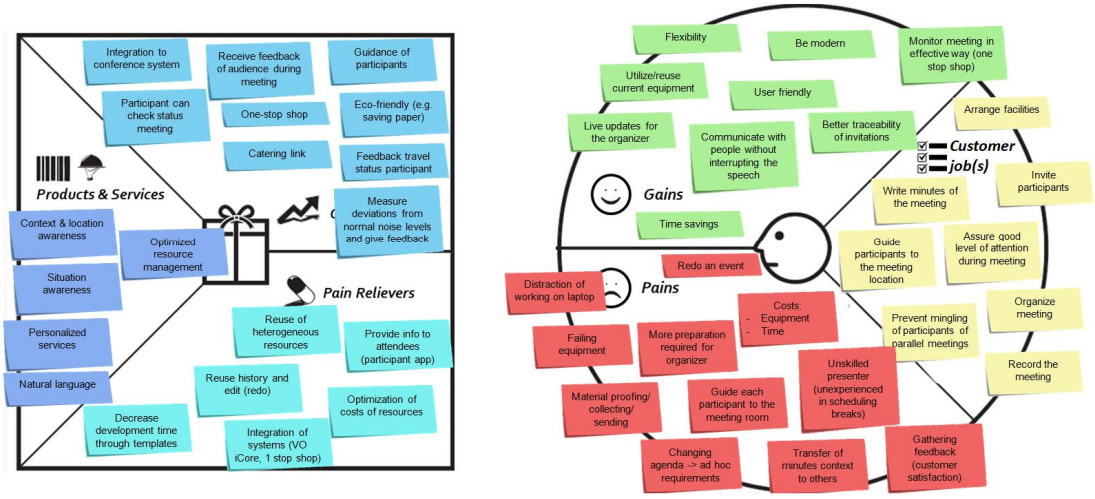


Figure 11: Value proposition canvas for Smart Office use case.

4.6.2. Stakeholder evaluation

For evaluating the smart meeting socio-economic value proposition two interviews were carried out. In that respect one interview was carried out with Mr. Gerrit Kraal, Offering Manager for Social Collaboration and also Senior Advisor on The New World of Work within Atos BTN (Belgium and the Netherlands). The second interview was carried out with Mr. Francisco Lopez Camacho, Consulting Manager of Sales & Marketing Department within Atos.

In order to identify the smart office (respective iCore) value proposition from a service developer perspective, two other interviews were carried out with Miguel Angel Mateo who is Software Architect at the Atos Research and Innovation Division and with Michele Nati who is a Senior Research Fellow in University of Surrey (UniS), involved heavily in the management and exploitation of the Smart Campus testbed at UniS, comprising of thousands of indoor and outdoor IoT devices.

4.6.2.1. The ATOS interview report (as service provider)

ATOS is implementing and exploring new ways of working for accomplishing more flexible work. Zero mail initiative tries to move out of mail and move into social collaboration. Blue Kiwi and SharePoint are the tools used for accomplishing a more collaborative way of working.

From their point of view, data plays an important role in the meeting area. It ¡s important for managing meetings to know the number of people staying in a specific room, tracking of room availability, knowing if there are people in a meeting room at a certain moment and where a colleague is at a certain moment in the building. The real objects that play a role in the processes are sensors, mobile devices, cameras and rooms.

In this area ATOS customers are companies whose employees need meeting services at office or at home such as: telecommunications companies, insurances companies, finances and public administration. The main services offered to their customers are:

- Social network at the workplace;
- Software for managing new types of devices, such as mobile devices. Employees bring their own devices; the platform has to support the different types of devices. A way to do it is by using web applications because they are hardware independent;
- Offering a set of devices for the employees and implementing the data protection for these devices. Every device has to be adapted to the system instead of adapting the system to the device.

The data sources are any entity involved in their activities, starting from agendas of the participants in a meeting, comments of the participants of the meeting up to files of recorded meetings. At this moment most of the needed data is acquired from tools like Microsoft Exchange, OneNote or Evernote. For the social network at the work place ATOS is using data acquisition tools which analyze web portals and Social Networks and different prototypes for working with the geolocation of the smartphones connected to the Social Network.

In order to improve the services offered to their customers, ATOS is investigating different technologies in order to be able to collect data about: rooms' availabilities, positions of persons and number of persons in a room. In this way they can provide added value service like: office protection, agility for reserving rooms or finding people in a building. Among the barriers data privacy is one of them.

From ATOS perspective, the smart office prototype is attractive because the companies are very interested in improving the efficiency of the meetings. The value is generated by the fact that, on one hand the services can be integrated with Blue Kiki (a product of ATOS) and on the other hand because of the features smart recording and smart wrap-up. The iCore based solution of the smart recording enables the service to be independent of recording devices from the room.

In order to improve the current prototype, the following features should be added: room availability, person's location and compatibility with iCal, open standard for scheduling meetings.

Alternative solutions, which have similar features, are Microsoft exchange as meeting software and the ones developed by IAP Solutions (develops M2M applications for Smart City and Smart Home domains).

The results are synthesized in the

Table 18 and Table 19.

Table 18. ATOS evaluation results for Smart Home use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
independence on devices from the smart office environment	the features of smart recording and smart wrap-up	data privacy

Table 19. ATOS evaluation results for Smart Home use case (willingness to accept iCore).

Ecosystem	iCore architecture
following features should be added: room availability, person's location and compatibility with ICal, open standard for scheduling meetings	No specific comments

4.6.2.2. The UniS and ATOS Research & Innovation interview report (as service developers)

The UniS internal customer is represented by the University Estates and Facilities, but they are attracting also external customers like Local Boroughs and private companies that need to make buildings smarter and save energy

The data used by the applications is generated by sensors such as energy meters, light, and temperature and presence sensors, together with user involvement through mobile phone based sensing technologies.

In order to provide personalised user experience depending on more accurate user context, more fined tuned indoor localization data will be beneficial. Apart from the localization, other barriers have juridical cause because of privacy concerns.

As an application developer, the iCore platform has added value not strictly bound to the use case, even though some of the applications developed by UniS could incorporate a Smart Meeting scenario, e.g. energy efficiency through tracking of people. The iCore features as described in the value proposition can bring significant benefits, easing the process of application development and the associated data collection and service integration, given the heterogeneity of devices and data sources.

Using the iCore architecture and concepts (particularly resource - devices utilization, easy reusability of them at different contexts, easier way to handle privacy and security considerations), allows UniS to increase the trust in the developed solutions, increase their credibility and in this way attract the interest of external customers.

In the past UniS has considered using the platform by COMPOSE EU project, but knowledge building and self-x capabilities of iCore appear to be much more developed than in that platform. To promote adoption of the iCore platform, UniS considers that some more dynamic privacy handling mechanisms that adapt across different services should be added.

The ATOS Research & Innovation group is the research and development hub for new technologies and a key reference for the whole Atos group. Their large expertise in research,

development and innovation projects, allows them to be able to bring new solutions and innovative elements to customers' business. The group focuses on projects development, combining economic exploitation of investigations' results and the most up-to-date technological achievements with high awareness of human factors (education sciences, disability-related issues, cultural diversity, and multilingualism).

ATOS Research & Innovation offers developments services to public authorities such as Madrid Transport Company. Depending on the applications, the data is generated by wide range of sensors connected to the internet from mobiles, tablets, cars, cameras, rooms, buildings, city sensors, etc. The data is collected using web services offered by Municipal Companies like EMT OPEN Data (http://opendata.emtmadrid.es/).

In order to improve the services offered to the customers, ATOS Research & Innovation group would like to have data about citizens' movements across the city, while they are using the public or private transport and about their environment (levels of noise, pollution, traffic congestion, pollen).In this way, they can offer applications to the city authorities that can improve the public transportation, reduce negative factors like CO2 emissions, noise, traffic jams and in conclusion improve the citizen experience. This can be also introduced in meeting organizations, offering the best mean of transportation to the participants to arrive to the meeting place with cost, time, and price effectiveness.

By using iCore, ATOS Research & Innovation can use the features of devices, by means of virtualization, in several domains. For instance the microphone of a pc can be used for recording a meeting and also to monitor that there is no body in a room during the night (security). To further consider adoption, ATOS would like to see a more complete prototype showing all iCore features into play.

The results are synthesized in the Table 20 and Table 21.

Table 20. UniS and ATOS Research & Innovation evaluation results for Smart Home use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
the features of devices, by means of virtualization, can be used in several domains; easing the process of application development and the associated data collection and service integration, given the heterogeneity of devices and data sources	knowledge building and self-x capabilities	Privacy concerns Localization capabilities

Table 21. UniS and ATOS Research & Innovation evaluation results for Smart Home use case(conditions for acceptance).

Ecosystem	iCore architecture
No particular conditions for	More dynamic privacy handling mechanisms that adapt across different services should be added; A more complete prototype would be required to

acceptance	showcase all I core features into play

4.6.3. Conclusions and implication

The proposed iCore solution in the Smart Office use case has a big exploitation potential because there are a lot of companies very interested in improving the efficiency of the meetings and willing to buy and implement new meeting solutions (the most attractive features provided by iCore are knowledge building and self-x capabilities).

The service provider involved in the interview responded positively the iCore smart office prototype and found very attractive the fact that it is compatible with other meeting solutions (like Blue Kiki). In order to further increase the potential of the solution, the person's location tracking has to be improved. Because person's location tracking was not among the objectives of iCore, a smart office service provider has to involve new actors namely vendors of indoor localization sensors. But, it is expected to be a trouble-less interaction, considering the iCore capability of handling heterogeneous devices.

The application developers involved in the interview responded positively as well to the iCore Smart Office prototype. Their answer, as expect, was more generic (not bound to the use case, but to the iCore architecture/concepts), and iCore has the potential to simplify the process of application development and the associated data collection and service integration, given the heterogeneity of devices and data sources. They have mentioned also the poor indoor localization capability of the prototype.

During the interviews, no strong barriers(deal breakers) in using iCore for developing smart office applications were identified.

4.7 Smart City Transportation

The Smart City Transportation use case belongs to the Intelligent Transport Systems (ITS) domain, which aims at better informing various users in the mobility domain to support their decision making processes regarding the use of infrastructure networks, thus contributing to user safety and comfort, efficiency of transport and travel movements and efficient maintenance of vehicles and infrastructure. This domain consists of a broad range of applications that can be divided in advanced traveller information systems, advanced, transportation management systems, ITS -enabled transportation systems, vehicle-to-vehicle and vehicle-to-infrastructure integration, commercial vehicle operations and value added services. Most of these applications are currently deployed as independent local applications, because applications that are deployed as part of a scalable interrelated system face the challenges of system coordination and economies of scale. Many of the applications in this domain are becoming established or are already established (existent for more than 5 years). This is reflected in the large number of actors that are active in the ITS domain. Overall the ITS vendor ecosystem can be divided into three main categories of actors: solution providers, hardware providers and IT vendors. Only few companies have capabilities in all three domains, enabling them to offer integrated solutions for the ITS domain.

Mobility is crucial for economic growth, job creation and provides people freedom. However, the ambitious targets for greenhouse gas reductions and the pressure to become less dependent on fossil fuels are expected to have a large impact on the existing business ecosystem. Also economic trends that have resulted in a declining car market and a structural overproduction of vehicles, will force automotive manufacturers to make changes to their business models. Value propositions will likely be extended to include multiple means of transport, and other products and services in order to provide customers with a total mobility solution. Furthermore, whilst more and more smart technology is being implemented in vehicles and public sector investments in ITS is growing, the average driver still seems hesitant about these developments. Drivers value new features like traffic jam predictions, parking assistance and real-time road warnings, but they are also wary about the fact that their vehicle can be constantly traced due to these new technologies and that their autonomous control over their vehicle is decreasing.

The Smart-City Transportation use case demonstrates the virtualization and use of ICT objects in automotive, to create, configure and use mobility functions and services while driving and, in a seamless way, also in pre-trip and post-trip services, linking to smart home and smart meeting. Although the focus is on a single driver, data provision from several cars can also be addressed, for the mobility management in a smart city. Major aspects and challenges are the availability of objects within the vehicle and from the outside world, considering the vehicle as a complex and autonomous eco-system and not an always connected environment. Another topic addressed is context awareness using cognitive technologies.

The Smart-City Transportation proof of concept demonstrates the “Smart Parking System” scenario, where two main real-life situations are addressed:

1. The User is driving downtown and needs to park his/her car; thus, he/she requests to the parking city infrastructure the location of the parking area – with parking lots available – which is nearest to the current vehicle position.
2. The User travels along the same routes recurrently (e.g.: from home to office, every working day early in the morning; from office to home, every working day late in the evening; from office to the swimming pool every Wednesday late in the evening; from

home to downtown, every Saturday morning; etc.). A "User Behaviour Adaptation and Prediction" component is able to detect these recurrent behaviours and to infer if the User is currently driving along one of such recurrent routes; then, it can provide the related knowledge to the "Smart Parking Service", which is able to assist the driver with information about the parking area – with parking lots available – which is nearest to inferred recurrent destination.

