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Hydra

Networked Embedded System middleware for
Heterogeneous physical devices in a distributed architecture

D12.6 Scenario Thinking Training

Integrated Project
SO 2.5.3 Embedded systems

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Index:

1. Introduction

Purpose and context of this deliverable

This deliverable is intended as a theoretical and practical training manual which enables external stakeholders to understand and employ the IDON method[1] in creating scenarios used to define end-user requirements. It thus forms part of the Hydra project's commitment to provide professional training material and sharing the project's experiences with external stakeholders.

The present training material is targeted at groups involved in conceptualising and developing highly complex end-user applications and deriving requirements in multi-stakeholder environments.

Scenarios are an extremely useful and important tool for specifying end-user requirements and subsystem functional, ethical and societal requirements. Scenarios also provide a framework for subsequent iterative requirement engineering phase and are thus a valuable tool for developers.

In addition to the present document, eLearning material may be developed using webcasting to demonstrate how the IDON method is carried out step-by-step in a scenario workshop.

Content of this deliverable

This document describes the Scenario Thinking Process using the IDON method to develop scenarios for user requirements purposes. It is part of WP12 Training.

Chapter 3 defines the aims of the Hydra training material and introduces the Hydra multimedia learning platform. The training methodology is traditional text based training material supplemented with eLearning using interactive webcasting of a scenario workshop.

Chapter 4 gives an overview of the process and purpose of Scenario Thinking in general.

The IDON method is described and explained in chapter 5 in the form of a step-by-step manual that guides the reader through the process – from workshop organisation to writing scenarios - using illustrative examples.

Chapter 6 describes the practical arrangements needed to successfully execute an IDON scenario workshop, including description on how to webcast a scenario workshop as part of the eLearning material.

Finally, chapter 7 provides a case study on how the Hydra project developed scenarios for the healthcare domain.

[1] The method is named after the use of "idons" in the process of mapping future domain factors to uncertainties. Hexagon Mapping is part of visual facilitation approach, which combines dynamic representation with creativity using visual idea representing units, called idons

2. Executive summary

Creating scenarios of end-user behaviour and interaction with platform functionality is an extremely useful instrument for identifying key technological, security, socio-economic and business drivers for end-user requirements in complex multi stake-holder applications. The scenarios can also provide the framework for subsequent iterative requirement engineering phases.

The Hydra project has derived a systematic formalisation of all relevant user requirements and subsystem functional, security and societal requirements from scenarios and storylines. Functional user requirements specifications involve the most important aspects of user expectations in the Hydra application domains. The scenarios also provide the framework for subsequent iterative requirement engineering phase.

Generally, using the IDON method will result in a set of scenarios that all points to alternative use cases within a given user domain and at a given point in time in the future. All scenarios will have the same frame of reference and – ideally – be equally likely to happen.

The IDON method consists of two parts: Scenario Development and Scenario Deployment.

The scenarios are developed in the *Scenario Development* part using experts and based on knowledge and systematic analysis. The aim is to develop a number of mind-challenging scenarios for each user domain by mixing inevitable trends with creative fiction.

In the *Scenario Deployment* part, technical experts and project decision makers interpret the scenarios and extract a framework for the functional, security, and socio-economic requirement specifications.

This document describes the IDON method to develop plausible scenarios step-by-step. It thus focuses on the Scenario Development part. The core of this part is to examine a set of wider environmental factors ambiguities and uncertainties in order to resolve, which role they are likely to play in the unfolding of scenarios.

The initial phase of the IDON method involves three steps: i) gathering environmental factors; ii) grouping them according to their degree of uncertainty; and iii) deciding their relative position on a two-dimensional grid. The quadrants in the grid allow us to sort the environmental factors into: pivotal uncertainties (Either/Or), Potential Jokers (Joker), Significant Trends (Trends) and Context Shapers (Scene).

The next phase in the IDON methodology deals only with factors of high uncertainty and direct impact on future trends. The uncertain factors are reformulated as "either / or" questions (flip/flop) and grouped into two main clusters according to connections and associations. Next, sub-clusters, or sub-plots, are created by grouping the questions in the main cluster into flip/flop statements.

Finally, the environmental factors are combined into four distinct possible future scenarios.

A sample healthcare scenario developed with IDON method in Hydra is provided for reference. It deals with health care professionals that are coping with an increased number of patients, as a result of demographic factors and the rising number of patients with chronic diseases. However, citizens demand timely, high quality care increasing the load on the already overloaded system. Even where ICT solutions exist for care and workflow improvements, many clinical procedures are still manual.

Equipment developers have a range of new technologies which can trace people's health status in real time, anywhere, anytime. However, even though healthcare professionals have a positive attitude to ICT, they tend to use ICT mainly in the form of diagnostic equipment and in patient administration to meet demands for cost control and efficiency.

3. Introduction to the training methodology

The current document is intended as a training manual in the use of the IDON Scenario Thinking method. It will thus give the reader a clear and concise description of the various steps in creating scenarios. It also includes an example of how scenarios for healthcare were created in the Hydra project, including the final scenarios, which helps to stimulate the reader's visualisation of the process and its end results.

Aims and objectives of the training

Accountable decision-making about future user requirements needs a high element of certainty - an adequate level of knowledge and confidence in our assumptions about that knowledge. But defining user requirements today is far more complex than ever before, taking place in a fast changing, highly uncertain information and technology driven environment. Compounding this, the illusive interlacing of shifting values and policies, social structures and behaviour increasingly undermine predictions on how the future will look. On their own, familiar planning and forecasting practices that have served us well in the past, cannot deliver the insights and answers we need now.

Scenario Thinking is not about predicting the future and, surprisingly enough, not about choosing the best way forward, though it is indeed a powerful and invaluable tool, which helps this. Its primary value lies in the development of new skills for improving the definition and planning of user requirements.

Developing and deploying these skills enables us to transcend the specific or localised circumstance solution, to go beyond short-term or one-off successes and acquire a consistency and robustness in coherent long-term user scenarios. We come to know the right questions to ask and where to look for missing pieces to the puzzle; how to spot unique opportunities and choose the best way forward.

The aims and objectives of providing the current training material on Scenario Thinking is to provide external stakeholder with a structured and efficient tool for developing various plausible scenarios that in turn have a specific set of user requirements. Being able to clearly define the user requirements is crucial for the development, as well as the implementation and user acceptance of new applications and technologies.

Introduction to Hydra

The Hydra project develops middleware for networked embedded systems that allows developers to create ambient intelligence applications. System developers are thus provided with tools for easily and securely integrating heterogeneous physical devices into interoperable distributed systems.

The middleware includes support for distributed as well as centralised architectures, cognition and context awareness, security and trust, and will be deployable on both new and existing networks of distributed wireless and wired devices that typically are resource constrained in terms of computing power, energy and memory. Hydra provides interoperable access to data, information and knowledge across heterogeneous platforms, including web services, and support true ambient intelligence for ubiquitous networked devices. Hydra middleware is based on a Service Oriented Architecture (SOA), to which the underlying communication layer is transparent.

Hydra uses one of many proven methods to derive requirements, i.e. the ISO 13407 "Human-centred design processes for interactive systems" standard. The reader is referred to the Hydra implementation of requirement engineering described in deliverable D2.9 Requirements engineering process revisited.

From the scenarios and storylines, a systematic formalisation of all relevant user requirements and subsystem functional, security and societal requirements will be derived. Functional user requirements specifications will involve the most important aspects of user expectations in the

chosen application domains. The scenarios also provide the framework for subsequent iterative requirement engineering phase.

Using the IDON method, four scenarios for each of the three chosen domains (Agriculture, Building Automation and Healthcare) were created that illustrate the Hydra project's functionality. End-user representatives will validate whether these vision scenarios capture their goals, tasks and context of use. The scenarios are visions of a future support and benefits of a system enhanced by the Hydra project for these user roles.

The Hydra multimedia eLearning platform

An important principle in the Hydra training is the establishment of a multimedia platform that allows for individualisation of learning processes, for information sharing and the capture of knowledge.

The multimedia platform can be used to webcast training sessions on the IDON Scenario Thinking Process. The training can be contextualised with timed slides presented during the workshop, and relevant teaching and reading material, which the trainee can download as the workshop progresses. Indexing of the workshop will allow the trainee to go back to a previous session to pick-up learning aspects or knowledge and thus radically enhancing the outcome of the training session.

Moreover, trainees may gather in groups to watch the webcasts together and form discussion groups on relevant topics covered by the training session. The platform allows the trainees to stop the webcasting to discuss certain aspects of the case, before resuming the transmission.

Finally, interactive tools are provided for immediate feedback in terms of polls and surveys which can be contextualised. The Hydra multimedia eLearning platform thus not only facilitates information and knowledge about Scenario Thinking and end-user requirements specifications, but it also enables the learner to comment on the knowledge presented. This annotation and analysis opens doors to adapting the knowledge analysed and to using it in new contexts.

The multimedia platform enhances situational learning and learning that may be adapted to culture, situation and learner abilities. The platform facilitates learning at different levels – depending on learner abilities and backgrounds, learner needs in terms of analysis and annotation of knowledge – and it is directly related to the trainees' need for methodologies and tools creating scenarios for end-user requirements specifications. Further information on webcasting as an eLearning tool can be found in chapter 7.

The Hydra eLearning Webcasting platform and video equipment for capturing the training session is made available by the partner IN-JET (see www.public-i.dk). The original Hydra scenario thinking workshops conducted at the start of the project were, however, not recorded on video so there is presently no training session to be presented as webcast. It is the aim that the first available external training session arranged by Hydra will be used to capture the process and present it as an eLearning session.

4. Scenario planning of the future

Midway upon the journey of our life I found myself within a forest dark, for the straightforward pathway had been lost.

(Dante Alighieri, La Divina Commedia, Inferno, 1306)

Accountable decision-making about future user requirements requires a high element of certainty - an adequate level of knowledge and confidence in our assumptions about that knowledge. But defining user requirements today is far more complex than ever before, taking place in a fast changing, highly uncertain information and technology driven environment.
Compounding this, the illusive interlacing of shifting values and policies, social structures and behaviour increasingly undermine predictions on how the future will look.

On their own, familiar planning and forecasting practices that have served us well in the past, cannot deliver the insights and answers we need now.

The process of Scenario Thinking (or Scenario Planning as it is sometimes called) is widely recognized as a tool for creating user requirements specifications under uncertainty. It essentially requires you to think from the outside in and takes you through a process that starts with creating context for the unknown.