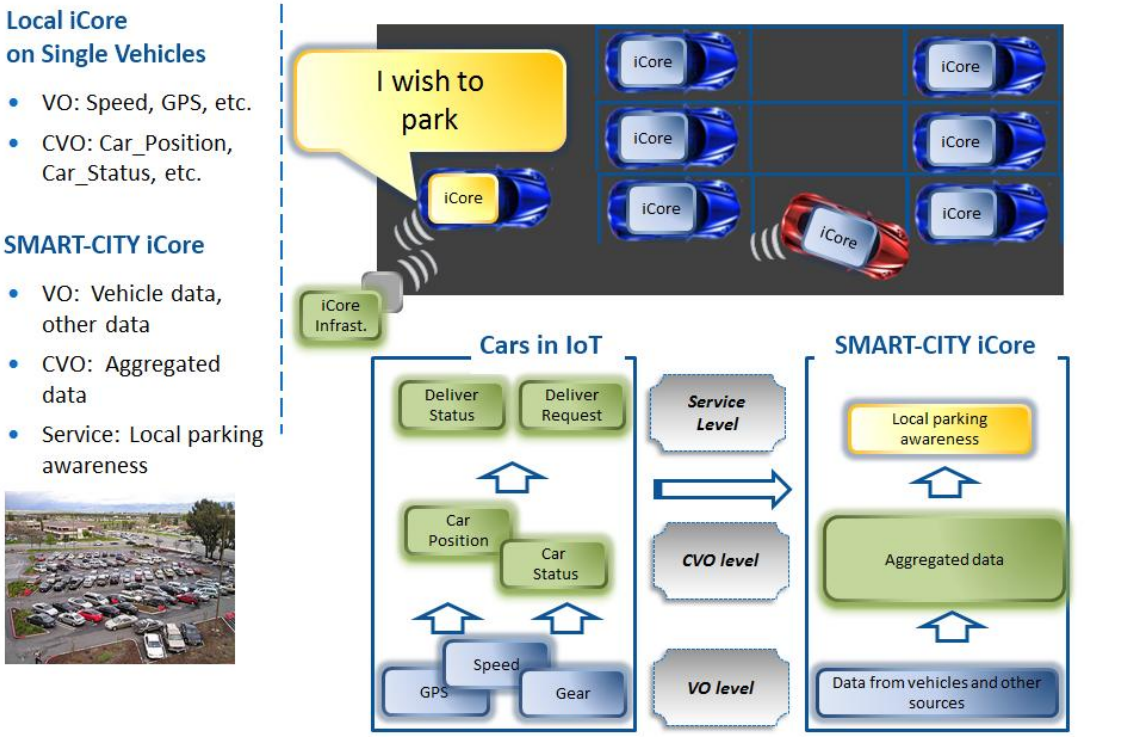


Figure 12: iCore Smart City Transportation Demonstrator

4.7.1. Smart city transportation value proposition

The key stakeholders for the smart city transportation use case include the driver and the company that provides the smart parking system to this user. The system can be embedded in the car, which requires acceptance of the system by the Car Manufacturer, or it can be sold as an application on a separate device, such as the smart phone. In this case we focus on the Car Manufacturer as the main stakeholder for the iCore solution and we have developed the value from Figure 13:

The following Value Statements have been presented during the interview:

- By exploiting Object Virtualization features iCore helps the Car Manufacturer's company to preserve the Connected Car Devices interfaces towards services while changing/enhancing devices' functions.
- By exploiting VO Composition features iCore helps the Car Manufacturer's company to disclose and grow their Connected Car Services offering to third parties ITS service providers.
- By exploiting Context Awareness features iCore helps the Car Manufacturer's company to improve the quality of their Connected Car Services, allowing for new road infrastructure resources (VO) to be automatically used by services.

- By exploiting Cognitive Features iCore helps the Car Manufacturer's company to seamlessly integrate Real World Knowledge to improve their Connected Car Services for their Customers (e.g. predicted traffic flows, etc.).
- By exploiting Dynamic Service/CVO Execution iCore helps the Car Manufacturer's company to improve the driving experience of their customers enabling the discovery and execution of services based on real world knowledge, user behaviour and context.

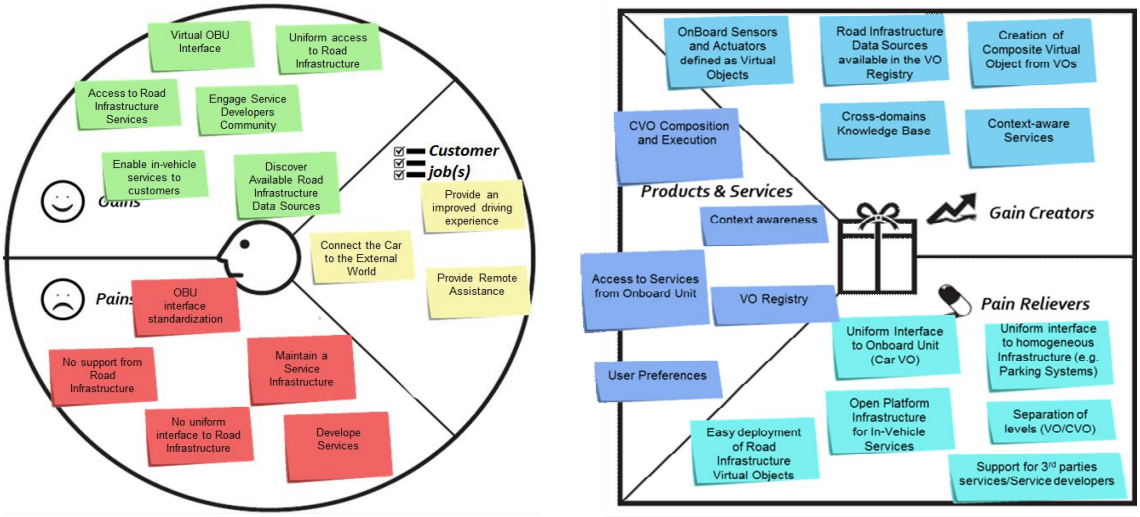


Figure 13: Value proposition canvas for Smart City Transportation.

4.7.2. Stakeholder evaluation

The stakeholder evaluation has been conducted with two stakeholders working at a car manufacturer (OEM): a Telematics Features and Services Manager; and a Telematics and Connectivity Unit Manager. The outcomes of both interviews are elaborated below.

4.7.2.1. Telematics Features and Services Manager interview report

The interview participant in responsible for managing the telematics features and services at a large car manufacturer. The main services provided to customers include the provision of information and suggestions that are useful to improve the driving experience, fuel efficiency and others, about which the interviewee cannot disclose further details. Some of the envisaged features and services rely on the availability of live data from different sources, such as vehicles, users or external information providers, thus the availability of these data is crucial. Two kinds of customers can be distinguished for the telematics features and services:

- Final customers/users (i.e. the driver) whose main wish is to improve the driving experience.
- Internal customers. These customers typically include technical and non-technical experts that have an interest in different vehicle domain and applications for which they would like to make use of gathered driver data (e.g. quality rather than reliability, CRM rather than sales and marketing) and thus they have different needs and goals.

The information and data that are currently used to provide the features and services to the two types of customers include vehicle related data, collected from the in-vehicle networks

and then further processed, as well as data coming from external sources, such as live traffic or weather information. The in-vehicle networks data are collected directly, while data coming from external sources are provided by third parties such as Service/Information Providers.

When asked about the needs for additional information or data the interviewee responded that regarding vehicle related data, all information available in the in-vehicle networks are potentially of interest: only few of them are used to feed services mainly because of the limited bandwidth available for data transmission and because of cost issues. Concerning data coming from external Service/Information Providers, parking availability is an example of interesting information, but the focus is more on the innovative services that could be offered and not on the information itself. The creation of innovative features and services that could attract customers is therefore the main focus for improvement for this stakeholder.

The interviewee sees many barriers for acquiring additional information or data, both technical (limitation in bandwidth for data transmission, security issues in data collection/management) and non-technical (authorization to data collection/management from final customers, etc.).

Compliance of the iCore framework with stakeholder's needs and wishes
At this point of the interview the iCore value proposition is presented to the interviewee. The first reaction is that the overall picture seems to be very attractive and potentially of high value, especially for what regards the creation and the easy deployment of components (well separated and with standard interfaces) that could make the creation, enhancement, and/or replacement of services easier than today. There are concerns about the hidden complexity of such an infrastructure and related costs. The interviewee thinks the decoupling of components enabling easy replacement/enhancement and the standardization of interfaces, which potentially decreases the efforts needed to introduce new services attractive features of the iCore solution. Less attractive seems to be the impact on in-vehicle implementations and the changes needed to make the current architectures compliant with the iCore approach are not clear. When asked if the stakeholder thinks the iCore framework lacks certain features that he deems important, he responded that this is not clear at first glance. The interviewee expects the iCore solution can provide added value through a significant acceleration in service development and deployment phases and, thus, a decreased time-to-market.

The interviewee says that the overall costs of the iCore solution shall not be higher than today: higher R&D costs should be clearly balanced by significantly lower variable costs. However, the more complex an architectural solution is, the more problems in development, deployment, management should be expected; the iCore architecture seems to be – at a first glance – much more complex than the one currently in place. Furthermore, before an OEM can consider the adoption of such a solution, it must be widely adopted and supported by most of (or, at least by most important) Service and Infrastructure Providers.

The interviewee does not know any other solutions on the market that provide similar functionalities as the iCore solution, but he would be willing to try these different solutions if they reach a reasonable maturity grade and wide adoption. For now, the interviewee thinks that iCore provides a higher standardization level, able to grant compatibility between components and components providers, compared to the current state of the art.

In principle, the interviewee responds positive to the iCore solution and is willing to try it if the overall cost of the solution shall not be higher than today and it shall be widely adopted by most of (or, at least by most important) Service, Contents and Infrastructure Providers.

The main outcomes of the interview are summarized in Table 22 and Table 23.

Table 22. Automotive OEM (Telematics Features and Services Manager) evaluation results for Smart City Transportation use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
The Telematics Features and Services Manager at a car manufacturer is in principle willing to try the iCore solution. Attractive features: decoupling of components enabling easy replacement/enhancement; the standardization of interfaces, which potentially decreases the efforts needed to introduce new services Significant acceleration is expected in service development and deployment phases and, thus, a decreased time-to-market	a higher standardization level, able to grant compatibility between components and components providers, compared to the current state of the art.	the impact on current in-vehicle implementations and the changes needed to make the current architectures compliant with the iCore approach is not clear. the iCore architecture seems to be much more complex than the one currently in place -> more complexity is expected to lead to more problems in development, deployment, management

Table 23. Automotive OEM (Telematics Features and Services Manager) evaluation results for Smart City Transportation use case (conditions for acceptance).

Ecosystem	iCore architecture
before an OEM can consider the adoption of such a solution, it must be widely adopted and supported by most of (or, at least by most important) Service and Infrastructure Providers.	the overall cost of the solution shall not be higher than today -> higher R&D costs should be clearly balanced by significantly lower variable costs

4.7.2.2. Telematics and Connectivity Unit Manager

The second interview was conducted with the Telematics and Connectivity Unit Manager at a large car manufacturer. His department provides graphs and environmental data about vehicle dynamics to internal customers, and suggestions and indications to external customers. The data used for these services originates from vehicle data available on a CAN bus, which is analyzed and translated in something useful for the intended customers:

- Internal customers who use the data for quality analysis of our products

- External customers (drivers) who want to know their vehicle performances and improve their driving behaviors.

Currently the department uses several vehicle data, such as position, speed, engine speed, fuel consumption, acceleration, etc. These data are currently stored on a USB stick and the end user will upload these data to the OEM's server using a client installed on his/her PC. When the interviewee thinks about the possibilities of connected services, he would like to get access to multimedia contents for rear seat entertainment, the availability of social and communities data in the car, and content linked to the current path or objective of the trip (weather information, location of a park, suggestions for a stop based on the driver's interests, etc.). The barriers that currently inhibit acquiring this additional content are the costs for data plan, roaming costs, lack of a data and content aggregator to provide a structured service.

Compliance of the iCore framework with stakeholder's needs and wishes

After presenting the iCore value proposition the stakeholder responds that he believes that this platform could be useful for next generation services. He especially likes the cognitive capability and the simplification of interfaces the iCore solution provides. What he is missing is a community for nerds to develop new services to stress the platform functionality of iCore. As added value he sees the fact that iCore would allow building enhanced services with a short time to market. Also he expects costs to be low due to big amounts of data and services connected enhancing the value of the proposed solution. However, the interviewee also expects that the integration of heterogeneous worlds is not as simple in practice. To take advantage of the opportunities the iCore platform offers the OEM would need to develop a different business plan and a different way to generate product values.

Also this interviewee does not know any similar solutions to the iCore framework, but he would be willing to try these if they are available. As an added value to the current state of the art, the iCore solution is expected to solve compatibility problems derived by different protocols and data format of different data sources and content providers.

Overall, the interviewee would be willing to try the iCore solution if the platform has a big number of content providers and data sources already available.

The main outcomes of the interview are summarized in the Table 24 and Table 25.

Table 24. Automotive OEM (Telematics and Connectivity Unit Manager) evaluation results for Smart City Transportation use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
the cognitive capability the simplification of interfaces allows to build enhanced services with a short time to	solves compatibility problems derived by different protocols and data format of different data sources and content	the integration of heterogeneous worlds seems a difficult task costs are expected to be low due to big amounts of data

market	providers	and services connected enhancing the value of the proposed solution. need to develop a different business plan and a different way to generate product values.

Table 25. Automotive OEM (Telematics and Connectivity Unit Manager) evaluation results for Smart City Transportation use case (conditions for acceptance).

Ecosystem	iCore architecture
a community for nerds to develop new services a big number of content providers and data sources already available.	None are mentioned

4.7.3. Conclusions and implications

The smart city transportation use case is employed in the ITS domain, which is expected to grow rapidly in the coming years. However, there are already many business actors active in the domain, offering more or less matured proprietary services. This offers both opportunities and barriers for the acceptance of the iCore solution in this domain, which is reflected in the interview results of the service developers at an OEM.

Both participants respond positively to the iCore value proposition, mostly valuing the standardization and simplification of interfaces compared to the current state of the art in the domain, which is expected to solve compatibility issues and result in a significant acceleration of the time-to-market for new services. However, they also see barriers for realizing this potential benefit of the iCore solution. Costs to make current in-vehicle implementations compliant with the iCore architecture are not clear. Also, the iCore approach of integrating heterogeneous worlds seems overly complex compared to the current architecture in place, resulting in negative expectations regarding the development, deployment and management of such a complex solution.

Based on both interview results, the OEM seems to be a risk-averse stakeholder, who would only consider making use of the iCore solution if it has been widely adopted by other stakeholders in the ITS domain. To make the iCore solution more attractive for the OEM stakeholder, iCore should first focus on attracting communities of both application developers and data providers.

4.8 Smart Business

Goods are transported from suppliers to retailer via a “mesh” of warehouses with road/air/sea transport in between. The real end-user’s issue is the lack of insight in the storage and transport conditions of goods between suppliers and consumer. To accomplish this, a fine grained ICT monitoring system (e.g. a wireless sensor network) is applied. E.g. a retailer wants to know if he can accept a shipment of temperature sensitive medicines, a transport operator wants to know if it can avert a claim of spoiled goods, since it thinks it kept the goods within the specified temperature tolerances and suppliers/retailers wants to know when to expect a delivery of goods. And in case of violation of storage and transportation conditions, parties responsible for the goods want to be able to act as soon as possible to reduce product spoilage (and associated claims).

Several technologies, methods and processes are already current practice and have been implemented in the supply chain, such as modified atmosphere packaging, temperature control, sanitation processes and cold chain monitoring. At present cold chain monitoring is mainly performed by the use of data loggers and typically only during transport and not throughout the entire supply chain.

The transport companies are interested to adopt new technologies which can optimise the cold supply chain and can reduce the amount of lost and damaged perishable goods and can increase the quality of services offered to the customers. The following trends are envisioned by the transport companies: cold chain monitoring implemented at all levels of the supply chain; enable every player involved in supply chain processes to improve the use of the data for decision-making; use a uniform set of data standards and communication mechanism; real time localization systems must be fast, inexpensive and must coexist with the existing infrastructure technologies; smaller information granularity; access complementary data sources.

The domain is highly influenced by economic factors (demand for large networks of logistic companies and competition is increasing and on-demand business world is accelerating); ecological factors (growing environmental sensibility and demand for reduction in CO2 emissions).

The economic value of goods transported and potential value that can be saved in the cold chain is large. However transport is mostly considered a cost factor and competition is heavy (and margins relatively low). Entry barriers are low for transporting, and we see many individual truckers – however deploying ICT solutions the organizing transporter is in the lead.

4.8.1. Smart supply chain management and logistics value proposition

The cold chain logistic business ecosystem contains a large variety roles and actors as follows: producers (who need to deliver their products), retailers (who sells the transported products), logistics companies, service developers and sensors vendors for logistics domain. Below is derived the value proposition for the main actors (stakeholders) of the logistics domain.

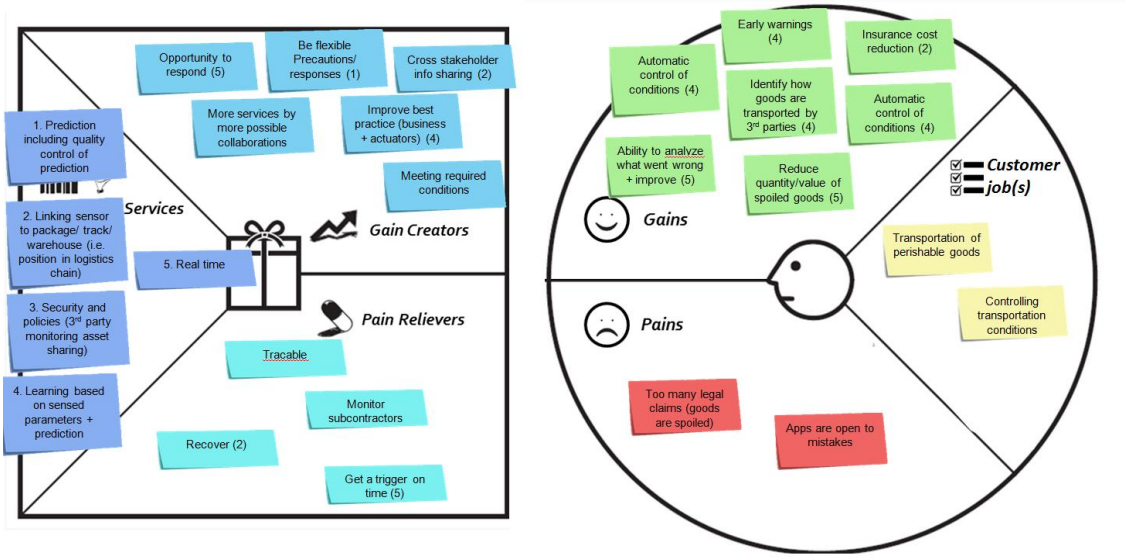


Figure 14: Value proposition canvas for Smart Business use case.

Logistic company

By the iCore' capability of providing real-time status on logistics (including subcontractors), making predictions and improving them the logistics company is able to monitor goods, provide evidence of compliance and respond timely to events and thereby preventing loss of goods.

The iCore' capabilities of defining data security polices and cross stakeholder information sharing rules enables the logistics companies to extend the collaboration with other 3rd party companies and to identify how goods are transported by them. In this way the logistic company is able to ensure better services (larger cold chain coverage and continuous transportation conditions monitoring) to the end clients.

By the iCore' capability to virtualize the resources (sensor and actuators) involved in the transportation process, the logistics company can define rules for automatic controlling of conditions inside the containers and warehouses. In this way the human mistake (e.g. the transport company employee forgets to change the state of the AC unit) is prevented and the loss of goods is reduced.

Service developers

By the iCore' capability of virtualize the resources (sensor and actuators), the service developers can handle in a standardized way the heterogeneous devices of the transportation environment and thereby obtaining productivity gains.

The iCore' capabilities of defining and executing service templates, for monitoring the products state during transportation and for automatic controlling the state of the actuators, enable the service developers to reuse the developing work, to increase productivity gains and to decrease the time used for applications development, thereby providing better services to logistic companies.

The native cognitive capabilities of the iCore framework enable the service developers to implement/train/execute machine learning models for monitoring the state of the products

during transportation. As a result of that the service developers can offer a new range of services to logistic companies.

Logistic company clients

By iCore capability of providing real-time status about products during transportation the clients of transport company can easily plan and adjust the stocks and thereby they provide better services to the customers.

The iCore capability of generating a report about the transportation conditions of the goods allows the clients of the logistic company to estimate the shelf time of the products and in this way the degree of spoiled goods is reduced.

4.8.2. Stakeholder evaluation

For evaluating the smart supply chain management and logistics value proposition two interviews have been carried out. As described in the previous section the main actors are the logistics company and the service developers. In that sense one interview was carried out with Mr. MARK BIJL, CTO, co-founder and product owner of the SmartView product of Antaris Solutions. The company provides monitoring services in the cold chain domain and Mr. MARK BIJL has provided feedback about the iCore smart business prototype from logistics company (stakeholder) perspective. In order to evaluate the smart business prototype from a service developer perspective the second interview was carried out with Mr. Cristian Serban from Siemens Corporate Technology Romania.

4.8.2.1. The Antaris Solutions interview report

Antaris Solutions offers the SmartView product, which provides monitoring services in the 'cold chain' sector (transport and logistics of products that require to be transported and stored within certain temperature ranges). Antaris Solutions is part of the Berlinger&Co. Group, Swiss.

Antaris uses data to provide insight in how well the 'cold chain' is operating and to provide feedback to the customers (via SMS and e-mail). In addition to that, they try to combine data from different sources to create 'context' and be able to explain why there was a sudden temperature increase. The sensors, which are produced by different vendors/manufactures, are used in their business to generate real-time data and have the capacity of processing the data as well.

The main types of customers, which use Antaris solutions are the following ones:

- Pharmaceutical manufacturers: are responsible for the quality of the pharmaceutical products until the moment of admission (legal). As consequence, this customer wants to ensure that the quality of the produce is good and wants to enforce ways of conduct (how to handle, how to store and how to transport the products). In this way can be avoided the process of administrating spoiled medicines to the patients and can be put claims on who is responsible for spoilage.
- Logistic service providers: are hired/contracted by pharmaceutical product manufacturers to transport the produce. These transport service providers want to have real time insight in the conditions of the goods, because this allows them to act before produce is spoiled. They also want a trace of the environmental conditions to

prove that they (under their responsibility) handled the products correctly (aversion of claims

- Facility monitoring: Yearly thermal mapping of reefers/cold chambers is a requirement from pharmaceutical manufacturers and is currently a costly operation. Requirement to provide a thermal map at several locations in a cold chamber. Requirements originate from pharmaceutical manufacturers.

The following data sources are used by Antaris:

- Temperature is main driving source for spoilage of products and is the main source of collected data;
- Humidity is often measured in combination with temperature.
- Position of devices: Begin/end shipments, planning and feedback on planning and used as proof that produce is placed in the right facilities (e.g. cold chamber during storage);
- Enterprise resource planning (ERP) systems are used as data source to get shipment master data (origin, destination route, flight numbers, required conditions).
- Open data sources: Flight data (departure/arrival);
- SmartView web application provides context to sensor data e.g. shipment started, shipment placed in cold room, shipment scanned etc.

The data is gathered using their own sensors and from 3rd parties: ERP systems, integration with sensor providers (e.g. reefers as a data source), open source databases (flight data). Antaris solutions can be improved by considering the following data sources (at this moment are not available): (1) accurate position information of sensors (also time related); (2) ocean freight arrival/departure would enable us to provide feedback to planning'; (3) same as above for road transport (trucks etc.) often this information is available, but by no means standardized; (4) local weather to correlate to predict exceeding of temperature bound; (5) information on reefer/cold room setting to check if correct settings are being used.

Antaris faced the different problems when they proposed new solutions/technologies:

- Some technology is not accepted because it is simply not recognized as option in regulatory documents or best practice documents. The transport and logistics sector is only slowly adapting.
- Corporate IT rules: long acceptance cycles for new IT concepts and not eager to be open to other parties. High demand for quality of solutions, each and every software release needs to be approved and certified by external parties. Things like data integrity are key (audit trails, GAMP). Concepts like learning and prediction are not easily accepted in this respect.
- Complex ecosystem of multiple stakeholders makes it difficult to insert new technology in the supply chain. Adaptation rate is slow. Still a lot happens with paper and pencil.
- many obstacles of juridical and organizational nature.

Compliance of the iCore framework with stakeholder's needs and wishes

By implementing iCore solutions, Antaris can shift the focus from integrator (different sensor manufacturers, different other data sources) toward analyzing supply chains, which provides

more value to their customers. In this way iCore will allow Antaris to: reduce time to market for new services; change their focus to analyses where the business is more valuable; get rid of vendor lock in and time consuming integration with different data sources; allow for more scalability in terms as number of devices as well as business-wise.

The iCore most attractive features are: interoperability between multiple vendors (iCore would be one interface and the device integration is pushed toward device vendors (which is also a risk concerning competing platforms)); combination of different data sources based on generic templates; repository of devices which can be used for management and maintenance tasks, especially with self-organizing capabilities; system knowledge which be exploited; learning capabilities will move from reactive/proactive mind set to predictive plus analysis. At the other end, natural language processing and user profiling are not very useful in the application domain.

If Antaris will implement the iCore technology, they will have to hire less developers (web app/databases etc), but more domain experts. The new challenge is to create iCore templates and feed the system with domain knowledge and in return, create feedback on/exploit data (e.g. real word knowledge) to their customers. This implies a radical change of expertise and it is not clear view on the expenses, also on expenses for third parties required to get iCore up and running.

Because the cold chain logistics is a very complex domain the following difficulties might appear wile implementing the iCore Solution: standardization of the platform; data integrity and audit trails (it might be possible that iCore is not easily accepted in terms of learning and prediction, if the sensors are broken, the predictions cannot be used as proof that medicine is stored according to the prescribed rules); the customers might be skeptical because iCore is complex.

According to Antaris in this domain there already exist similar proprietary solutions developed by SAP (general supply chain solutions) and SAG (analytical packages/learning functions). But none of the solutions from the best of their knowledge covers what iCore covers except of some overlapping functionalities. They have used Pentaho (which offers data integration and business analytics) for online analysis and learning. iCore misses domain specific implementation and for implementation it requires adaptation to the domain (this might be a strong point, but also a potential weakness).