The Scenario thinking process

The purpose of Scenario Thinking is to challenge the preconceived notions people have of the future, or their maps, and to afford people the flexibility to change those maps. The process is intended to open up the way you think about the future. However, Scenario Thinking is not about predicting the future and, surprisingly enough, not about choosing the best way forward, though it is indeed a powerful and invaluable tool, which helps this. Its primary value lies in the development of new skills for improving the definition and planning of user requirements.

Scenarios help identify threats, recognize opportunities and make choices about issues of strategic importance. Scenarios illuminate the possible, what might be. It asks you to do something a bit counterintuitive, which is to go beyond the known into the unknown, outside your expertise. Scenarios are snapshots of possible/alternative futures that help us plumb the uncertainty about the future. Scenarios provide coherent, comprehensive, internally consistent descriptions of plausible futures built on the imagined interaction of key trends.

In essence the Scenario Thinking process is designed to arrive at several parallel hypotheses about the future, which can be held at the same time. These hypotheses are given form and are able to be pictured by users by embedding them in a story or scenario. In turn this means that the same person can look at the evidence through different sets of glasses and see things in a different perspective.

The first step in Scenario Thinking is to fix ourselves firmly in the present. When thinking about the future, we do so within a context; a starting place or how things are now, gives rise to an opening array of ideas or facts, which in turn are related to some sense of a desired goal or objective for future user interaction.

As we convert this information into well defined stories of possible future situations and what our options for action in them are, we surface the inherent uncertainties facing us that need to be dealt with or overcome. An obvious fact often forgotten is that these uncertainties have sprung out of our original thinking, assumptions, omissions and commissions.

The quality and disposition of original input will strongly influence the flow of thought, handling of material and quality of output. In order to make the best use of scenarios it is important to clarify our intentions and identify the issues or areas to test with the multiple futures.

Using scenarios?

Scenarios are snapshots of possible/alternative futures that help us plumb the uncertainty inherent in the future. Scenarios provide coherent, comprehensive, internally consistent descriptions of plausible futures built on the imagined interaction of key trends. It essentially requires you to think from the outside in and takes you through a process that starts with creating context for the unknown.

As you read the scenarios, think about how you might answer each of these questions:

- Is this even remotely possible?
- Would the world be a better place in this scenario?
- If you were a user in this scenario, what would you be doing differently?
- If you knew for sure that this scenario was to come true, what would you as a user do now?

The Scenario Thinking process is designed to arrive at several parallel hypotheses about the future, which can be held at the same time. These hypotheses are given form and are able to be pictured by users by embedding them in a story or scenario. In turn this means that the same person can look at the evidence through different sets of glasses and see things in a different perspective.

IDON Scenario Thinking is based on the logical intuitive story-and-simulation approach to scenario thinking and was originally developed in consultation with Arie de Geus, author of "The Living Company" while head planning coordinator of Shell International.

Both the eu-DOMAIN and the Hydra project (under the 6th Framework Programme) have used the IDON method to systematically create plausible future scenarios as a tool for identifying key technological, security, socio-economic and business drivers for future end-user requirements.

In Hydra, a total of 12 scenarios for three different domains (Building Automation, Agriculture and Healthcare) were created to form the bases for a systematic formalisation of all relevant user requirements and subsystem functional, security and societal requirements. They provide a snapshot of end-user behaviour and interaction with the Hydra middleware. The scenarios also provide the framework for subsequent iterative requirement engineering phase and the validation of project outcome.

As pointed out above, the purpose of scenarios is to provide us with a snapshot of possible futures which in turn allow us to identify key drivers for future end-user requirements. The creation of scenarios shall therefore always be carried out in the initial stage of a project in order to ensure a valid framework for the subsequent iterative requirement engineering phase in the project.

5. The IDON method

Mapping approaches have received a great recognition in the education and business professional activities. Hexagon Mapping is part of visual facilitation approach, which combines dynamic representation with creativity using visual idea representing units, called idons. Idons afford manipulating, combining and rearranging as a continuous process of formulating thoughts. Hexagon mapping accepts some of the basic theoretical assumptions of system dynamic mapping and the principles of lateral thinking.

Having established the context of investigation, through a variety of information gathering techniques, dialogue and modelling methods, the knowledge is shaped into distinctive alternative stories of the future or scenarios.

The IDON method consists of two parts: Scenario Development and Scenario Deployment.

The scenarios are developed in the *Scenario Development* part using experts and based on knowledge and systematic analysis. The aim is to develop a number of mind-challenging scenarios for each user domain by mixing inevitable trends with creative fiction.

In the *Scenario Deployment* part, technical experts and project decision makers interpret the scenarios and extract a framework for the functional, security, and socio-economic requirement specifications.

This training focuses exclusively on the Scenario Development part.

IDON methodology

The entire IDON process will be explained in detail in this chapter and can be illustrated in this way:

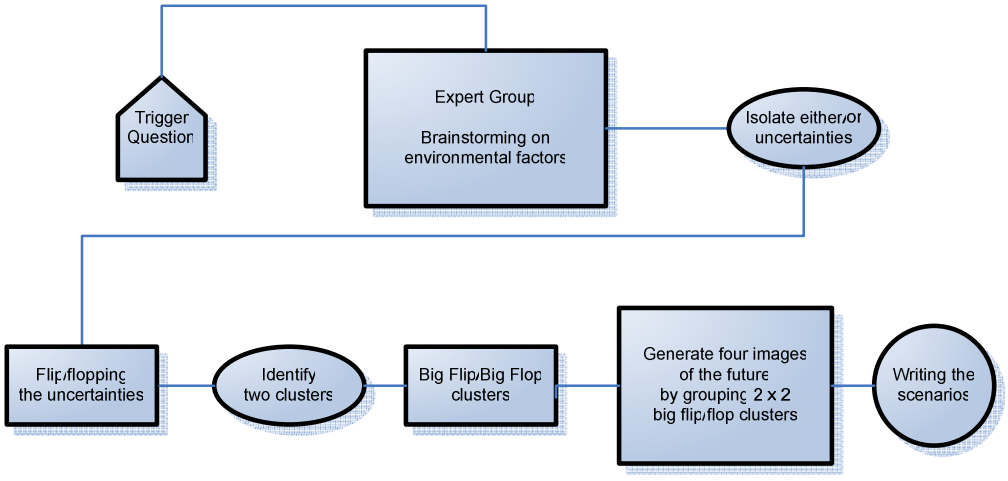


Figure 1: The IDON process

The initial phase of the IDON method involves three steps: i) gathering environmental factors; ii) grouping them according to their degree of uncertainty; and iii) deciding their relative position on a two-dimensional grid. The quadrants in the grid allow us to isolate the environmental factors of pivotal uncertainties.

The second phase in the IDON methodology deals only with factors of high uncertainty and direct impact on the appliations. This phase involves also three steps: i) the uncertain factors are reformulated as "either / or" questions (flip/flop); ii) they are grouped into two main clusters according to connections and associations; and iii) sub-clusters, or sub-plots, are created by grouping the questions in the main cluster into flip/flop statements.

In the third and final phase of the Scenario Development, the environmental factors are combined into four distinct possible future scenarios that all point to alternative use cases within a give user domain and at a given point in time. All scenarios will have the same frame of reference and – ideally – are equally likely to happen. Finally, the scenario team writes up the four different scenarios in narrative form so that they can be pictured by users and developers.

First phase execution – The Scenario Workshop part 1

The first phase of the IDON method involves three steps which are carried out with user domain experts during a workshop. After this workshop, a variety of environmental factors will have been identified, evaluated and ranked through the systematic approach of the IDON method.

This phase one constitutes the core of the IDON technique. Its purpose is to examine a wider set of environmental factors' ambiguities and uncertainties as identified by the group, in order to resolve which role they are likely to play in the unfolding of a variety of scenarios. The three steps are:

Scenarios must be created for all of the project's defined user domains as the user requirements specifications necessarily will differ depending on the domain. It is necessary to carry out the process of creating scenarios for each domain separately. This entails that scenario workshops must be organised for each domain. A full day is required for each workshop and the meeting room must be big enough to allow the participants to move around.

5.1.1 Defining the participants' roles in a Scenario Workshop

The first step when organising a scenario workshop is to identify all the relevant user-groups for each domain. This is essential as the scenarios are to be used to identify user requirements. For example, when creating scenarios for the healthcare domain, it is necessary to identify the various stakeholders/user-groups within the healthcare domain, e.g. medical professionals, healthcare administrators, healthcare technology developers, patient organisations and patients. The experts' roles are to define the trends in their field of expertise in relations to a set of predefined environmental factors.

Once identified, experts from all the user-groups are invited to participate in the scenario workshop informing them about the method that will be used to create the scenarios. Furthermore, the experts should be given a brief introduction to the IDON method at the workshop to allow them to understand the purpose of the workshop and the role they are expected to play. There should be between 5 and 10 experts in each scenario workshop in order to provide a good spread of expertise.

During the workshop, there obviously need to be a group moderator as well as 1-3 additional facilitators from the scenario team. The group moderator is responsible for running the workshop and for moderating the discussing to ensure that all environmental factors are discussed. The group moderator is also responsible for the final documentation and write-up of the scenarios.

5.1.2 Formulating the "Trigger Question"

To elicit responses from the experts, the moderator presents a Trigger Question at the workshop. Its purpose is to identify and group the environmental factors. The Trigger Question must be an open question about the future in order to trigger creative thoughts about the subject. It relates to the application domain in which the scenario thinking process is focuses. Possible Trigger Questions could be:

> *How do we develop and deploy intelligent, ubiquitous and secure networked products and services in buildings and facilities in 2015?*
>
> *How do we develop and deploy intelligent, ubiquitous and secure networked products and services for healthcare in 2015?*
>
> *How do we develop and deploy intelligent, ubiquitous and secure networked products and services in agriculture and the food industry in 2015?*

Trigger questions can also be very specific for a certain application domain or organisation:

How is energy saving products used in a pan-European network of services in 2020?

How do we perform cardio-vascular risk management in high-risk diabetes groups in the community in 2020?

The group moderator and the facilitators should prepare additional trigger questions to support the main Trigger Question in order to ensure that the discussion continues to flow. The facilitators' main role is to make notes of all the thoughts that arise. These should be noted down on note cards in the form of short, to the point statements.

5.1.3 Identifying environmental factors

Step 1: Gathering environmental factors

Identifying the environmental factors is a key step and it is important that the Trigger Question is considered in terms of all the defined environmental factors because it allows us to think about the Trigger Question – and the future – from a variety of perspectives.