The results are synthesized in the Table 26 and Table 27.

Table 26 Antaris Solutions evaluation results for Smart Business use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
interoperability between multiple vendors; combination of different data sources based on generic templates; repository of devices which can be used for management and maintenance tasks; system knowledge which be exploited; learning capabilities	none of the competing solutions covers what iCore covers except of some overlapping functionalities	standardization of the platform; data integrity and audit trails (it might be possible that iCore is not easily accepted in terms of learning and prediction, if the sensors are broken, the predictions cannot be used as proof that medicine is stored

will move from reactive/proactive mind set to predictive plus analysis		according to the prescribed rules); the customers might be sceptical because iCore is complex.

Table 27 Antaris Solutions evaluation results for Smart Business use case (conditions for acceptance).

Ecosystem	iCore architecture
Some technology is not accepted because it is simply not recognized as option in regulatory documents or best practice documents. Corporate IT rules: long acceptance cycles for new IT concepts and not eager to be open to other parties Complex ecosystem of multiple stakeholders makes it difficult to insert new technology in the supply chain. many obstacles of juridical and organizational nature.	iCore misses domain specific implementation and for implementation it requires adaptation to the domain

4.8.2.2. The SIEMENS Corporate Technology interview report

SIEMENS CT develops solutions for large distributed systems in domains such as smart grids or logistics. The Siemens portfolio in these domains is very wide and the following types of applications can benefit from the IoT enhancements: efficient and multimodal logistic solutions for individual companies as well as cities and metropolitan; protection, planning, control, monitoring, and diagnostics of grid infrastructures.

Data is very important in these domains and depending on SIEMENS CT customers' needs the software solutions we are delivering contains modules for analyzing the data and deriving information from it. The applications offered to the SIEMENS CT clients contain various software components used for: data analytics, decision support, configuration systems, stream analysis, predictive systems etc.

For the logistics domain, they considered and used the data generated by the following sources: transportation details, transportation reports (logs), logs and real-time data about the storing conditions of the products and others. Most of the cases the developed applications were performing batch processing and the client has the responsibility to provide the historic data. But, they have developed some applications which were performing stream processing/analytics. . In this later case, it is the clients' responsibility to provide/give access to the data sources.

Compliance of the iCore framework with stakeholder's needs and wishes

From a logistic company perspective the iCore prototype (the instantiation of the iCore framework for the logistic domain) has a great potential: it reduces costs, increases the prestige, increases the shelf time and many others. But it has a major drawback, namely the fact that all the logistics companies already own applications and are collaborating with companies like SIEMENS, SAP or IMB to add new features, functionalities. In conclusion the logistic companies already have the framework. What iCore proposes is a framework which

can be used for easily development of applications and easily extend the functionalities. This implies additional investments for the logistic companies apart from the ones already done.

The prototype is very attractive because it offers support for continuously monitoring the devices and the predictive capabilities. Both characteristics provide added value compared to the current solutions. But, a real logistic needs a lot of other features (e.g. parcel management, route planning etc.) which right now are not implemented and have to be further developed.

From a service developer profile, as it is SIEMENS CT, a framework that provides standardized way of accessing the data is very appealing because it reduces the considerably the development time. The only drawback is of the approach is the VO back end because the sensor vendor has to deliver an iCore compatible sensor. There are a lot of companies who develop their proprietary protocols and in this way they force the clients to by the whole solution from them. It is highly improbable, at this moment that, these companies are going to change their business models. But, still there are a lot of sensor vendors who will provide iCore compatible sensors.

The iCore feature of CVO templates execution also reduces the development time. The advantage exposed by the CVO execution engine (which is wrapper over a CEP engine) is represented by the syntax used for creating the CVO templates. More precisely the domain expert doesn't have to have advanced programming skills in order to create the CVO templates. What is missing is a CVO container for executing jobs, because right now it provides only data analysis/processing capabilities.

The cognitive capabilities of the framework, as are implemented/presented in this prototype are very attractive. Not only for the cold chain logistic domain but also for other domains where the data had to be analyzed in real-time and prediction models are used to forecast different situations.

The generic characteristic of the platform is very attractive because of uncountable reasons. The problem with all the generic component comes when its' performance is compared with the performance of a dedicated component. And most of the time the dedicated platform is performing better.

The iCore platform or a system that implements the iCore architecture has the following clear advantages:

- The overall products development time is reduced
- Simplifies the process of accessing the data sources and collecting the data
- Simplifies the job of the domain expert.
- Breaks the silos type of application typology and enhances the horizontal application development process.
- Improves the way the apps are developed using the CVO and service templates
- Allows rapid application extension

All these advantages are very attractive for a service developer type of company as it is SIEMENS CT, regardless the domain for which develop applications (cold chain logistics, smart grids etc.).

Considering the current structure of the company, the shift to an iCore based technology will imply, among others, the following main (important) changes. On one hand the developers have to be trained accordingly. This can be accomplished relatively easy if the organization

decides to use the platform. On the other hand the organization will have to provide support and maintenance for the existing clients. As a result the organization will need a mix team.

In the logistics domain, there are other companies which are developing these types of applications e.g. SAP, IBM. All of them are configurable solutions and new features can be added according to the customer needs. The attractive points of the iCore solution, compared to the ones mentioned, are represented by: the support for continuously monitoring of the devices and the predictive capabilities.

The results are synthesized in the Table 28 and Table 29

Table 28 SIEMENS Corporate Technology evaluation results for Smart Business use case (willingness to accept iCore).

Perceived utility and usability	Perceived advantages with respect to competing solutions	Perceived costs/barriers
The overall products development time is reduced Simplifies the process of accessing the data sources and collecting the data Simplifies the job of the domain expert. Breaks the silos type of application typology and enhances the horizontal application development process. Improves the way the apps are developed using the CVO and service templates Allows rapid application extension	cognitive capabilities of the framework provides standardized way of accessing the data	developers have to be trained accordingly the organization will have to provide support and maintenance for the existing clients

Table 29 SIEMENS Corporate Technology evaluation results for Smart Business use case (conditions for acceptance).

Ecosystem	iCore architecture
no particular condition for acceptance	no particular condition for acceptance

4.8.3. Conclusions and implication

Considering the value proposition of the Smart Business scenario for the logistics companies, iCore has the potential to support the interoperability between multiple players. On one hand the virtualization feature supports the utilization of heterogeneous devices manufactured by

different vendors. On the other hand, the communication/collaboration between different logistic companies is facilitated. In addition to that the cognitive capabilities of the iCore framework enhance the real-time monitoring. In this way better services can be offered to the end clients and the transportation risks which are supported by the transportation company are reduced. Even if the trend in the cold chain logistic is to go towards reactive approach (monitor the transportation conditions and generate early warnings) the change cannot be very easy implemented because iCore is not a standard of the platform and is possible to fail the audit trails.

For service providers the iCore framework provides a set of build-in tools (resource virtualization, CVO/SL templates, cognitive mechanisms) and has the potential to reduce the development time and the cost of the applications build on top. The iCore framework is attractive for the service provides in the domain of large scale distributed systems (smart grids, logistics). Even if the framework has clear advantages compared to the existing solutions, it is probable that is going to be slowly accepted by the large companies because their clients will not be willing to invest in a new technology as long as they have the desired applications.

5 Appendix A: List of stakeholders

The Table 30 provides details about the stakeholders involved in the interviews. The documents resulted after the interviews are not public, had been included in the project portal and can be made available to the European Commission on request.

Table 30. List of stakeholders involved in the interviews.

Use case/trial	Name	Company name	Stakeholder type
Smart tour in the city	Eleftheria Bramou	CLIPPER TRAVEL	Service provider/ end user
	Dr Konstantinos Tsagkaris	WINGS ICT Solutions	Service developer/Solution provider
Urban security	Marc Dehondt	Thales	solution provider
	Eric Pivot	HubOne	solution provider
Smart Hospital Asset Management	Dr. Massimo Soffiati; Dr. Annalisa Cuccu ; Marina Cologna	Santa Chiara Hospital in Trento	end user
Smart Theme Park	Anonymous	-	Service provider
Smart Home	Dr. med. Alexander Rudi	FA f. Innere Medizin (Doctor´s office within policlinic in Dresden)	Service provider
	Anonymous	Private citizen Private citizen	end user
Smart Office	Mr. Gerrit Kraal;	Atos BTN (Belgium and the Netherlands)	service developer
	Mr. Francisco Lopez Camacho	Atos	service developer
	Michele Nati	University of Surrey	Service provider
Smart City Transportation	Anonymous	Automotive OEM (Telematics Features and Services Manager)	Service developer
	Anonymous	Automotive OEM (Telematics and Connectivity Unit Manager)	Service developer

Smart Business	MARK BIJL	Antaris Solutions	service developer for cold chain domain
	Cristian Serban	SIEMENS Corporate Technology	service developer

The Table 31 provides details about the persons who organized the interviews.

Table 31. List of interviewers involved in iCore socio economic evaluation.

Use case/trial	Interviewer name	Interviewer company name	Stakeholder
Smart tour in the city	Vasilis Foteinos, Dimitris Kelaidonis, Antonis Moustakos, Panagiotis Vlacheas, Vera Stavroulaki, Panagiotis Demestichas	UPRC	CLIPPER TRAVEL and WINGS ICT Solutions
Urban security	Stefane Menoret	Thales	Thales communication and security international business development manager protection systems results for Smart Urban security Trial
	Stefane Menoret	Thales	HubOne
Smart Hospital Asset Management	Andrey Somov	Create Net	Santa Chiara Hospital
Smart Theme Park	Dingbo Duan; Jian Ma; Harold Liu	Beijing University of Posts and telecommunications, China; Wuxi Smart Sensing Stars, Co. Ltd, China; Beijing Institute of Technology, China	Anonymous
Smart Home	Erik Mademann, Danny Schumann,	ZIGPOS	Animous User Dr. med. Alexander

	Frank Stephan		Rudi (doctor leading a doctor praxis)
Smart Office	Miguel Rodriguez, Jorge Pereira	Atos Origin	Atos BTN (Belgium and the Netherlands); Atos
	Stylianos Georgoulas	UNIS	UNIS
Smart City Transportation	PROVERA Michele	CRF	Automotive OEM
Smart Business	Lodewijk van Hoesel	Ambient Systems	Antaris Solutions
	Dan Puiu, Lucian Sasu	SIEMENS Corporate Technology	SIEMENS Corporate Technology

6 Appendix B: Interview guide

In this appendix the steps followed to organize the interviews are presented.

Stakeholder selection:

- Focused on the solution provider. Note that in the Brasov workshop mostly the customer of the solution was selected as most important in the ecosystem. For the interview rounds we suggest that the solution provider is a must and the customer thereof a strong wish.

Interviewer selection

- Senior, two persons

Preparation

- Value Proposition instantiation, see chapter 3
- Send invitation

Execution

- Record, take notes

Processing

- Written responses, focused on Part C and E, other parts to substantiate
- Timeline

Analysis

- Interaction with WP1

Bellow, until the end of this appendix the iCore Stakeholder interview guide is presented:

(text in italics shows instructions and examples that serve as background information for the interviewer, text in italics + underline gives small tasks that need to be prepared by the interviewer before the interview)

Introduction

Before I start with my interview I want to introduce myself and explain the goal of this project and the reasons for this interview to you.

- Introduce yourself
- Explain the goal of iCore and this interview:
    - [Interviewer company] takes part in a European research project called iCore (Internet Connected Objects for Reconfigurable Ecosystems) which aims to provide the technological foundations for the Internet of Things (IoT). There are two main classes of problems that need to be addressed by the Internet of Things (IoT). First, **the vast amounts of heterogeneous objects**. Second, the existence of **different users and stakeholders**.

  - The iCore initiative addresses two key issues in the context of the Internet of Things (IoT), namely how to **abstract the technological heterogeneity** that derives from the vast amounts of heterogeneous objects, while enhancing reliability and how to consider the views of different users/stakeholders (owners of objects & communication means) for ensuring proper application provision, business integrity and, therefore, maximize exploitation opportunities.
  - The iCore proposed solution is a **cognitive framework** comprising three levels of functionality, reusable for various and diverse applications. The levels under consideration are virtual objects(VOs), composite virtual objects (CVOs) and functional blocks for representing the user/stakeholder perspectives.
  - The goal of this interview is twofold: first, we want to analyze your needs and wishes, as an iCore stakeholder, with respect to IoT solutions. Second, we want to validate the iCore value proposition for your business with you.
  - We have identified you as an iCore stakeholder, since *… [specify]*
- Interview process
  - We will use your responses together with those of other stakeholders to identify to which extent the iCore Value proposition differs or overlaps in different applications and to derive insights about the acceptability of iCore in different application contexts. This interview will recorded/noted and be processed to a written report. The report will not be included integrally in a project deliverable but in a consortium only appendix. Upon your request we can anonymize your name and company and provide you the opportunity to approve the report.
  - I expect that the interview will last for 2-3 hours. *(Decide if you want to record the interview, ask for permission if you do)*
  - Are we allowed to mention your name and organization when reporting on the results or do you want to stay anonymous?
- Definitions:
  - *The Internet of Things (IoT) refers to uniquely identifiable objects and their virtual representations in an Internet-like structure.* Typical examples are: smart grids, remote smart meters, assisted living, traffic control, …
  - *iCore: Internet Connected Objects for Reconfigurable Ecosystems*
  - *VO: virtual objects*
  - *CVO: composed virtual objects*
  - *RWO: real world objectsBM: Business Model*
  - *VP: Value Proposition*

Part A: Stakeholder jobs, needs and wishes

In this first set of questions, I will ask you a few questions about the organization you work for to get a better understanding of your work, your customers and the role of data in your organization.

1. Could you give a short introduction of yourself and the organization you work for?

- Is your role with respect to iCore ____? *E.g. service provider, object provider, soft component provider, end user… The interviewer should prepare the answer to this question in beforehand and cross check with the interviewee if this role is indeed correct.*

2. What are the main jobs you/your organization is trying to accomplish?
    - Which (business) processes or activities do you try to control / manage? (*Think of control in terms of measuring, monitoring, predicting and correcting and improving)*
    - Does data play a role in accomplishing these jobs? *(Explain that data will be zoomed in in a few minutes with more questions)*
    - Which real world objects play a role in these processes? Do they produce or process data?
        - *Examples real world objects: Sensors, mobile devices, cameras,… but also transported goods, people, rooms, schedules,…*
3. Who are your customers and their needs?
    - Which services do you offer to these customers?

Exploring use and opportunities of data, information, knowledge

*The following questions will zoom into the topic of "data". In this interview we do not distinguish data, information or knowledge. *It might be useful to specifically consider the role of reusable information, applicability of predefined templates, aspects that might be observed or learned (on the fly).*

4. Which information/data do you currently use (collect, analyze) to fulfill your job(s)?
5. How do you gather these data at the moment?
    - Do you gather these data yourself or do you get it from third parties? If so, from whom?
6. Which additional information/data would you like to have to improve your job(s)? *(Interview leader should prepare some domain specific examples of potentially interesting other data sources in beforehand)*
7. In which way could additional information/data improve your job?*
8. Do you see other opportunities for data in your domain?
9. Which barriers do you encounter in gathering, analyzing and using these additional data?
    - Are the barriers of organizational, technical or juridical nature?

Part B: iCore value proposition

In the next half hour I want to introduce you to the iCore platform and the value proposition it offers for your domain and your organization in particular. (please make an estimation of the time in beforehand depending on the complexity of the case)

10. Introduction iCore solution + value proposition *(see chapter 3)*
    - Interviewer explains the general idea behind iCore incl. features *(examples of features are: self-x, virtualization, growing real world knowledge, growing system knowledge, high-level semantic expressions, complex service abstraction, dynamic/programmable service composition, dynamic resource optimization* and
    - the instantiation of iCore for this Use Case domain, i.e. what iCore looks like in this Use Case *(it may be difficult to distinguish iCore from the prerequisites/context of the solution)*

- How could iCore help to create value in your Use Case? *(this question is meant to check if the interviewee indeed understood the iCore concept; this further detailed in the next question)*
- Explain the value delivered through iCore making use of the Value Proposition you have developed *(see chapter 3)*
    - *think of better control with respect to goals, improved compliance, decreased risks, improved opportunity spotting and realization, improved continuity, improved utilization*
    - *The Value Proposition / business model canvas has to be prepared in beforehand by the interviewer, (s)he can receive support from TNO for filling out the canvas*
- Sketch how typical non-technical requirements are being addressed in iCore *(see chapter 3.4)*
    - *Control*
    - *Quality Guarantees*
    - *Security*
    - *Interoperability*
    - *System Performance*
    - *Scalability*

Part C: Compliance with stakeholder's needs and wishes (socio-economic requirements)

After having introduced iCore to you, I would like to discuss with you if the iCore solution indeed can provide value for your organization and how it corresponds with your needs and wishes.

11. What is your first reaction to the iCore value proposition?
12. Which features do you find most attractive?
    - *Prepare the features applicable for your domain in beforehand (see question 10)*
13. Which features do you not like?
14. Which features do you miss?
15. What would be the added value of the iCore solution for your job?
    - How important is an increased quality/performance of *…product/service…* for you/ your organization? *(Also consider perception of quality)*
    - How important is and increased safety of *…product/service…* for you/ your organization? *(Also consider perception of safety)*
    - How important are better strategic choices, **e.g. with respect to new products or services or new roles in an ecosystem,** for you/ your organization?
16. Which costs do you expect when using the iCore solution? *(not just expenses, but also change in organization, processes, coordination,…)*
17. Which difficulties do you expect when using the iCore solution? *(e.g. in collaboration with suppliers; acceptance of customers etc.)*
18. How would your product/service/solution change if you would make use of the iCore solution? *(make use of the business model canvas and the value proposition)*
19. How would the implementation of iCore impact your organization? *(E.g. working with new objects/sensors or devices, working with templates changes activities and business processes, need new partners, need to change legacy systems,… How complicated is all of this?)*

20. How would your job change if you would implement the iCore solution? *(E.g. role change from solution provider to service provider, or become more specialized in a component,…)*

Re-view question 15 *(perhaps the previous questions have brought new insights)*

Part D: Competing solutions

21. Which other solutions do you know in your domain that have similar functionality as iCore? *(Interview leaders should prepare this question with a first quick scan of other solutions)*
22. Have you considered using these solutions?
23. What is the added value of iCore over existing solutions?

Part E: Acceptance

24. Would you make use of the iCore solution? Under what conditions?

Market attractiveness

Fit with iCore values

Horizontal expansion potential

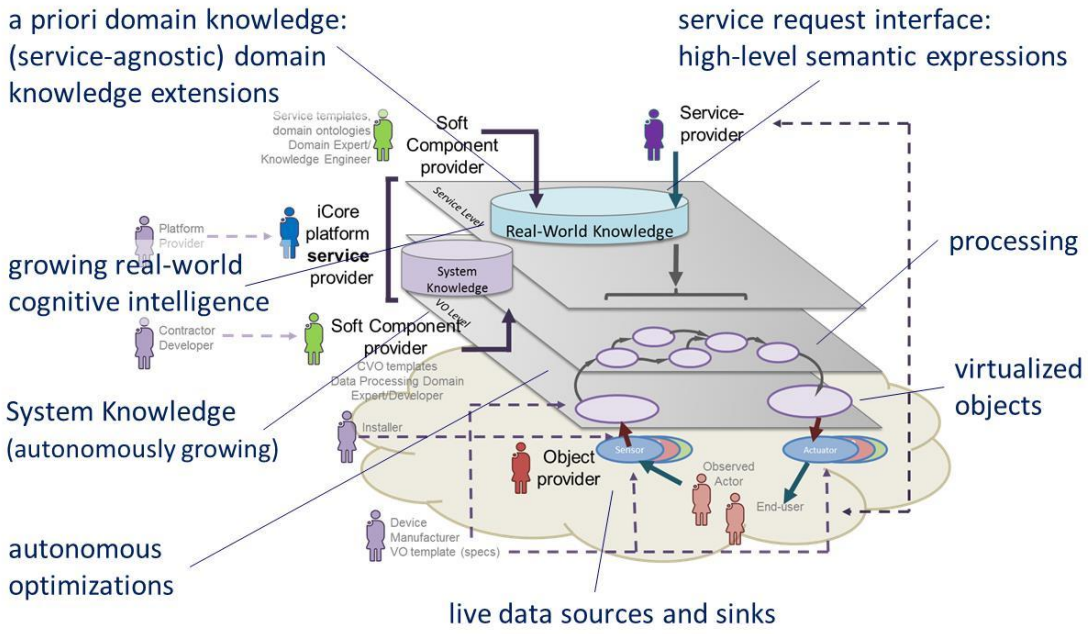
Conclusion

Thank you very much for your time. Are we allowed to mention your name and organization when reporting on the results or do you want to stay anonymous? *(better to ask this question twice at the beginning and end of the interview)* Do you want to receive the results of this study?

7 Appendix C: Resources document

This appendix contains the materials used by the interviewers to introduce iCore concepts to the interviewees.

The iCore concept



Features

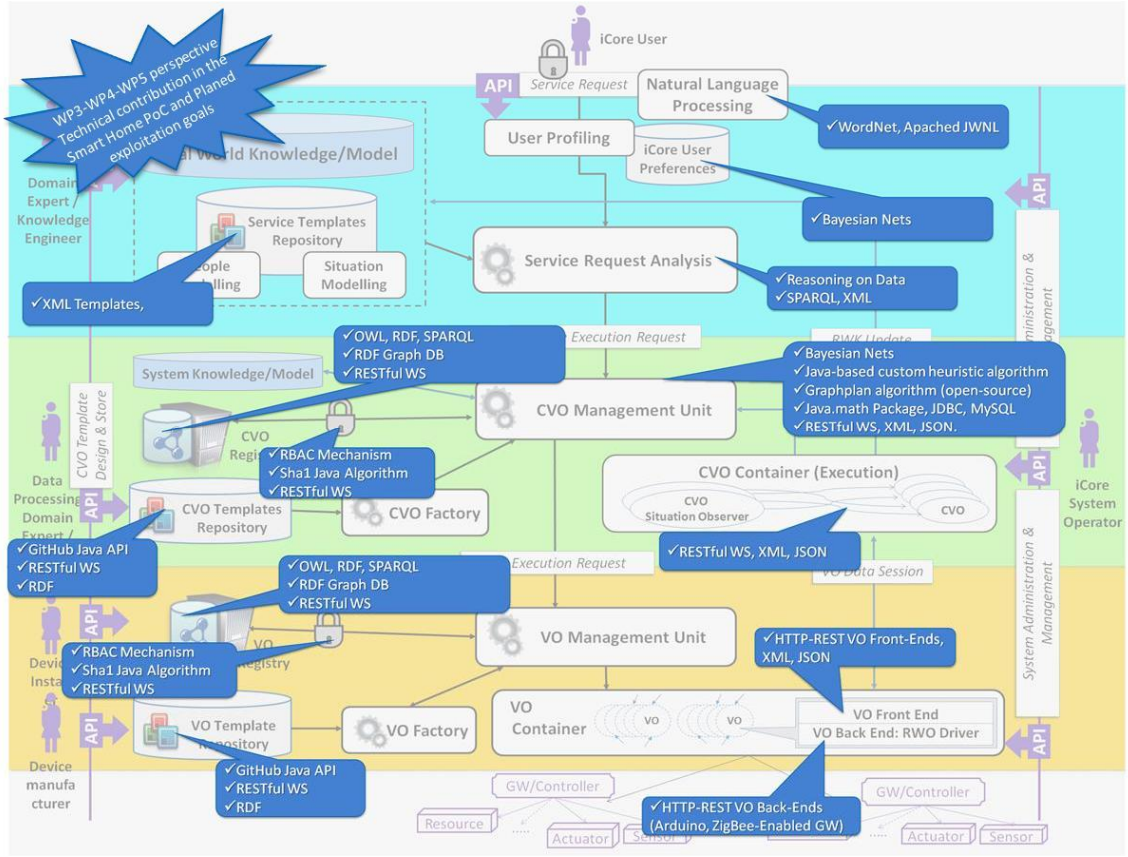
Taken from *'SmartHome_PoC_Implementation_20140516.pptx'*

- ✓ **Cognitive IoT functionalities** in the Smart Home PoC.
- ✓ **Self-X Features** (configuration, healing, optimization, protection).
- ✓ **Machine Learning** mech. to allow the knowledge building and support the knowledge based instantiation of CVOs.
- ✓ **Dynamic on demand** creation of **IoT Apps** for the Smart Home/ Ambient Assisted Living domain.
- ✓ **IoT Application** creation based on the **user preferences** and the **context**.
- ✓ New IoT Smart Home services become available due to enhanced context-awareness and self-management features enabled through the iCore platform.
- ✓ Provisioning of smart, personalized IoT Applications / Services.
- ✓ **Bayesian Network** for knowledge building on **User Preference**.
- ✓ **Coordination** and **access control** of available resources.