The group moderator initiates a discussion in the workshop based on the Trigger Question and urges the participants to think creatively about the environmental factors in relation to the subject.

Some of the groups of environmental factors that might be covered in the discussion process are:

- research and technology trends
- institutional and market trends
- social values and life-styles
- economic futures
- management and delivery systems
- ethical and value questions
- global political influences
- ecological and environmental issues

The group moderator is responsible for ensuring the group considers all the environmental factors in relation to the Trigger Question, and that these thoughts are noted down. There should be a well balanced number of notes for each environmental factor; 4-5 statements (as put on note cards) for each environmental factor as a minimum.

All statements presented by the experts are noted down on note cards by the 1-3 facilitators from scenario team. It is important that the group moderator can be fully concentrated on moderating (and maybe take part) in the discussion among the experts. Therefore, the facilitators play an important role in capturing the various environmental factors that are presented during the discussion. If more facilitators are active, they will most likely capture the same environmental factor more than once, but this is normal. A process of cleaning up will later remove the duplicates.

Environmental factors are noted on paper note cards. Each environmental factor is described in very few (1-4) words. - resist the attempt to write a long description. This is not the purpose here but will be needed for clustering of factors later, so a description on the back of the card could be useful. Some examples of note cards are shown here:

It is possible to use coloured note cards with each colour representing a specific group. The advantage of this is that the moderator always has a overview of how and if each of the groups have been properly addressed. The drawback is that it undoubtedly leads to errors and distracts the facilitators from the more important task of capturing the factors correctly. I better option is to mark

each note card with a sign or a letter for each environmental factor group after the process (M for "market", E for "environment", etc.).

It is essential for the subsequent flip/flopping that each environmental factor consists of one and only one statement. A statement like: "Energy efficient buildings with collaborative working environments" does not have a single flip or flop. Rather, the statement should be broken down on two environmental factors: "Energy efficient buildings" and "Collaborative working environments".

It is also important that you omit subjective qualifiers for the environment. The only thing that is need now is to capture the factor; not value it. For example, do not use "Collaborative working environments will be needed in the future", even if this was what the experts discussed. Just write "Collaborative working environments". The qualification is part of the flip/flop process. There may be a certain uncertainty about this statement, and the flip/flop will extract two statements from it: "Collaborative working environments will be a must in the future" and "Collaborative working environments will not be needed in the future".

As the environmental factors are captured by the facilitators, they are placed on one or more whiteboard in the room in any order.

It is recommended that you spend sufficient time for this step, since it is the most important one for eliciting knowledge from the experts. A good starting point for making rich scenarios requires that you collect between 60 and 80 environmental factors distributed across all groups. You can easily plan for 3 hours for this work.

Step 2: Positioning environmental factors on a grid

The next step of the process is to group all the environmental factors according to their degree of certainty/uncertainty and direct/indirect impact on the proposed application or product.

During the discussion, it has transpired that the experts show varying degree of certainty of whether an environmental factor will materialise in one way or the other in the future. Take the technology factor "Availability of Internet". Most experts will agree that it is pretty certain that the Internet will be available also in the time span of the Trigger Question. This environmental factor has a high degree of certainty. On the other hand, the factor "Cost of Internet" may be much more uncertain. Will Internet information continue to be "free" or will there be payment imposed? This environmental factor will have a high uncertainty.

The second question to ask for each environmental factor is, whether it has a direct or an indirect impact on the application or product. If we are thinking of the future of an internet based service, obviously the environmental factor "Availability of Internet" will have a direct impact. So will the factor "Cost of Internet". But a political environmental factor such as "Censorship of Internet" may have an indirect impact on the service domain we are analysing.

The matrix will looks something like the next page, when environmental factors are being grouped according to the certainty and impact criteria. Note that uncertainty is upwards. This means that those environmental factors that are really interesting will be in the upper right quadrant: Highly uncertain and having a direct impact on the application.

High UNCERTAINTY

Joker

Either/or

€ Cost of communication

E Quality of water

Indirect Impact

Direct Impact

M Intelligent buildings

Scene

Trends

High CERTAINTY

The dimensions of the grid are introduced without interpretation at this point (interpretation only begins at the scenario building phase, see below).

The workshop participants will be asked to step up to the whiteboard and sort the captured environmental factors according to these criteria. The goal is to sort the different environmental factors, placing them on the grid, where the participants feel they best belong. The grid should be big enough to allow all the note cards to be placed so they can all be seen clearly. Experts may work independently or in smaller groups. It is likely, that some environmental factors will be moved several times back and forth.

Each environmental factor is taken in turn and its position discussed and provisionally fixed according to its perceived "Higher" or "Lower" degree of uncertainty and "Indirect" and "Direct" impact in the user cases. Note that absolute positioning is not the point; it is the relative positioning that is important.

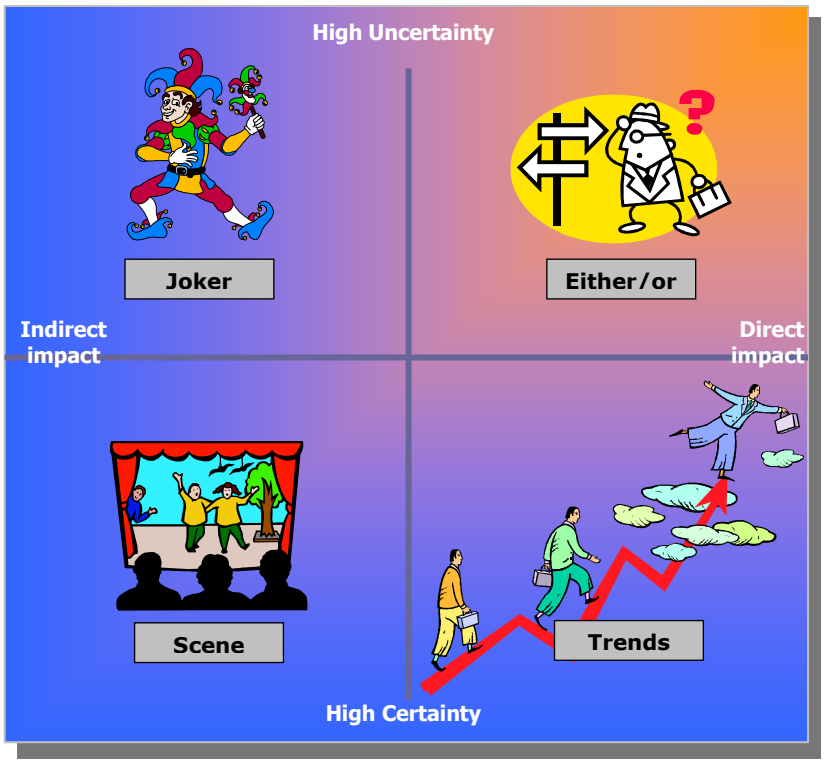
It is very likely that participants will disagree as to where a specific factor ought to be placed on the grid. In this case, participants should be allowed to discuss the matter and come to an agreement on where to place the factor. The group moderator may need intervene in the discussion and may either try to mediate a consensus between the disagreeing or decide to save the factor in question for a group review once all the note cards/factors have been positioned. It may also be necessary to re-phrase some environmental factors in order to make them fit into the grouping.

Step 3: Survey all factors

When all the factors have been placed in position, the whole set is reviewed by the group and fine adjustments is made in relative positioning.

5.1.4 Isolate either/or uncertainties

The positioning of the environmental factors on the grid will guide us in the writing up of the scenarios. Each quadrant has a different interpretation but there is no sharp line of distinction either vertical or horizontal. The behaviour of each quadrant in broad terms is as follows:



Top - right: Pivotal uncertainties (Either/Or)

These factors are likely to have a direct impact on the user cases, but their outcome is uncertain. They are pivotal in the sense that the way they turn out may have strong directional consequences. These factors will determine the shape of the different scenarios. In the workshop, participants will only focus on the factors in the "Either/Or" quadrant.

Top - left: Potential jokers (Joker)

These factors are pretty uncertain as to their outcome and maybe also less relevant to the user cases. However, it could be dangerous to treat them as merely noise. They represent factors that should be monitored in case they move strongly to the right, i.e. develops a direct impact on the application.

Bottom - right: Significant trends (Trends)

These factors impact more directly on the application and it should be possible to anticipate their effect.

Bottom - left: Context shapers (Scene)

These are relatively certain factors and are bound to shape the future context.

In the scenario building we are going to explore the uncertainties from the "Either/Or" quadrant to derive a set of different scenarios for the user cases. Each scenario will thus reflect the uncertainties attached to those environmental factors that have been grouped in this quadrant.

The environmental factors grouped in the other quadrants will be retained for reference and inclusion in the final stage of writing up the scenarios in the following ways:

- The factors in the scene quadrant (the context shapers) are those that should be woven into every scenario, if it is written up fully. These factors will be used to describe a common scene for all scenarios.
- The significant trends will also run through each scenario but in a manner, in which they manifest, will be different in each one. The factors in this quadrant can be said to constitute different sets placed on the scene.
- The potential jokers are useful factors to bring into the scenarios during the process, if the scenarios are starting to become too uniform.

Second phase execution – The Scenario Workshop part 2

The second phase deals only with factors of high uncertainty and direct impact. This phase involves also three steps: i) the uncertain factors are reformulated as "either / or" questions (flip/flop); ii) they are grouped into two main clusters according to connections and associations; and iii) sub-clusters, or sub-plots, are created by grouping the questions in the main cluster into flip/flop statements.

Scenarios can be thought of simply having three levels. At base level there are the context shapers, which seem pretty inevitable and will tend to underpin all scenarios at a given time – these are changes that are common throughout like the *stage* in a theatre.

At the intermediate level there are trends and these can be quite complex because of the variety of ways they can interact with each other. These will be modified from scenario to scenario but still retain their basic condition. These can be likened to the changing scenery in a play.

At the differentiated level, each scenario has some unique variances. These differences arise from the uncertainties we perceive. An uncertainty about something means that at least things could go this way or go the other way. Uncertainties may be main line or they may be jokers.

As these uncertainties interact in different ways that affect how things turn out, the combinations of even twenty variables are astronomic. We need a way to simplify this information, without diluting its impact, into different emergent stories of the future. These may be perceived as the different

dramas that might be put on in a theatre. In order to do this we go through the following stages in creating prototype scenarios from which a full set of scenarios can be developed.

5.1.5 Flip/flopping the uncertainties

Looking at the factors in the quadrant marked "Either/Or", participants are invited to think of each one as an uncertainty question for which there are two possible outcomes. The questions have to be phrased in a way so that the outcome state (i.e. the answer) is either positive ("flip") or negative ("flop"). Remember that some jokers may be added as uncertainties to avoid that the scenarios become too uniform.

An example may illustrate the technique. Assume that the group is working on writing scenarios in a teaching environment. When we flip/flop the first question "How will the price of education develop in the future?" we get the following two statements: "Yes, education will be affordable" (flip) "No, education will not be affordable" (flop). When the factor in question has either "flipped" or "flopped", the uncertainty is resolved.

The results should be put in a table as exemplified below as this gives a good overview of the flip/flop results. The left-hand column lists the questions/factors that were phrased based on the environmental factors (as written on the note cards that were positioned in the quadrant "Either/Or"). The right-hand column then lists the "flipping/flopping" of each environmental question.

Price of education How will the price of education develop in the future?	+	Education will continue to be affordable
	-	Education will become relatively more expensive than today
Access to information How accessible will information be?	+	Easy access to information
	-	Difficult to get access to information
Media types Which media type will proliferate?	+	Electronic media dominates
	-	Traditional media will be retained
Mobility How will people move around?	+	Commuting will be increasingly difficult
	-	Mobility will increase
Equipment Will people have access to the necessary equipment?	+	Access to learning equipment is facilitated
	-	Equipment is only available to few
Learning method What will be the dominant leaning method?	+	Emphasis on individual learning
	-	Emphasis on shared learning
Organizational How will organizational learning evolve?	+	No take-up of organizational learning
	-	Adoption of organizational learning
Collaboration Will people collaborate with co-workers?	+	Minimal collaboration
	-	Collaborative thinking at work
Feedback What kind of feedback is available?	+	Poor feedback systems
	-	Effective feedback systems
	-	Global pressure for "best in class"

5.1.6 Identifying two clusters

The participants will now search for connections and associations between the various environmental factors (uncertainties). Uncertainty areas connect because of the impact of their influence of each other, either because if one "flips" the other will "flop" or because they are likely to align by association. This is a kind of domino effect. The group will continue to work with the associations until there are two main clusters or at least two priority clusters out of a set.

In the example above there are 10 environmental factors (uncertainties) of which the first 5 have to do with how people will approach learning ("Learning Location"). The remaining five can be said to relate to the "Learning Culture". It is thus possible to set up the two main clusters as follows:

Cluster One: Learning Location	**Cluster Two: Learning Culture**
• Price of education • Access to information • Media types • Mobility • Equipment	• Learning method • Organizational • Collaboration • Feedback • Global pressure

5.1.7 Naming Big Flip / Big Flop clusters

In the clusters we now have groups of questions. When one if the uncertainty questions resolves to, say, a "flip" side, it will tend to correlate with the "flip" side of all the other uncertainties in that cluster. This will end up resolving the entire cluster as a large scale "flip" or "flop". It is rather like a group of little magnets organizing themselves to a main North-pole and South-pole.

The two outcomes of the whole cluster are called sub-plots, which will combine in different ways according to the "flip/flop" questions to give us different scenarios.

In the example we can now group the uncertainties in the "Learning Location" cluster as big "flips" and "flops":

Big Flip Cluster "Learning Location"	**Big Flop Cluster "Learning Location"**
• Education affordable • Easy access to information • Electronic media dominates • Commuting increasingly difficult • Access to learning equipment	• Education will be expensive • Difficult to access information • Traditional media retained • Mobility will increase • Equipment only for the few
leads to the name:	leads to the name:
REMOTE LEARNING	**LOCAL LEARNING**

In a similar way we can group the "Learning Culture" cluster:

Big Flip Cluster "Learning Culture"	**Big Flop Cluster "Learning Culture"**
• Emphasis on individual learning • No up-take of organizational learning • Minimal collaboration • Poor feedback system • Global pressure reducing	• Emphasis on shared learning • Adoption of organizational learning • Collaborative thinking at work • Effective feedback system • Global pressure for best in class
leads to the name:	leads to the name:
INDIVIDUALISM DOMINATES	**CORPORATISM DOMINATES**

Each name needs to express a coherent alternative view of the combined uncertainties – more than simply "good" or "bad" but suggestive of how things might develop. They should be imaginative and evocative, like good chapter headings of a novel, as well as easy to remember so that they can be used to quickly identify a tremendously complex set of future uncertainties in a large number of environmental factors.

The last two steps may in some cases prove to be too complicated to perform during the workshop. They require substantial insight into the IDON methodology and may not be suitable for a large group. The moderator may thus decide to call the end to the workshop and perform the clustering analysis and flip/flopping with just the scenario team and/or other relevant partners.

Third phase execution – Post Workshop analysis and scenario writing

In the third and final phase of the Scenario Development, the environmental factors are combined into four distinct possible future scenarios that all point to alternative use cases within a give user domain and at a given point in time. All scenarios will have the same frame of reference and – ideally – are equally likely to happen. Finally, the scenario team writes up the four different scenarios in narrative form so that they can be pictured by users and developers.

5.1.8 Generating and Naming Scenario Structures

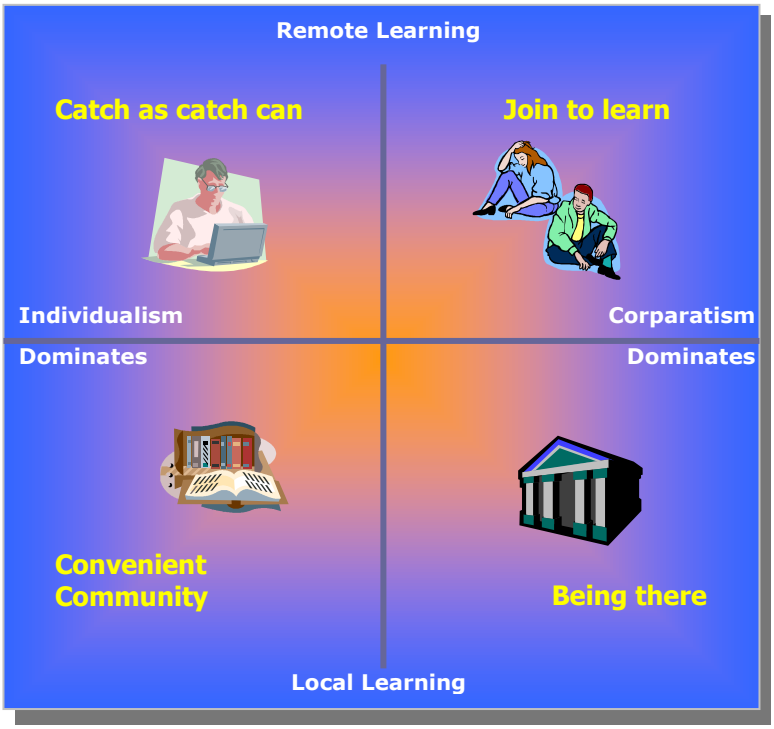
When the subplots have been generated using the "flip-flop" method, they need to be combined to form scenario structures. On the one hand this is a logical process in which there are a set number of combinations statistically, i.e. four possible combinations. On the other hand, it is an intense exercise of imagination and judgment where the participants are challenged to synthesize each set of combinations to formulate scenario stories, which are stimulating and relevant to the thinking task. The purpose of this is to arrive at creating four scenarios generated from the two clusters, each of which has two states or sub-plots. The titles of these scenarios will represent four distinct possible futures extrapolated from the thinking done by the group and will hold rich meanings, which can be further fleshed out when the scenarios are written up after the exercise is completed.

The four outcomes from the two clusters can be combined in four different ways to form images of the future. In our example, the possible combinations are as follows:

1. Remote Learning + Individualism Dominates
2. Remote Learning + Corporatism Dominates
3. Local Learning + Individualism Dominates
4. Local Learning + Corporatism Dominates

Combination number 1 consists of the two flip clusters, number 2 and 3 each consist of a flip and a flop cluster, and number 4 consists of two flop clusters. We can thus see clearly here how it is possible to use the environmental factors defined as pivotal uncertainties (those in the Either/Or quadrant) to derive at four distinct future scenarios, but each equally plausible.

The group now uses their imagination to form a mental picture of the world that emerges within each of the four combinations and formulate a provisional title for that world. The result will be presented in a two dimensional grid like this:



This last step in the scenario building concludes the objectives of the scenario workshop and the group moderator now has a structured framework to begin the writing up of the four different scenarios.

5.1.9 Writing Up Scenarios

Having followed the steps described above, we now have a clear structure on which to begin writing the scenarios. It is now also time to use the environmental factors that were positioned in the other three quadrants on the grid, i.e. the scene, the trends and the joker (see also chapters 6.4.1 and 6.4.2).

Step 1: Development of the scene

When a scenario is written, the writers start with the scene, which is common for all scenarios. The elements for defining the scenes are found in the lower left "Scene" quadrant of the original grid of environmental factors. The scene must reflect the basic characteristics of the user area, for which the scenarios have been developed.

Step 2: Building the set

The environmental factors in the lower right "Trend" quadrant constitute the changing sets that are built on the scene for each scenario. Trends have a direct influence on the story in the scenario, but only the environmental factors that are relevant to the scenario are used.

Step 3: Defining the script

In the final step, the script is written from the prototype scenario so that the scenarios come to life as imaginative plays.

In writing the scenarios, it is useful to let the environmental factors enter the scene, set or script according to a simple grouping:

1. What is happening?
2. How is it happening?
3. Why is it happening?

The final scenarios may be illustrated with pictures to stimulate the reader's imagination.

It is advisable to begin the writing up process shortly after the workshop.

6. Executing the IDON method

This chapter takes you through a series of physical and preparatory steps required to perform the IDON methodology in your own organisation.

The IDON method is performed in a moderated workshop. It is necessary to carefully plan and execute the workshop in order to gain full benefit from the participating experts.

A suggestion for the agenda for the IDON workshop is provided in Appendix A. A PowerPoint presentation has been developed, which you can use to present the IDON method. You can add your own domain specific slides to introduce the domain and the trigger question to the experts. An outline of the presentation is attached as Appendix B.

Physical environment and requirements checklist

The venue for the scenario workshop should be big enough to allow participants to move freely around, e.g. when placing the environmental factors on the grid.

The Trigger Question must be formulated by the group moderator prior to the workshop.

A brief PowerPoint presentation of the IDON method, the project and the user domain in question should also be prepared and presented by the group moderator.