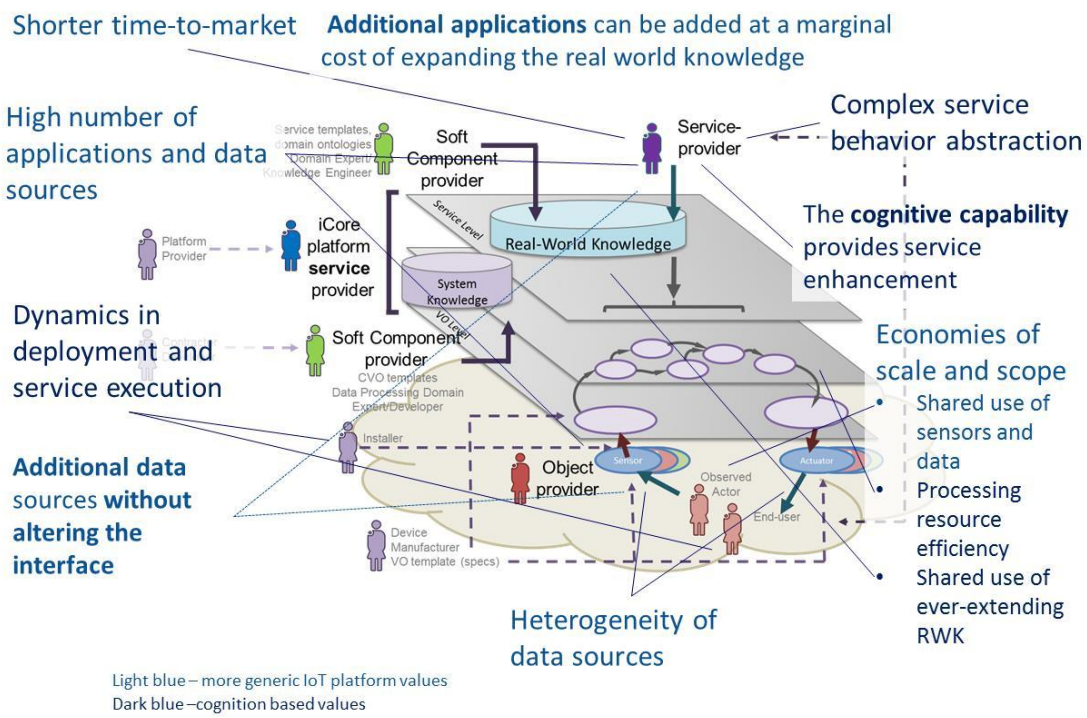
- ✓ **Semantic-based** access **conflicts resolution**.
- ✓ **Autonomic management** and **control of devices** in the smart home, such home appliances.
- ✓ **Semi-dynamic / Semi-automatic software deployment** for VOs and CVOs.
- ✓ **Semantic interconnectivity** between object and application.
- ✓ **Semantic-based communication schemes**.

Components

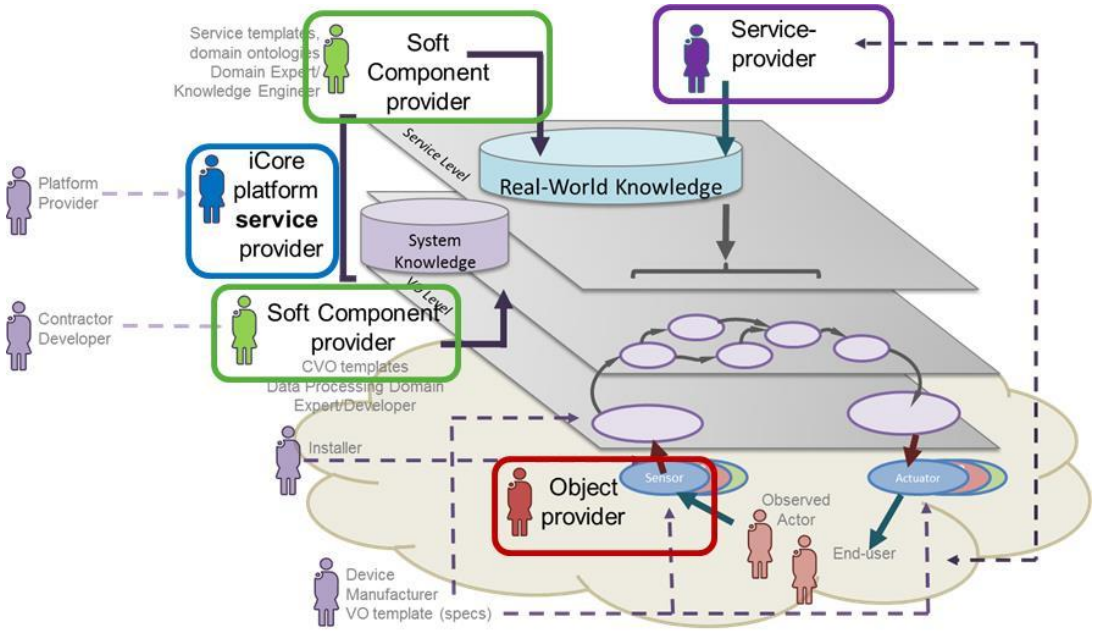
Taken from *'SmartHome_PoC_Implementation_20140516.pptx'*



Generic values



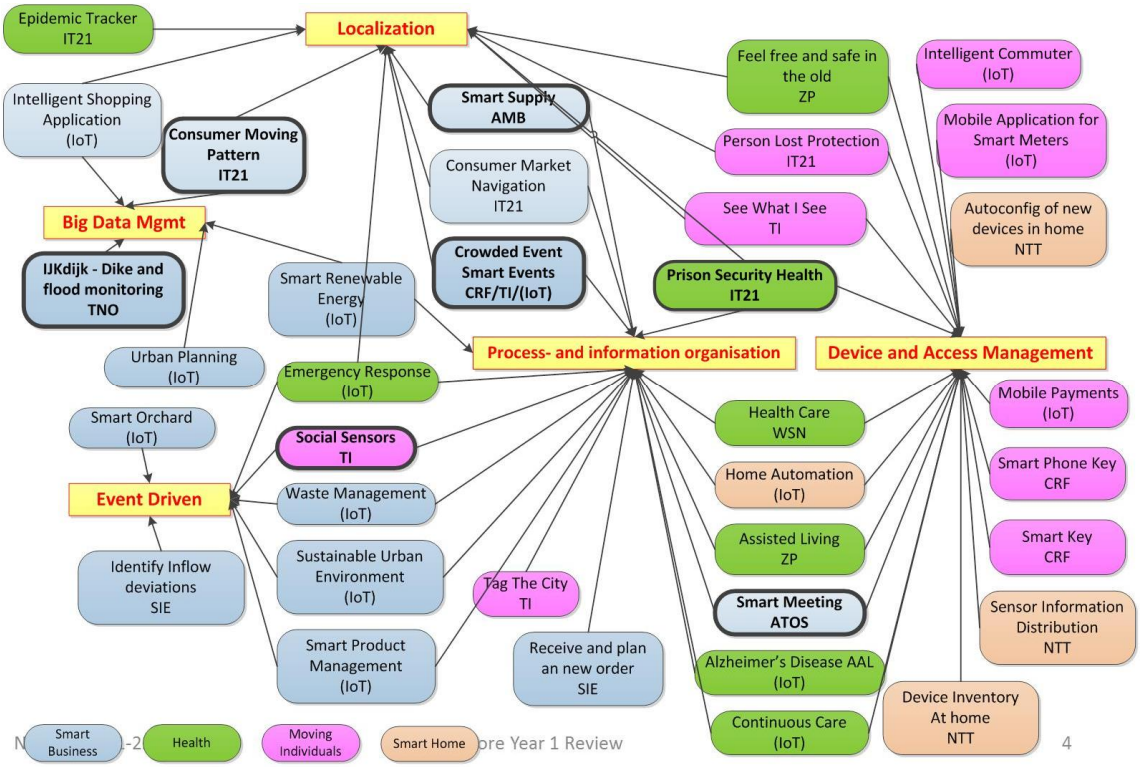
Business Roles



The benefits of programming or dynamically composing real world services and IoT applications are imaginary control rooms

This chapter is needed to understand how to create an iCore Value Proposition.

IoT as an imaginary control room



We have identified patterns in a number of typical IoT use cases:

- Localization – finding objects that meet criteria, in order to …
- Process- and information organisation – ensuring availability of information to facilitate decisions and make processes interoperable and executable and resilient, in order to …
- Device and access management – ensure availability and control of devices, in order to …
- Event driven – detect deviations from thresholds in order to execute processes or prevent certain situations, in order to …
- Big data management - detect patterns in data to identify developments, e.g. to predict certain situations, in order to …

All these patterns can be positioned in context of **the process to achieve some objective**. We generalize this to the control room

Typically in a control room processes, objects, KPIs etc. are being measured and monitored. If they reach certain thresholds then (to some extent predefined) measures are taken. Usually to make sure things run again **'as planned'**, **avoid risk**y situations or **reach objectives** (sales).

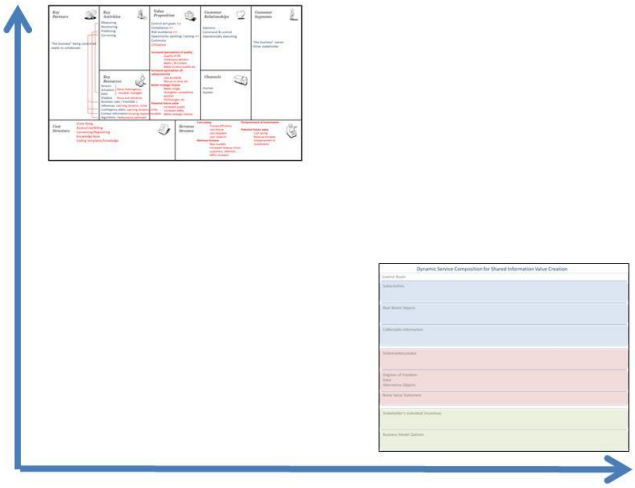
In other words IoT Use Cases can be put in context of measure and control loops.

Yes, identifying new opportunities should be considered part of a higher level objective (*request?*)

Broadening then deepening

"deepening" the application
Improving the business by modeling the business as a **control room**
Instantiate the *'Generalized Control Room'* business model in context of the business and indentify how the control of the business can be improved by enhancing the resources required.

Typical for existing applications and static stakeholder sets
iCore is a platform/system extension



"broadening" the application
Expanding the *degrees of freedom* available for optimization by modeling the business as a **dynamic/programmable service composition**
Instantiate the 'Dynamic Service Composition' canvas for the business objective and define the 'solution space'

Typically requires stakeholder collaboration and drives new applications and business models
iCore is a new platform or an extension of an existing one

"deepening" the application
Improving the business by modeling the business as a **control room**
Instantiate the *'Generalized Control Room'* business model in context of the business and indentify how the control of the business can be improved by enhancing the resources required.

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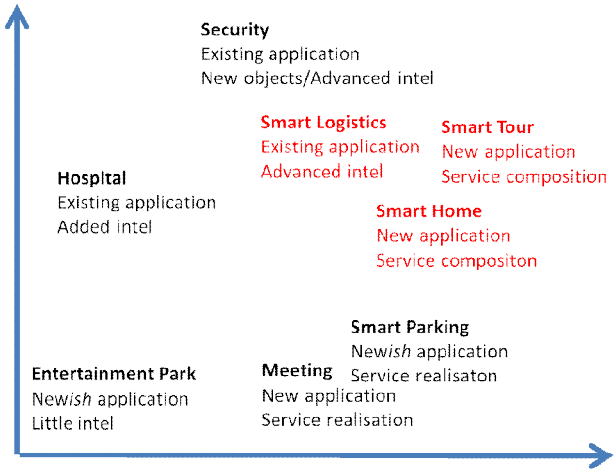


"broadening" the application
Expanding the *degrees of freedom* available for optimization by modeling the business as a **dynamic/programmable service composition**
Instantiate the 'Dynamic Service Composition' canvas for the business objective and define the 'solution space'

Typically requires stakeholder collaboration and drives new applications and business models
iCore is a new platform or an extension of an existing one

Broadening: Applying Dynamic Service Composition to real world service delivery

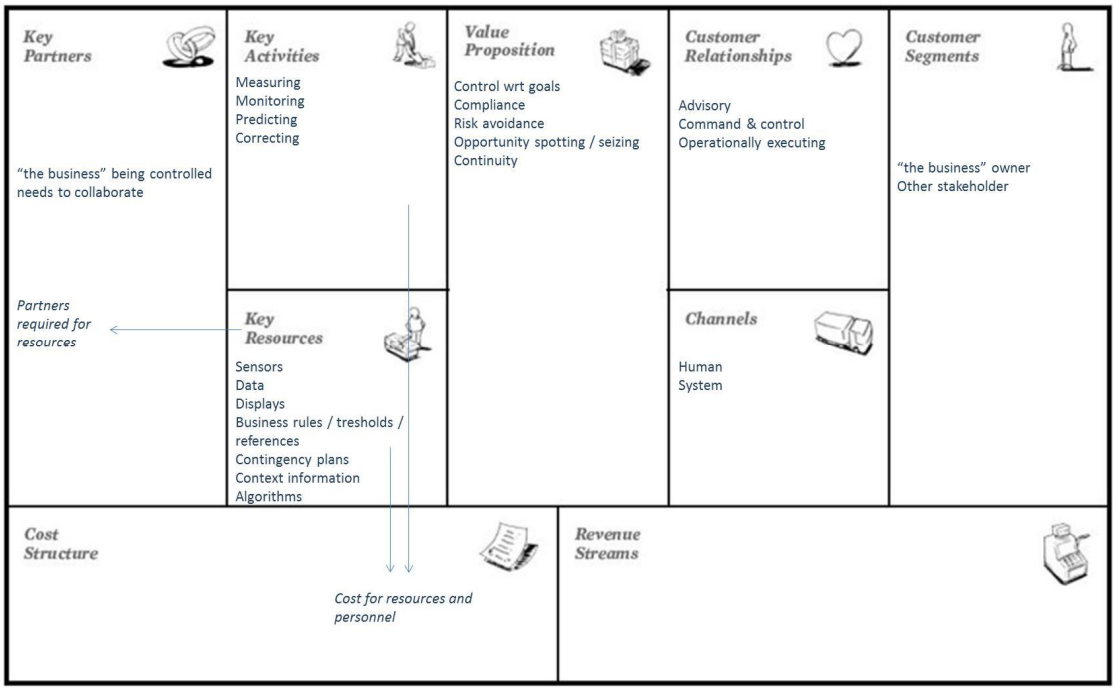
A procedure to identify the Value of iCore by means of broadening the scope and identifying 'degrees of freedom' by trying to see Dynamic (programmable) Service Composition concept to real world business processes.