The following requisites are necessary:

- One or more large whiteboard
- A large number of note cards
- Blu-Tack or sticky tack that allow for easy sticking/removing of the note cards
- Whiteboard marker pens
- A projector

Attendance Tools

The names, functions, organisational affiliation, as well as contact details and a short bio of each participant should be prepared and made available for the other participants.

Also, large name signs with affiliation should be provided.

Webcasting

The Hydra multimedia training platform will be based by an existing recording studio equipment and webcasting platform provided by the partner IN-JET. IN-JET possesses both recording and production equipment, which will be used for the multimedia production in Hydra. Hosting will be provided at a cost.

The public-i system wraps functionality and context around the streaming media technology in a dedicated player, i.e. a web browser that contains multimedia content. By wrapping contextual information both textual and graphical - around the encoded live video stream, we are able to offer a far richer learning experience. The architecture is open, making use of web services and XML to facilitate data exchange. This means that it is simple to plug in 3rd party content and functionality as part of the eLearning platform. An example of the dedicated player is shown in Figure

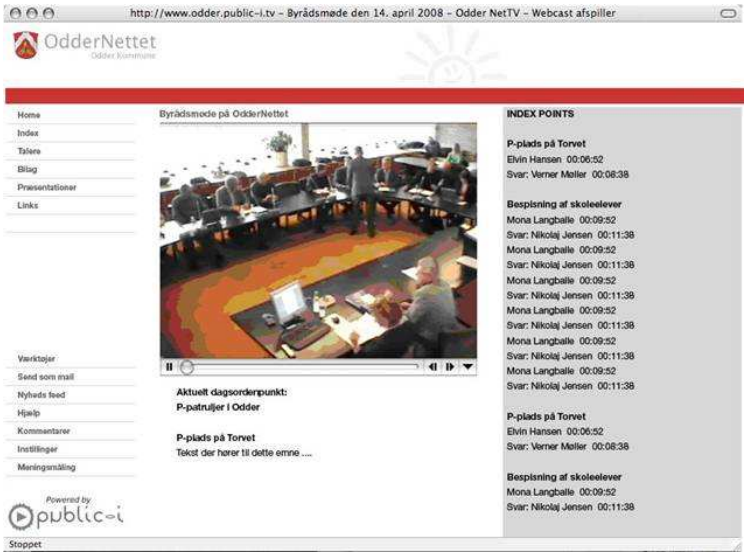


Figure 2 Example of contextualised webcast for eLearning

The system is based on a client / server architecture. The client encoder PC (provided by IN-JET) is used to capture and encode the training sessions. The encoded content is streamed alongside live contextual information such as slides, names and bios of the participants. Client encoder settings are synchronized with the central server database which stores all webcast and system data.

Unlike the majority of live webcasts that involve the use of camera crews to capture an event's content, the public-i system simplifies this process by the use of cameras remotely-controlled from the encoder PCs.

Multimedia eLearning environment and checklist

The following requirements apply to training sessions conducted in and on-line eLearning environment.

In order to provide a rich learning experience, it is important that a learning plan is created and the contextual information is provided before the training session starts.

The aim of the on-line training activities is to provide a training session as the foundation for a case repository for scenario thinking. Trainees are able to perform their own internal scenario thinking workshop using the technique (the IDON method) provided by Hydra eLearning platform.

6.1.1 Contextual information required

The contextual information required for a rich learning experience comprises:

- Indexation (timing) of the agenda items from the training session allow the learner to jump back and forth in the training. This is done semi-automatically by the operator during the recording.
- Slides used during the presentations shall be indexed and provided as contextual information, shown alongside the video/audio presentation and available for download.
- Additional material, text documents, graphics, etc. should be indexed to the agenda and downloadable

- Discussion between participants to be recorded and indexed with speaker names and profiles.
- Possible inclusion of the presentations of results from the scenario thinking workshop to be integrated into the video presentation.

The contextual information will be created and uploaded to the public-i CMS system after the completion of the training session.

6.1.2 Hardware requirements at trainee's side

The public-i system can utilise either of the two streaming media formats that dominate the market, i.e. Real Media and Window Media. For simplicity, the Hydra project has selected the Windows Media platform. However, this can be easily extended to Real Media in the future.

To participate in the eLearning programme, the learner needs an ordinary PC with Windows Media.

6.1.3 Modelling and presentation tools

To fully explore the potential of the eLearning platform, trainees should conduct their own on-site workshops, either concurrent with the webcast or immediately after a learning session. The webcast media allows the trainees to stop the learning program and carry out their own domain specific scenario thinking work before resuming the learning program.

Appropriate tools and forms for the business modelling group work should be provided. These tools consist of:

- Internet connection to see the eLearning webcast
- Whiteboard with pens
- Adhesive cardboard idons used to note down the environmental factors.

During the session, the moderator will use the presentation PC for introductions and presentations.

6.1.4 Questionnaire and feedback

A short questionnaire to collect feedback from the user of the eLearning platform is provided with the webcast. The intention of this questionnaire is to measure whether the group's training objectives have been met. At the start of the training session, the group of trainees as a whole is requested to fill in group's objectives in the questionnaire, which will be evaluated at the end of the session.

The questionnaire will further provide feedback in form of problems that have been identified in the execution of the training session and to collect suggestions and comments for future improvements and enhancements.

A series of polls (simple trivia's) will be displayed during the training session to check, if the groups is progressing well.

7. Case scenario: Healthcare

The Hydra project carried out three scenario workshops using the IDON method for each of the three user domains: Agriculture, Healthcare and Building Automation. The healthcare scenarios described below are good examples of how the IDON method works to help us derive at a set of user requirements through the detailed description of what happens in the scenarios.

The full description of the scenario process and all the scenarios defined in Hydra can be found in the deliverable: D2.1 Scenarios for usage of HYDRA in 3 different domains.

The Trigger Question used in the workshop to identify the environmental factors was:

How do we develop and deploy intelligent, ubiquitous and secure networked products and services for healthcare in 2015?

Identification of Environmental Factors

Factors were identified from among all the possible environments that could influence healthcare in 2015:

- Technology trends
- Clinical trends
- Economic futures
- Social values and life-styles
- Ethical and value questions
- Organisation and logistic systems
- Environmental issues
- Global political influences

The workshop participants defined a total of 63 factors in all areas:

Technology trends (T)
Support industry
Non-battery solutions
2-in-1 devices
Energy constraints
Bandwidth
Traditional methods prevail
Real time performance
Wireless solutions
Traceability
Multifunction devices
Automatic semantic translation
Security models
Near field communication
Automatic processes
Device design
Predictive technology
Virtual communities

Clinical trends (C)
Health check-ups
Conditional treatment offers
Remote diagnostics
Body sensors
Robot surgery
Monitoring limits
Remote treatment limits
Self-monitoring

Economic futures (€)
Economic incentives
Public/private financing
Reimbursement across borders
Long-term public investments
Cost of WAN
Expensive battery-driven solutions
Limited health costs

Social values and life-styles (L)
Healthy lifestyle
Social pressure to be healthy
Lifestyle change
Paying for "safety"
Invisible health support devices
Empowered patients
Individualised motivation
Private health insurance
Lifestyle information
Smart devices motivate

Ethical and value questions (V)
Radiation risks
Quality of life
Attitudes to ICT
Ownership of data
Personal data issues

Organisation and logistic systems (O)
Responsibility for devices
Access to data
Emergency access rights
Individual access rights
Patient involvement
Patient choice
Private healthcare providers
Non-healthcare professionals
Relationship to GP/doctor
Compliance
Face-2-face consultations

Environmental issues (E)
Technological waste

Global political influences (G)
Politics of health
Structural reforms
Public healthcare system
Data access regulations

The environmental factors were then group according to the certainty and impact criteria, which yielded the following matrix:

High UNCERTAINTY

Joker

G Structural reforms

T Secondary support industry

C Health check-ups

€ Economic incentives

L Healthy lifestyle

V Quality of life

G Politics of health

L Social pressure to be healthy

C Conditional treatment offers

L Private health insurance

V Radiation risks

€ Reimbursement across borders

C Body sensors

€ Cost of WAN

T Security models

O Responsibility for devices

T Non-battery solutions

T 2-in-1 devices

T Energy constraints

C Remote diagnostics

L Lifestyle change

T Bandwidth

€ Long-term public investments

L Paying for "safety"

O Emergency access rights

O Access to data

L Smart devices motivate

T Traditional methods prevail

T Real time performance

T Predictive technology

C Robot surgery

O Individual access rights

€ Public/private financing

T Wireless solutions

T Traceability

T Automatic semantic translation

Either/or

Indirect Impact

Direct Impact

C Monitoring limits

C Remote treatments limits

O Patient involvement

L Individualised motivation

O Compliance

O Relationship to GP/doctor

O Patient choice

V Personal data issues

G Public healthcare system

O Private healthcare providers

T Virtual communities

O Non-healthcare professionals

L Lifestyle information

Scene

C Self-monitoring

€ Expensive battery-driven solutions

T Multifunctional devices

L Invisible health support devices

€ Limited health costs

T Device design

V Attitudes to ICT

T Body networks

T Automatic processes

O Face-2-face consultations

L Empowered patients

V Ownership of data

G Data access regulations

E Technological waste

Trends

High CERTAINTY

Flip-flopping the Pivotal Uncertainties

Looking at the factors in the "Either / Or" quadrant marked we now turn to grouping them in clusters. Each of the clusters will form different scripts in our scenarios.

We now think of each of the uncertainties as a question, for which there are two possible outcomes: The "flip" (+) and the "flop" (-) outcome. When the factor in question has either "flipped" or "flopped", the uncertainty is resolved.

The following table presents all the uncertainties in the Either/Or quadrant and the related flip-flow questions.

Responsibility for devices Responsibility for the functionality of medical devices has not been assigned to specific party	+	Healthcare providers have assumed responsible from manufactures for the proper functioning of medical devices.
	-	It is unclear if the healthcare provider or the manufacturer is responsible for ensuring that proper functioning of medical devices.
Long-term public investments What is the political attitude towards long-term investments in ICT in healthcare?	+	Long-term investments in ICT in healthcare are regarded as necessary for improvement of the healthcare system and self-management initiatives.
	-	It is difficult to convince politicians to make long-term investments in ICT for improvement of the public healthcare system.
Non-battery solutions What types of energy solutions are available for medical devices?	+	Non-battery driven solutions are widely available, significantly improving the performance level of medical devices.
	-	No real developments in this area have been achieved and medical devices are still battery-driven.
Energy constraints To what extent is the performance level of medical devices on energy consumption?	+	It is possible to secure a high level of performance independent on energy source and consumption.
	-	To achieve a high performance level medical devices have a very high energy consumption.
Remote diagnostics Is remote diagnosis used within healthcare?	+	Most GPs practice remote diagnostics on an increased number of patients.
	-	All patients must be seen by a GP in person before they receive a diagnosis.
Body sensors Is it possible to use body sensor for healthcare purposes?	+	Body sensors are used to predict and prevent development of diseases.
	-	Body sensors have not been developed sufficiently and cannot be used for medical purposes.
Cost of WAN What kind of impact will WAN telecommunication networks have on ICT in healthcare?	+	Healthcare systems use the low cost WAN telecommunication networks for mobile medical devices in healthcare.
	-	The cost and availability of WAN telecommunication networks inhibits the use of mobile medical devices.
Access to data Will there be restrictions on access to data?	+	Medical companies have free access to personal health data.
	-	Medical companies may not access personal health data.
Traditional methods prevail To what extent will ICT change healthcare system and practice?	+	ICT solutions and methods of treatment will be an important supplement to traditional non-ICT healthcare treatments, improving healthcare overall.
	-	ICT is still limited within healthcare and its advantages for improving healthcare and self-management have not been realised.

Real time performance Is it possible to make any guarantees regarding data transfer time?	+	The transfer of health data within real time or set time frames will be guaranteed.
	-	It is not possible to guarantee that health data transfers will occur in real time.
Robot surgery Will robot surgery be a widely used practice?	+	Robot surgery is a widely used practice within secondary healthcare.
	-	There have not been sufficient developments within robot surgery to be able to offer it to patients.
Wireless solutions How well-developed will wireless solutions be?	+	Wireless solutions are so reliable that they can be used in any kind of healthcare situation.
	-	Due to reliability risks, wireless solutions may only be used for non-critical healthcare matters.
Bandwidth Will bandwidth be an issue when it comes to data transfer	+	There will always be enough bandwidth available for data transfers.
	-	Data transfers are problematic due to insufficient bandwidth.
Emergency access rights Is it possible to have set rules that determine access rights to health data in emergency situations?	+	Access to a person's health data is based on the particular context and situation.
	-	It is not possible to base access rights to a person's health data on context and situation.
Individual access rights How may individual access rights to health data be granted?	+	There is a system in place which is able to automatically sort data access according to each healthcare professional's individual rights.
	-	It is not possible to ensure that healthcare professional's individual data access rights are automatically granted.
Traceability Will it be possible to trace people's health state?	+	ICT makes it possible to trace people's health state anytime and anywhere.
	-	There is no system in place which allows for tracing people's health state.
Paying for "safety" What characterises elderly people's attitude towards private payments for healthcare monitoring services?	+	The elderly wants to be able to buy more and better monitoring healthcare services as well as invest in medical devices for home use in order to feel more secure in their homes and on the road.
	-	The elderly will rather live without the added security monitoring and medical devices provide than paying for these services and devices themselves.
2-in-1 devices Will 2-in-1 devices be widely available?	+	Support/health devices have been merged with lifestyle devices thus creating a 2-in-1 device that meets the needs of the market.
	-	Despite market demands, a 2-in-1 device merging lifestyle devices with support/health devices has not been developed.
Security models What kind of security models will be available?	+	Security models are designed and adjusted to individual needs and specific contexts.
	-	Only general and generic security models are available.
Lifestyle change What is the general attitude towards healthy lifestyle?	+	Overall, people will be serious about changing their lifestyle to live healthier in order to avoid or managed lifestyle diseases.
	-	Despite health problems most people are not making any real efforts to change their unhealthy lifestyles.

Public/private financing What will the future financing of healthcare look like?	+	The costs of healthcare services are split equally between public and private funding to secure sufficient resources for improved healthcare.
	-	The majority of healthcare services will continue to be financed publicly thus placing some financial restrictions on the availability of healthcare services.
Predictive technology Will it be possible to use technology to predict changes in health?	+	Technological developments have made it possible to predict diseases and changes in health status, e.g. oncoming heart attacks can be discovered.
	-	Insufficient research and development in the field of predictive technologies have meant that these are not available on the market.
Smart devices motivate Are there any extra benefits of smart devices besides the technological possibilities they offer?	+	Smart devices motivate people to live healthier as they include a competitive element, e.g. tracking weight loss or counting number of steps walked per day, thus setting fun goals for people.
	-	Most people have little knowledge of the countless functions smart devices offer and therefore fail to use the smart device as a motivator towards better health.
Automatic semantic translation Will automatic semantic translation be in place?	+	It is possible to use semantic translation in relation to e.g. patient journals and other health data.
	-	Automatic semantic translation of health data is not available.

Clustering the Uncertainties

We will now group the pivotal uncertainties in two groups by searching for connections and associations between the various uncertainties.

When inspecting all 24 uncertainties it becomes obvious that they can be separated into two distinct groups. The first group of uncertainties is related to the information and communication technologies that are used in healthcare and the economic aspects of the implementation of ICTs in healthcare. We have named this cluster "**Technology Drive**".

The second group of uncertainties is related to the clinical trends and the organisation of the healthcare system and how these are influenced by the technological developments and the use of ICT. ICT opens up for new ways of ways to treat patients and of delivering healthcare. We have named this cluster **"Clinical Innovation"**.

Technology Drive

- T Wireless solutions
- T Energy constraints
- T Non-battery solutions
- T Bandwidth
- € Cost of WAN
- T Predictive technology
- T Traceability
- T Automatic semantic translation
- T Real-time performance
- T Security models
- T 2-in-1 devices
- L Smart devices motivate

Clinical Innovation

- C Remote diagnostics
- C Body sensors
- O Access to data
- C Traditional methods prevail
- C Robot surgery
- C Emergency access rights
- C Individual access rights
- O Responsibility for devices
- € Long-term public investments
- L Lifestyle change
- L Paying for "safety"
- € Public/private financing

Naming the Sub Plots

Having identified all the flip-flop questions and grouped the uncertainties in two clusters, we are now ready to perform the last step before scenario write-up, i.e. naming the different subplots that will define the scripts.

In the clusters we now deploy the flip-flop questions from above. We analyse and group the responses thus resolving the entire cluster as a large-scale flip or a large-scale flop. We do this for each cluster at the time.

In the **Technology Drive** cluster we arrive at the following large-scale flips and flops:

Big Flip Cluster – "Technology Drive"	**Big Flop Cluster – "Technology Drive"**
• Wireless solutions are so reliable that they can be used in any kind of healthcare situation • It is possible to secure a high level of performance independent on energy source and consumption • Non-battery driven solutions are widely available, significantly improving the performance level of medical devices • Technological developments have made it possible to predict diseases and changes in health status, e.g. oncoming heart attacks can be discovered • Healthcare systems use the low cost WAN telecommunication networks for mobile medical devices in healthcare • There will always be enough bandwidth available for data transfers • ICT makes it possible to trace people's health state anytime and anywhere • It is possible to use semantic translation in relation to e.g. patient journals and other health data • The transfer of health data within real time or set time frames will be guaranteed • Security models are designed and adjusted to individual needs and specific contexts • Support/health devices have been merged with lifestyle devices thus creating a 2-in-1 device that meets the needs of the market • Smart devices motivate people to live healthier as they include a competitive element, e.g. tracking weight loss or counting number of steps walked per day, thus setting fun goals for people	• Due to reliability risks, wireless solutions may only be used for non-critical healthcare matters • To achieve a high performance level medical devices have a very high energy consumption • No real developments in this area has been achieved and medical devices are still battery-driven • Insufficient research and development in the field of predictive technologies have meant that these are not available on the market • The cost and availability of WAN telecommunication networks inhibits the use of mobile medical devices • Data transfers are problematic due to insufficient bandwidth • There is no system in place which allows for tracing people's health state • Automatic semantic translation of health data is not available • It is not possible to guarantee that health data transfers will occur in real time • Only general and generic security models are available • Despite market demands, a 2-in-1 device merging lifestyle devices with support/health devices has not been developed • Most people have little knowledge of the countless functions smart devices offer and therefore fail to use the smart device as a motivator towards better health
which leads to the name:	*which leads to the name:*
TECHNOLOGY CONVERGENCE	**TECHNOLOGY DIVERGENCE**

The "big-flip" of the **Technology Drive** cluster describes an efficient healthcare system with a high performance level due to the convergence of new ICT technologies and clinical demand. Patients are highly engaged in their health and actively use high-tech medical and health support devices to achieve a healthier lifestyle and quality of living.

Development and implementation of new ICT technologies in healthcare have enabled better health practise to be put in place and innovative healthcare services have been developed using techno-logical innovations. Conversely, ICT innovations have been spurred by new clinical practice and

medical discoveries (the virtuous circle). This version of the cluster facilitates scenarios featuring ICT technology that supports and complements clinical practices to achieve a common goal.

On the other hand, we have the "big-flop" situation where ICT developments and implementations in healthcare are out of synchronisation and technology supported solutions are very expensive.

The general public is unaware of the technological possibilities of smart devices and home medical devices in relation to improving their lifestyle. Take-up of new ICT technologies in medical practice and healthcare administration is slow or sometimes avoided, so the full potential of ICT in healthcare is far from being realised. Developers have not responded adequately to market demands, so the clinical and medical value of the solutions is often unclear. Conversely, medical practitioners and healthcare authorities have not been sufficiently interested in trying out new ICT technologies and have not created a basis for synergetic cooperation (the negative spiral). This version of the cluster facilitates scenarios with little uptake of ICT and continued focus on traditional clinical practises.