1. Starting point: application
   Goal, activity, task,…. ➔ the control room and the business

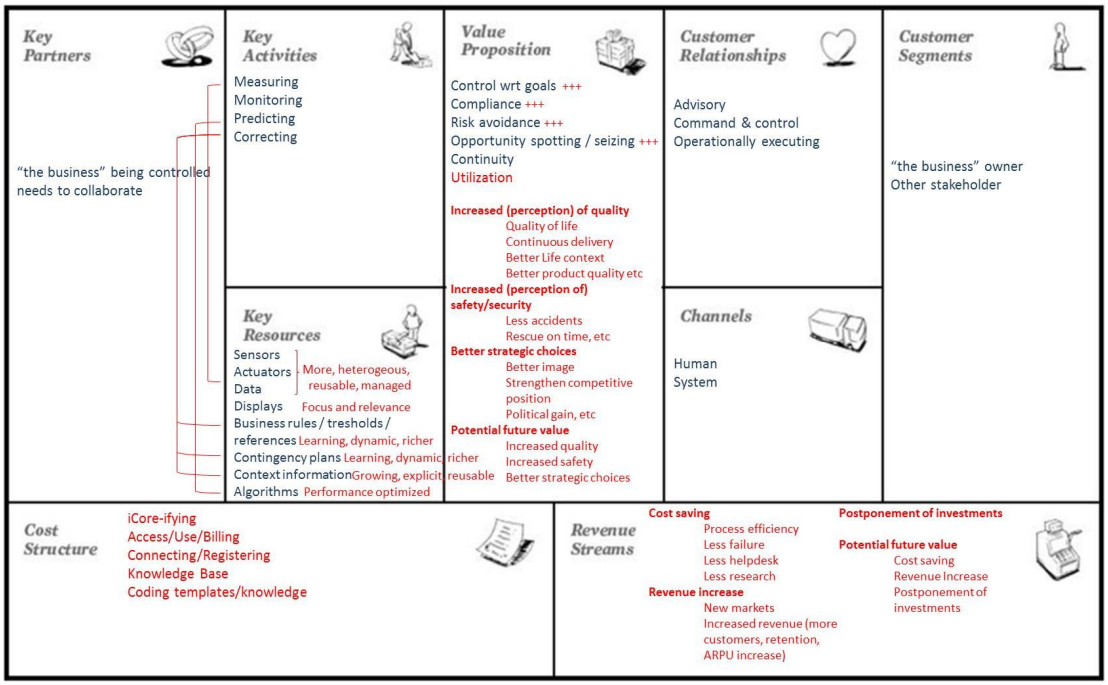
2. Subactivities (of the business process) 3. Related real world objects (classes) 4. Collectable Information (measurement)	Description
5. Stakeholders and stakes to optimize (control) 6. Increasing degrees of freedom – Data-based – Alternative objects 7. Naive Value Statement	Value creation
8. Stakeholder's individual incentives 9. Business Model Options 10. Evaluation	Value capturing

Deepening: Imaginary Control Room Business Model Canvas

What a control room looks like in general

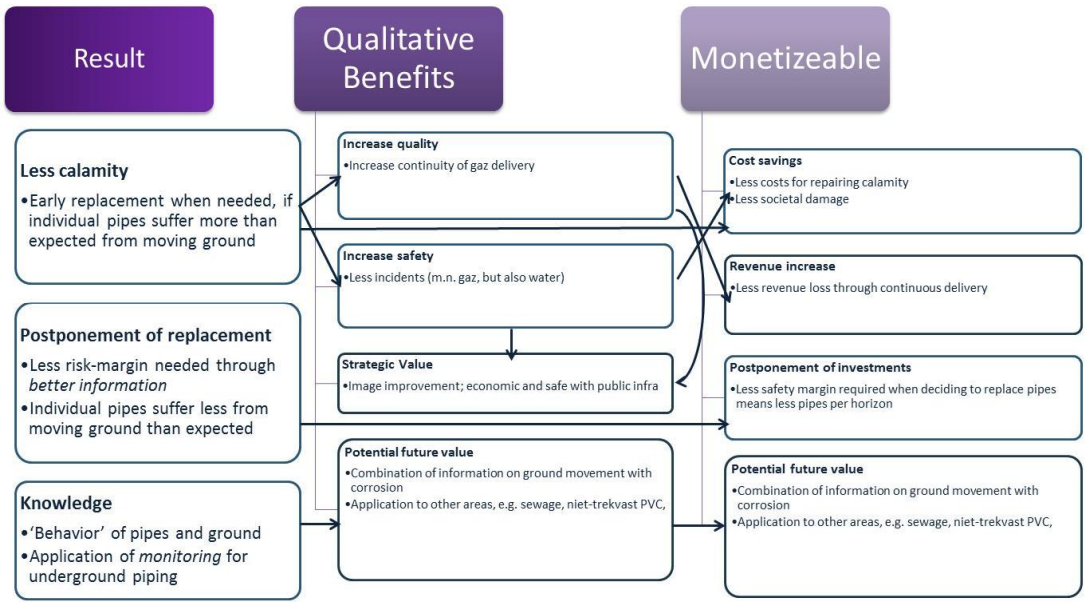


How a control room can be improved with iCore



Example of benefits

Below an example of how potential values of measuring the ground and the state of gas pipes in the ground can be translated into benefits for DSOs and eventually quantified in euros.



Value Proposition Canvas

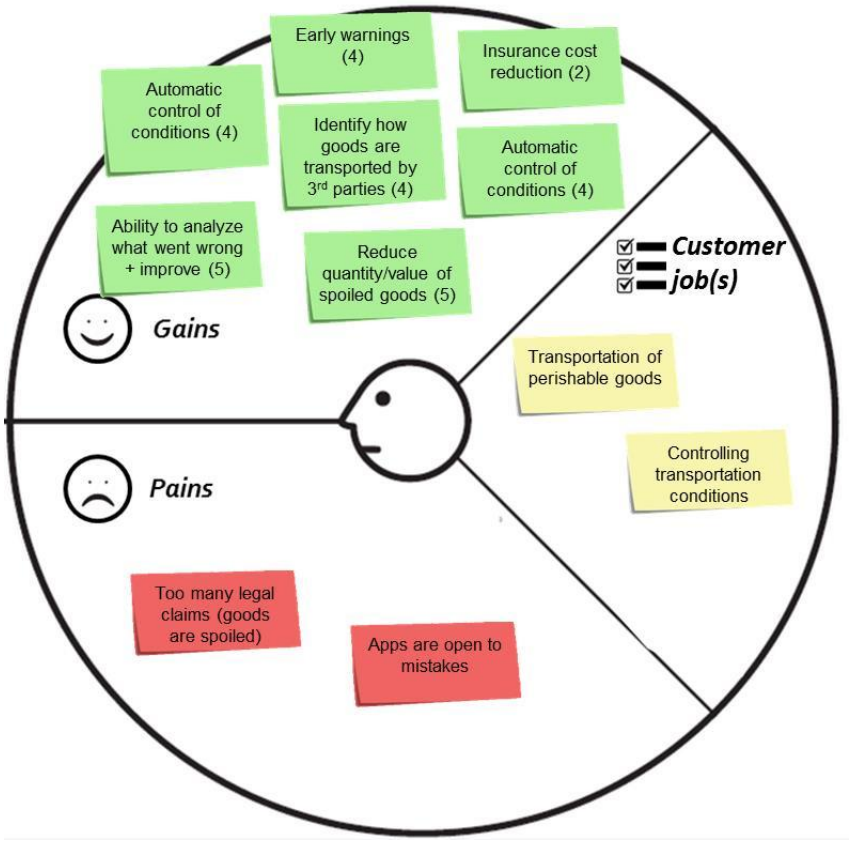
Link to previous sections: Why it is important to have a 'Dynamic Service Composition' and 'Imaginary Control Room' perspective on the stakeholder.

Please refer to *'iCore WP 1 - presentation workshop session approach.pptx'* for more details on applying the Value Proposition Canvas. This was used in the Brasov workshop. Output of those caroussel sessions were recorded in *'23052014 WP 1 Results Value Proposition Designer.pptx'* and *'Value Proposition_Carousel_20140605.pptx'* [link to iot-icore.eu]

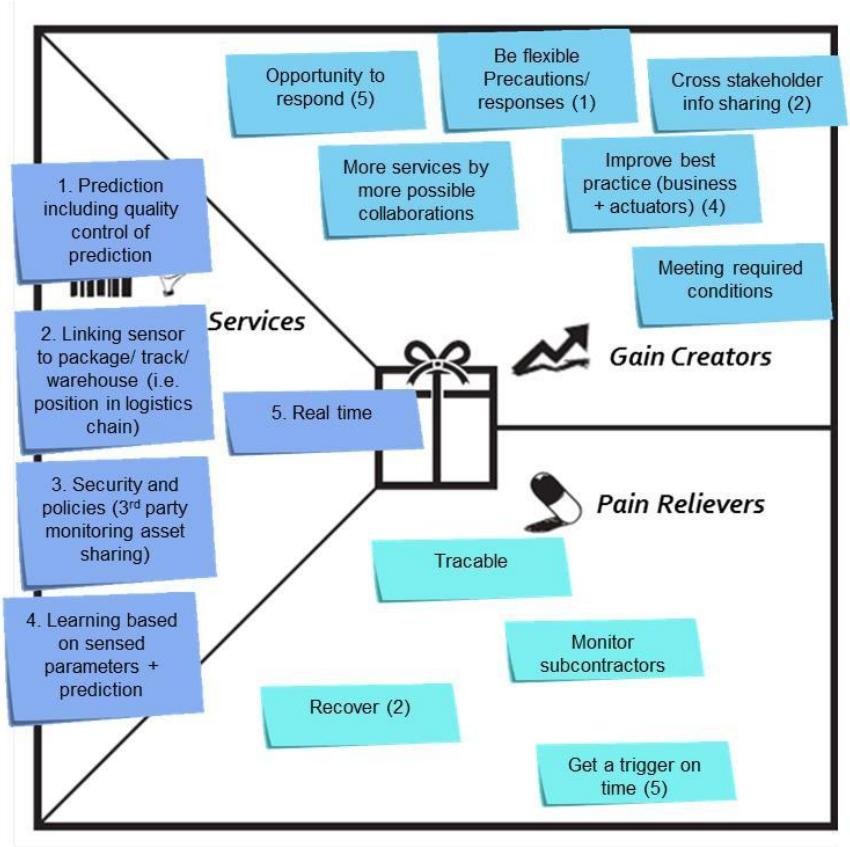
Identifying stakeholders

Stakeholder category	Specific stakeholder	Importance
Transport company		5
Clients of transport company	Medicine manufacturer, pharmacies	4
Service developers	BU Logistics & airport solutions Siemens	3
Data scientist		2
Logistics expert		2

Customer Jobs, Pains and Gains



Value Proposition



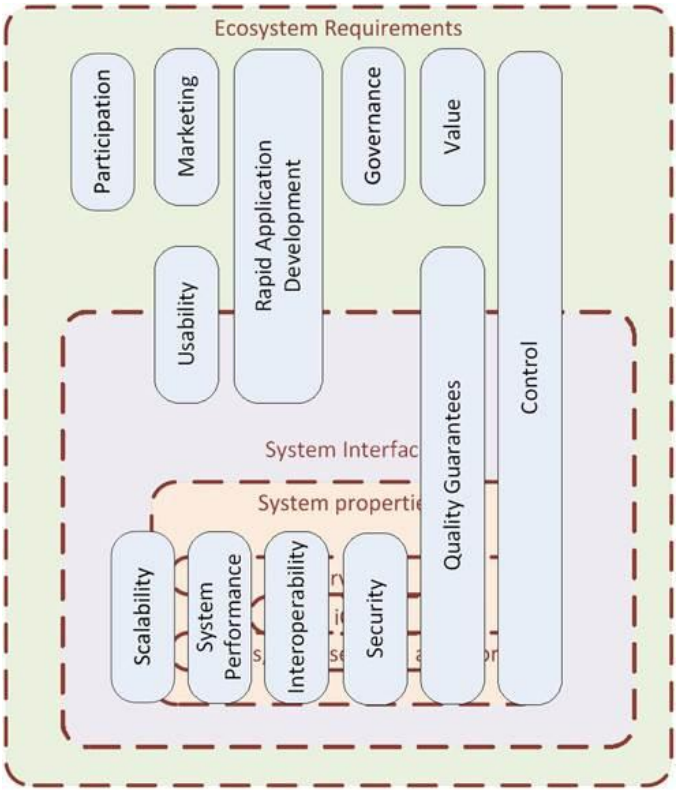
Value proposition as a Value Statement

"By iCore's capability of providing realtime status on logistics (including subcontractors), making predictions and improving them the Logistics Service company is able to monitor goods, provide evidence of compliance and respond timely to events and thereby preventing loss of goods"

Requirement classes

In Deliverable 1.2 we have identified a large number of socio-economic requirements inspired by a large set of IoT use cases (including the ones in scope of iCore) and by consulting a variety of stakeholders . These requirements have been integrated in WP2. In the graphic below we illustrate the clustering of these requirements. Below that you will find some explanation on how these clusters are addressed within iCore.