In a similar way we can group the **Clinical Innovation** cluster:

Big Flip Cluster – "Clinical Innovation"	**Big Flop Cluster – "Clinical Innovation"**
• Most GPs practice remote diagnostics on an increased number of patients • Body sensors are used to predict and prevent development of diseases • Medical companies have free access to personal health data • ICT solutions and methods of treatment will be an important supplement to traditional non-ICT healthcare treatments, improving healthcare overall • Robot surgery is a widely used practice within secondary healthcare • Access to a person's health data is based on the particular context and situation • There is a system in place which is able to automatically sort data access according to each healthcare professional's individual rights • Healthcare providers have assumed responsible from manufactures for the proper functioning of medical devices • Long-term investments in ICT in healthcare are regarded as necessary for improvement of the healthcare system and self-management initiatives • The elderly wants to be able to buy more and better monitoring healthcare services as well as invest in medical devices for home use in order to feel more secure in their homes and on the road • Overall, people will be serious about changing their lifestyle to live healthier in order to avoid or managed lifestyle diseases • The costs of healthcare services are split equally between public and private funding to secure sufficient resources for improved healthcare	• All patients must be seen by a GP in person before they receive a diagnosis • Body sensors have not been developed sufficiently and cannot be used for medical purposes • Medical companies may not access personal health data • ICT is still limited within healthcare and its advantages for improving healthcare and self-management have not been realised • There has not been sufficient developments within robot surgery to be able to offer it to patients • It is not possible to base access rights to a person's health data on context and situation • It is not possible to ensure that healthcare professional's individual data access rights are automatically granted • It is unclear if the healthcare provider or the manufacturer is responsible for ensuring that proper functioning of medical devices • It is difficult to convince politicians to make long-term investments in ICT for improvement of the public healthcare system • The elderly will rather live without the added security monitoring and medical devices provided than paying for these services and devices themselves • Despite health problems most people are not making any real efforts to change their unhealthy lifestyles • The majority of healthcare services will continue to be financed publicly thus placing some financial restrictions on the availability of healthcare services
which leads to the name: **CLINICAL REVOLUTION**	*which leads to the name:* **CLINICAL EVOLUTION**

The "big-flip" of **Clinical Innovation** cluster illustrates a future where revolutionary new medical methods and clinical processes supported by high public investments and successful implementation

of ICT technologies have brought about new highs in disease prevention and treatment. Citizens are deeply involved in their own health and are willing to invest time and resources in achieving a healthier lifestyle, but they are also in getting more extensive healthcare services with better support and more focus on preventive and predictive care. Healthcare services are still mainly publicly financed to secure free access for all. This version of the cluster facilitates scenarios featuring ICT technology that is embedded in clinical practices to achieve a superior and ambitious goal.

The "big-flip" cluster describes a situation where medical and clinical practise still is much more evolutionary than revolutionary. New methods and processes are mostly developed in response to eminent demographic or financial threats rather than proactively in anticipation of future needs.

Insufficient and improper implementation of ICT solutions in healthcare has made it difficult to optimise clinical processes and methods to improve healthcare services. There is an overall reluctance to take advantage of the possibilities ICT offers, both among authorities responsible for healthcare provision, among healthcare providers and even among the general public. This version of the cluster facilitates scenarios featuring ICT technology used to bridge gaps in medical practices and repair non-functional or inefficient traditional clinical processes, rather than proactively to secure a healthcare system that can match future challenges.

Multiple Images of how Healthcare Systems are being Developed in 2015

We are now able to define the structure of the scenarios for the healthcare domain.

7.1.1 Developing the Scene

In this process, we start with the scene, which is common for all scenarios. The elements for defining the scenes are found in the lower left "Scene" quadrant of the original grid of environmental factors. These factors are deemed by the experts to be rather certain and thus serve at the reference point for all four scenarios. The "Scene" factors are mostly related to non-technical influence on healthcare in the future, such as organisation and logistic systems and clinical trends.

Lifestyle diseases are of important societal concern. Everyone even remotely related to healthcare, politicians, healthcare administrators, medical and non-medical professionals such as teachers, social workers and private employers, is strongly engaged in encouraging people to live a healthier lifestyle. This involves eating and drinking with reason, stop smoking, avoiding stress and exercising regularly. The methods involve information, training and more information.

Healthcare systems are primarily publicly financed but more and more patients seek individual private treatment to avoid waiting lists. In general, patients have a less authoritative relationship to their GP/doctors than today. Patients also want to have more influence on their treatment such as free choice of GP/doctor in both the primary and secondary healthcare sector.

Generally, patients are much more involved in their own health not the least due to increased access to on-line information on health and lifestyle diseases, net doctors, virtual communities and availability of smart devices which is a significant tool for helping and motivating people to live healthier and manage their chronic conditions. However, on the flip side of the overall situation, patient compliance is still a serious problem because patients some times take matters into their own hands which ironically hinder effective self-management of especially chronic diseases.

7.1.2 Building the Sets

The environmental factors in the lower right "Trend" quadrant constitute the changing sets that are built on the scene for each scenario. The experts have identified several trends. They do not necessarily form a cohesive, single targeted trend for the future. Rather, the trends point in different directions for different sorts of applications and different target groups. The trend corresponds to one of the four scenarios defined later (identified in [square brackets]).

One trend [1] concerns the increased number of patients, as a result of both demographic factors and rising number of people with chronic diseases, combined with increased demands from citizens for timely, high quality care. This means ever increasing healthcare costs. Politicians must constantly

try to contain the costs through various initiatives, even if it leads to degradation of service, because there is a limit to how high a proportion of GDP can be allocated to health. Healthcare professionals have developed a positive attitude to ICT technologies and tend to use it in patient administration and case management, in order to meet the demands for cost containments and efficiency.

Another trend [2] points towards the use of well-developed self-management schemes for people with chronic conditions. Self-management of chronic diseases has shown remarkable results over the years and is one of the most successful case management techniques in recent years. It is also instrumental for cost containment and in the fight against case overload in both primary and secondary healthcare systems. ICT platforms are extensively used in fully automated processes to support self-management and remote monitoring using minimally-invasive, multi-parametric devices. Automatic process means that devices are self configuring, self discovering and easy to use so that self-management requires minimal intervention from patients. Remote monitoring is seen as an important supplement to other case management methods; it does not replace direct, face-to-face interaction between doctor and patient. Most patients, and doctors, prefer it this way.

A third trend [3] focuses on the increase in assistive medical devices (smart devices) and how these will become an integral part of healthcare, particularly in relation to improved self-management of chronic diseases. Wearable devices interconnected in a wireless body network, are easy to wear, and often multifunctional, when patients need different devices for monitoring different parameters. They are also ergonometric, invisible or easy to hide for convenience. And they are designed to help people live normally and to take the focus off the disease itself rather than act as a constant reminder of their condition. An example is the integration of entertainment functions into medical devices. The only major problem with healthcare devices is that many of them still need expensive, bulky battery power for operation. This increases costs, limits usability and contributes to more electronic waste.

A final trend [4] is the continued issue of securing privacy, secure access, non-repudiation and rights of ownership of health data. Personal health data are extremely sensitive and privacy has been an increasing concern with citizens. National legislation is in place across Europe to restrict access to health data and protect the right of the patient, but in some countries the regulations can be a hindrance for efficient and effective healthcare, because the rules are not sufficiently adapted to the procedures in the real world. The balance between privacy and protection of health data and efficient and informed healthcare is difficult and is still an unresolved issue in Europe as a whole. The question of ownership of health data is closely related to this issue. Patients have full ownership of their own health data and thus full control of access rights which in some cases restrict the efficiency of e.g. emergency care, shared care or even highly popular and otherwise effective multidisciplinary, multifaceted constructs such as chronic disease liaison groups and palliative support schemes.

7.1.3 Defining the Script

In the final step, the four scenarios come to life as imaginative plays defined by scripts. In writing the scripts, the environmental factors enter according to a simple grouping: What is happening, how is it happening and why is it happening?

What is happening?

The scene shows a typical user situation around 2015. The developer user is being presented with a series of requirements for new medical equipment and health care systems. Developing infrastructure for this domain has a series of unique requirements, such as safety, accuracy, 24/7 operation, data security and privacy, adaptability to legacy systems, configurability, usability for users and administrators, scalability, cost benefit, etc., etc. The complexity and the stringent extra-functional requirements often drive both development and manufacturing cost through the roof. The developers will therefore increasingly be met with the need to reuse existing devices or systems, use off-the-shelf components where possible.

How is it happening?

The main thrust for the developer users script are extra-functional features such as the regulatory requirements, medical equipment standards, safety and security aspects, and the commercial benefits to be derived from the under laying business cases. It is essential for the successful adoption of new technology in the healthcare sector that cost/benefit analyses shows sufficient clinical and economic benefit to the healthcare professionals and decisions makers

The developer user tends to favour integration of systems and devices using standardised middleware, which adheres to medical standards. By using a Hydra middleware, the developer users are able to develop integrated solutions, compliant with medical standards and regulations, secure and trustworthy, with high degree of functionality and precisely targeted the medical end-user in question.

Why is it happening?

The complexity of the overall healthcare system including its tortuous business models and multiple value chains makes system conceptualisation a major challenge to developers. Focus is on making every part of the system adaptive using methods of end-to-end reconfigurability. The key objective of such end-to-end reconfigurability methods is to develop architectural design of reconfigurable devices and supporting system functions so as to offer an expanded set of operational choices to the different actors of the value chain, e.g. doctors, patients, administrators, manufacturers, etc.

One primary target group is the GP's or doctors in the primary healthcare system. They are the frontline users facing the patients and they need the most support in dealing with new technology. They require extreme ease of use, high efficiency in the day-to-day operation of the system in order to relieve the high caseload, and security and privacy on behalf of the patients. Most important, though, is that the system comes with an agreed and supported fee structure and business model.

Writing the scenarios

The four scenarios have been written on the basis of the scenario thinking process with the group of experts in healthcare, health information, pervasive healthcare and embedded software technologies in medical equipment. The scenarios have been illustrated with pictures and drawings to stimulate the reader's imagination.