The purpose of this is to convince the stakeholder/interviewee that iCore has addressed these. We want to avoid that the stakeholder is distracted or concerned by unclarity on these issues. That would keep us from understanding the stakeholder's response to the iCore Value Proposition.



- System properties: issues that iCore in conjunction with the 'underlying' devices, data sources, sensor-and-actuator networks should address.
- System interface: refer to interaction of users with the broad system
- Ecosystem: configuration of the business ecosystem typically involves inter-organisational activities

Control

Control is addressed by setting access and use rights to data, objects and system level in terms of SecKit (a respective toolkit), information models (including appropriate info e.g. metadata) and governance model (identifying roles and rights).

Object Virtualization represents a means to have an optimized resource control and real-time data control.

Quality Guarantees

Quality guarantees is addressed by SLAs and their incorporation to the service execution request; service templates and their appropriate selection are also important; reconfiguration actions during service execution take place to ensure resilience and quality.

Security

Security is also addressed by the SecKit offering authentication and access control.

The possible integration of the security toolkit as provided by the partner JRC, provides the means to establish security control for the application and data access.

Interoperability

Interoperability is addressed through the existence of VO, a common representation of RWOs, and its reuse independently of domain and context (however taking into account the access rights). External to iCore devices, data streams, systems can be described and registered as VOs (we test such cases in IERC common demos).

The technical heterogeneity is hidden thereby facilitating the easy integration of any number of objects independently of the underlying technology (positioning sensors based on IEEE.15.4, accelerometers, embedded sensors e.g. light-pressure, etc.). This is accomplished by the use of the MQTT protocol, a standardized pub-sub messaging protocol for communicating with the IoT objects. It also ensures that the system remains scalable and easily interoperable, since the pub-sub works on a bus that allows actors to publish and subscribe with low effort.

System Performance

System performance, considering the system as a whole, is not something trivial to answer. I think that the inclusion of policies in iCore system and the representation of system performance criteria as policies can guide the system to optimize itself. Also, reconfiguration actions can take place due to systemic reasons.

Scalability

Scalability is ensured by the distributed VO registries, service templates, reuse of objects/service templates in various domains/contexts, approximation capability.

It also ensures that the system remains scalable and easily interoperable, since the pub-sub works on a bus that allows actors to publish and subscribe with low effort.

Cognitive management

The cognitive management framework provides useful features e.g. deriving knowledge from the real world data to be used to provide additional and improved services. e.g. semantic enrichment to enable contextual reasoning, situation modelling,etc.(e.g. building prediction models based on the real time object movement patterns using machine learning algorithms). It also provides the flexibility to extend these services to other use-cases and domains easily.

Service abstraction

With an explicit service requirements analysis with natural language processing features, it ensures the easy translation of user requirements. It provides the ability to define user policies(e.g. energy efficiency, accuracy) which can define the quality of the service delivered. Also from a data perspective, there are mechanisms which provides self-x features to improve the data reliability.

Usability

- A user-interface will be integrated which provides ease of access to the end users and ensures a wider reach to the potential interested parties. (Usability, out of Class req)

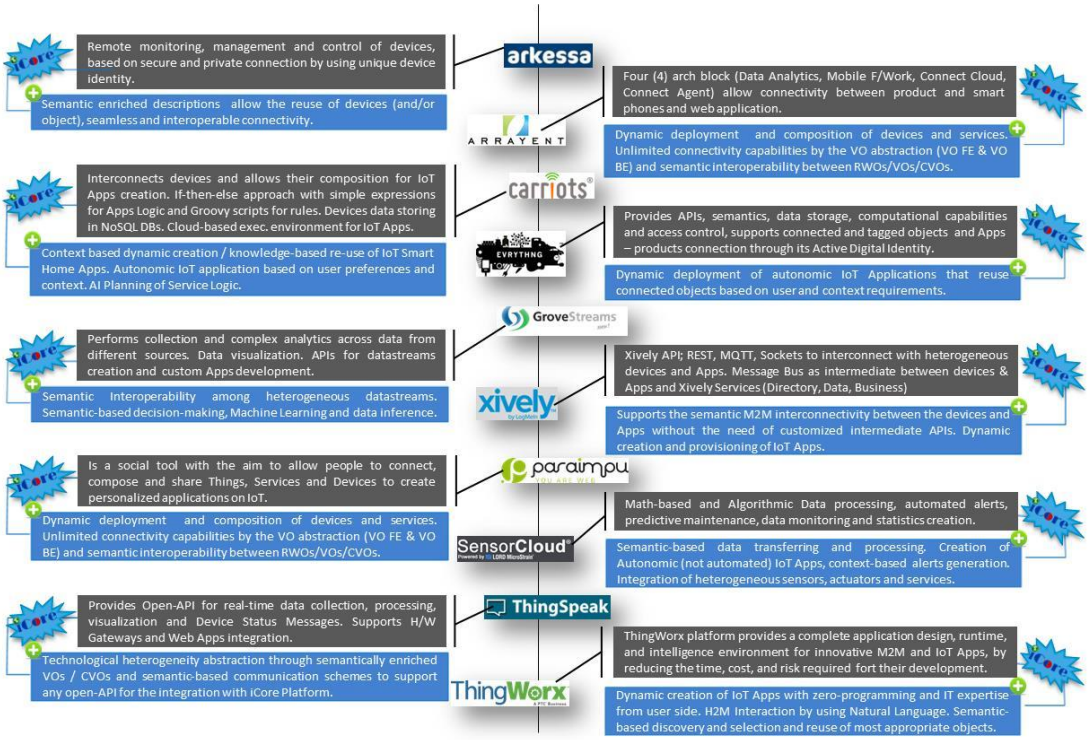
Existing solutions

Domain specific platforms

Please read D1.3 Vision of the future business ecosystem, new roles and models of acceptance, Chapter 4 on Existing Business Ecosystems (from p. 64)– for insights on the Use Case domain.

IoT platforms

This graph is taken from *'SmartHome_PoC_Implementation_20140516.pptx'* as prepared by UPRC.



Arkessa Platform. [Online]: http://www.arkessa.com/. Accessed: May 2014.

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Carriots cloud platform. [Online]: http://www.carriots.com/. Accessed: May 2014.

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Xively IoT Platform. [Online]: https://xively.com/. Accessed: May 2014.

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SensorCloud Platform. [Online]: http://sensorcloud.com. Accessed: May 2014.

Thingspeak Platform. [Online]: https://www.thingspeak.com/. Accessed: May 2014.

Thingworx Platform. [Online]: http://www.thingworx.com/. Accessed: May 2014.

8 ANNEX D – Smart Hospital HW/SW constraints

ETSI certification

Standardization is a key factor for single market and is needed for coexistence of various technologies sharing the same physical medium. Use of wireless technologies in different environment's needs to accord with actual regulation and legislation. ETSI, the European Telecommunications Standards Institute, produces standards for Information and Communications Technologies (ICT) that are used by national governments to enforce regulations. The standard "**EN 301 489-1** (v1.8.1) (**Council Directive 2004/108/EC** on Electromagnetic Compatibility) Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements" needs to be fulfilled to operate with radio equipment.

Manufacturer, that produces or import products inside the European Union have to certify their products and sign it with the CE logo of the "Communautès Europèennes". Therefore, it is needed to fulfil all terms of references. The manufacturer himself asserts conformance based on its compliance assessment.

Electromagnetic compatibility requirements

Indoor localization in ICore will make use of radiofrequencies (RF). In particular, the used technologies will be:

- ZigPos-RTLS: based on the IEEE 802.15.4 standard [57].

The usage of radio spectrum is regulated at the national, European and international level. All the technologies to be used in ICore for indoor localization purposes operate in the so-called ISM (Industrial, Scientific and Medical) bands.

The ISM bands are portions of the radio spectrum reserved internationally for the use of RF energy for industrial, scientific and medical purposes. Large portions of the ISM bands (and, in particular, those used within ICore) are unlicensed, i.e., no license is required to operate a device transmitting in such a band. Which implies, conversely, that devices may be operating in a harsh environment characterised by high levels of interference.

The ISM bands are defined by the ITU-R in 5.138, 5.150, and 5.280 of the Radio Regulations [60]. Individual countries' use of the bands designated in these sections may differ due to variations in national radio regulations. The bands in which the ICore enabling devices will transmit are available for unlicensed use in all countries where ICore pilots will be deployed.

In the EU, low power wireless devices are generally referred to as short-range devices (SRD). The allocation of frequency bands and their use in the EU are based on recommendations by the Electronic Communications Committee (ECC), which is part of the European Conference of Postal and Telecommunication Administration (CEPT). The ECC document covering SRD is ERC/REC 70-03. The 45 member countries of the CEPT must then adopt these recommendations into law for them to be binding, so there are occasionally differences between the member countries. No significant difference has been identified for the purposes of the ICore piloting activities.

ECC recommendation defines 13 different types of SRD applications. The SRD applications relevant for ICore are n.1, "*Non-specific Short Range Devices*" and n. 3, "*Local Area Networks, RLANs and HIPERLANs*". The ECC recommendation 70-03 defines both the maximum transmit power and limits to the duty cycle and the bandwidth of the transmitter for each allocated

frequency band. For example a limit of -10dB on the ERP (Effective Radiated Power) is required when operating in the band 2400MHz-2483.5 MHz, which is one of the bands in which ICore devices will operate.

Electromagnetic Compatibility (EMC) refers to the ability of a device to operate properly in its intended environment without producing excessive interference to other devices. All electronic devices must meet certain regulations regarding EMC. These regulations cover both intentional (for example, transmission signals) and non-intentional (electrical noise) radiation.

Other potential regulatory issues are induced radiation and RF exposure. Induced radiation refers to how well a device withstands unintentional radiation from an external source (e.g. high voltage line or microwave oven). RF exposure regulations, on the other hand, determine if the device emits radiation that is harmful to human beings. This is normally only a concern for high-power transmission devices, but there have been some concerns (yet to be proven) that long-term exposure to even low-levels of electromagnetic radiation could potentially result in cancer and other health problems. For devices that may be positioned within 20 cm of a human body, SAR (Specific Absorption Rate) testing is required to ensure radiation levels are below a certain limit. In Europe, compliance in terms of RF exposure for the kind of devices used within ICore is standardized as CENELEC EN 62479:2010, which has been made part of 2006/95/EC directive.

The procedure required to bring wireless equipment to the EU market is outlined in the Directive 199/5/EC of the European Parliament and of the Council (R&TTE - Radio and Telecommunications Terminal Equipment directive). The R&TTE directive is based on self-declaration, that is, the manufacturer who supplies wireless equipment to the market declares that the product satisfies the legal requirements. Basically, the entity that places the equipment on the market is responsible for its compliance.

The CE marking is a mandatory conformity marking for some categories of products sold within the European Economic Area (EEA). It consists of the CE-Logo and, if applicable, the four digit identification number of the notified body involved in the conformity assessment procedure. The CE marking states that the product is assessed before being placed on the market and meets EU safety, health and environmental protection requirements. Devices to be used in ICore should be required to be CE marked.

Medical devices (or operation in medical domain)

According to the **Directive 2007/47/EC** [61] amending Council Directive 93/42/EEC [62] “medical device means any instrument, apparatus, appliance, software, material or other article, whether used alone or in combination, including the software intended by its manufacturer to be used specifically for diagnostic and/or therapeutic purposes and necessary for its proper application, intended by the manufacturer to be used for human beings for the purpose of:

- Diagnosis, prevention, monitoring, treatment or alleviation of disease,
- Diagnosis, monitoring, treatment, alleviation of or compensation for an injury or handicap,
- Investigation, replacement or modification of the anatomy or of a physiological process,
- Control of conception,

and which does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its function by such means".

According to the same law, "devices shall be divide into Classes I, IIa, IIb and III. Classification shall carried out in accordance with Annex IX".

Certification

The CE marking indicates a product's compliance with EU legislation and so enables the free movement of products within the European market. It is mandatory according to the Directive 2007/47/EC amending Council Directive 93/42/EEC.

According to this Directive, the EC type-examination is "the procedure whereby a notified body ascertains and certifies that a representative sample of production covered fulfils the relevant provisions of the Directive".

"Member States shall presume compliance with the essential requirements referred to Article 3 in respect of devices which are in conformity with the relevant national standards adopted pursuant to the harmonized standards the references of which have been publishes in Official Journal of the European Communities; Member States shall publish the references of such publish the references of such national standards"

9 List of Acronyms and Abbreviations

Acronym	Meaning
C2	Control and Command
COP	Common Operational Picture
CVO	Composite Virtual Object
ECG	Electrocardiography
IoT	Internet of Things
ITS	Intelligent Transport Systems
OEM	Original Equipment Manufacturer
OODA	Observe Orient Decide and Act
RWK	Real World Knowledge
SK	System Knowledge
VIP	Very Important Person
VO	Virtual Object