7.1.4 Writing Up the Scenarios

We are now going to define four scenario structures generated from the two clusters "Technology drive" and "Clinical innovation" each of which has two states or sub-plots. The possible combinations are as follows:

1. Technology convergence + Clinical evolution
2. Technology convergence + Clinical revolution
3. Technology divergence + Clinical revolution
4. Technology divergence + Clinical evolution

From these four combinations we can write-up four scenarios in the following way:

1. Overload

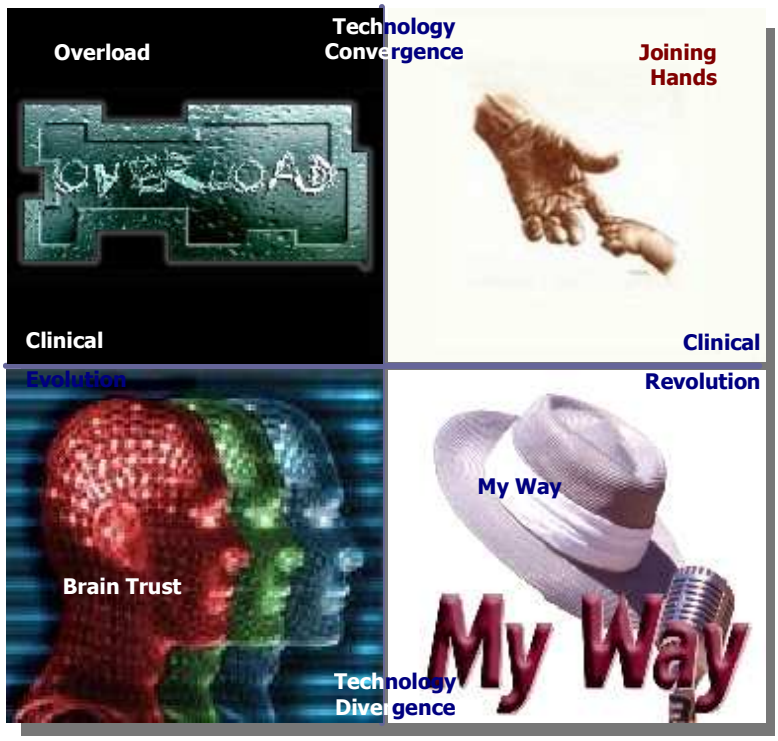
This scenario addresses the constant drive to cope with an increased number of patients, as a result of demographic factors and the rising number of patients with chronic diseases. Healthcare services continue to be publicly funded and politicians must constantly contain costs through various initiatives, so it is difficult to make investments in ICT solutions, unless they have a very short pay-back. However, citizens demand timely, high quality care increasing the load on the already overloaded system. Even if ICT solutions exist, many clinical procedures are still manual. Developers have a range of new technologies which can trace people's health in real time, anywhere, anytime. However, even though healthcare professionals have a positive attitude to ICT, they tend to use it mainly in patient administration and to meet demands for cost control and efficiency. Jokers are the emergence of private health insurance and economic incentives e.g. tax levels depending on health.

2. Joining Hands

This scenario addresses the proliferation of self-management schemes for long term diseases and as prevention tools for life style changes. Clinicians and developer users work together to bring about a wealth of smart devices and low power sensors in wireless, self configuring body networks which semantically interfaces to legacy health care systems. The systems are reliable and safe and doctors increasingly rely on the remote information to also perform diagnosis and long term risk assessment. Since citizens are serious about their health, partly because of social pressure, self management has become a major tool in matching the rising need for high quality health care in addition to frequent health checkups. Politicians have realised the need for making long term investments in ICT infrastructure but many patients spend additional money for top class care. The challenge for developer users of Hydra middleware is to make the applications sufficiently intelligent even with power and resource constrained embedded devices. The demand for both functionality and extra-functional features is very high.

3. My way

Medical researchers and practitioners are using range of new and highly advanced markers for early detection of diseases to counter the increasing impact from lifestyle and unhealthy living. The rising number of private insurances encourages the healthcare professionals to invent unconventional smart sensor systems for remote diagnostics, monitoring and early warning if groups of high-risk patients. But developer users have pursued their own objectives, which not always supports the progress in clinical methods. One problem is that communication networks specifically for health care applications has not materialised in Europe like in the US. Another challenge for developer users is the integration of a large number of heterogeneous, multifunctional, ergonometric, and invisible devices imported from other applications and to turn them into a coherent medical application.



3. Brain Trust

The thrust in this scenario is the slow, but steady progress of synergetic cooperation between technology developers and medical researchers and clinical practitioners. The majority of health care services are publicly financed, putting a great pressure on government spending. Most people are not making any real efforts to change unhealthy lifestyles, and development of ICT infrastructures are mostly concerned with administrative efficiency and cost savings. One area where real progress has been made is in terms of security and privacy for patient data. National legislation is in place across Europe to restrict access to health data and protect the right of the patient and all developer users must comply with these rules. Patients have full ownership of their own health data and thus full control of access rights, which in some cases restrict the efficiency of e.g. emergency care, or shared care.

For reference, we provide the full text of one of the scenarios below. All scenarios can be found in the deliverable D2.1 Scenarios for usage of HYDRA in 3 different domains.

Sample healthcare scenario developed with IDON method

Overload

Health care professionals are coping with an increased number of patients, as a result of demographic factors and the rising number of patients with chronic diseases. Since healthcare services mostly are publicly funded, politicians must constantly contain costs through various initiatives, so it is difficult to make investments in ICT solutions for disease control, unless they have a very short pay-back. However, citizens demand timely, high quality care increasing the load on the already overloaded system. Even where ICT solutions exist for care and workflow improvements, many clinical procedures are still manual.

Equipment developers have a range of new technologies which can trace people's health status in real time, anywhere, anytime. However, even though healthcare professionals have a positive attitude to ICT, they tend to use ICT mainly in the form of diagnostic equipment and in patient administration to meet demands for cost control and efficiency.

Michael Johnson is 29 years old and is severely obese with a BMI[2] of 31. Overweight increases the risk of many diseases and health conditions, including hypertension, diabetes II, stroke and others. Michael lives in Southampton, UK, and works as a long-distance truck driver. He spends most of his time on the road which has become a second home for him. He drives all over Europe but rarely get a chance to see much other than motorways, the restaurants and rest areas along the motorway. He doesn't mind so much; he just loves driving his truck and being independent.

About 6 months ago, he fell very ill with strong chest pains. After several tries he finally managed to set up consultation with his family GP, Dr. Ross. After extensive examining and blood tests, Dr. Ross called him in to tell him his diagnosis: *"I am afraid that due to your overweight, you have developed diabetes type II, Michael. Your blood pressure and your cholesterol figures are also too high"*. Dr. Ross went on to give Michael a thorough introduction to diabetes, its occurrence and the potential risks he was facing. Dr. Ross also told him that he must loose weight, start to eat a healthier diet and do more exercise, if he wanted to steer clear of a heart attack, which could potentially kill him.

Dr. Ross wanted to put Michael on a strict clinical treatment programme with close monitoring. He wanted to track Michael's glucose level and blood pressure to avoid potentially life threatening situations and keep an eye out for any deterioration of Michael's general health status as to alleviate occurrence of related conditions. For longer term health improvement, he instructed Michael to loose at least 4 stones (25 kg). The treatment plan was a combination of dietary changes to a fat-free, high nutrition diet, and daily exercise. Dr. Ross told him that weight loss would lower his blood pressure and improve cholesterol level. Since he had diabetes II, it could also reduce his blood glucose and haemoglobin A levels. *"Weight loss and exercise is thus a key factor to your wellbeing. You must learn to manage your disease"*, Dr. Ross told him.

At first, Michael was very dismissive about Dr. Ross' instructions and showed no interest in following the self-management scheme. Being constantly on the road makes it hugely inconvenient for him to monitor health status, change his diet and exercise. On the other hand he is slightly worried about his future life, so when Dr. Ross tells him about the liaison communities that exist for patients like him, he becomes interested. A self-management group, OurHealth, has recently been created in Southampton. It is formed around a virtual community in which members use internet and wireless technologies to stay in contact with each other anywhere, anytime, posing new ways of interacting socially. It uses peer pressure to help members stay on track with their diet and weight loosing programmes. The virtual community also includes doctors, other healthcare professionals, such as dieticians and fitness instructors, and ICT experts maintaining the community infrastructure.

[2] Body Mass Index (BMI) is basically the relationship between a person's height and weight

It all fitted quite well with Michael's work and lifestyle and he decides to give it a try. On Dr. Ross' recommendation, Michael buys electronic home care devices that can measure his weight, blood pressure and glucose level. The devices are battery operated and he can easily carry them with him. Tim Jones, an ICT specialist in OurHealth suggest to Dr. Rah, one of doctors at OurHealth, that Michael should be more closely monitored when he is on the road. Tim suggests that data from Michael's medical devices can be automatically uploaded to his patient record (EPR) using the NHS Connecting for Health backbone[3]. In this way, Michael can be professionally monitored without really realising it. Since all devices are BlueTooth enabled, Tim suggests equipping Michael with a mobile phone with BlueTooth and java processor. Tim will then turn it into a multiple-parametric smart device that automatically can upload data to the NHS system, for doctors to monitor his progress.

Michael is extremely happy with his new smart device, which he uses for entertainment (music and movies), information (news, traffic and weather), communication (voice and text) and now medical monitoring and feedback. The smart device collects and sends off the readings to his EPR in NHS using the 3G broadband network in Michael's truck. This network is used for fleet management and technical monitoring of truck performance by his company, but the company has allowed its drivers to use it also for private communication. The truck's GPS system also provides location information.

Today is a typical day for Michael. It is his second day on the road on the way from Southampton to Lisbon. Michael has performed his usual measurements and the data are encrypted and stored on his smart device, where they are filtered and compared to previous readings. As long as the data remains on the smart device, they are completely private and Michael needs to authorise each secure transmission to the NHS databases. When the data have been analysed, Michael receives an audio message via his car stereo, which the smart device has automatically interfaced to. This way he can keep his eyes on the road. It informs him that the measurements are good. His cholesterol level is down, his weight is down and the glucose level is stable. It asks him if he wants to upload the data to the NHS system. Michael confirms in natural language and the data are uploaded. Five minutes later Dr. Rah from OurHealth calls him on the mobile phone to congratulate him. The data filter has flagged Michael and both Dr. Rah and Dr. Ross have been notified.

The next hour, Michael chat with friends from OurHealth until it's time for him to stop for lunch. As Michael drives into the parking lot, his smart device registers the different food the restaurant offers translated into English. The information contains dietary information, which is compared to his health data collected earlier that day and his dietary plan. The smart device analyse the restaurant's lunch menu and displays a list (in English and French) of the food that Michael can have. Michael chooses a salad and the kitchen automatically receives his order, when he enters the restaurant.

The biggest challenge however, has been to get Michael to exercise. Michael practically lives in his truck and he never sets foot near a fitness centre. But Michael has got a new pair of Nike running shoes. Build into the shoes are wireless sensors that collects information on the number of steps taken and calories burnt. Data are sent to his smart device and when he gets back to the truck, the smart device uploads the data to OurHealth database; geocoded with location information. There is fierce competition among the virtual community members for running the longest distance. A winner is drawn every week and featured on the community's web site. A special price is also given to the two members, who have been furthest away from Southampton. Michael thinks this is great fun.

As a consequence of joining the OurHealth community, Michael is on his way to a better life. He is now very much in line with the increased public focus across Europe on healthy food and exercise; his BMI is reduced to 28 and he is slowly moving into a lower risk group. Once he reaches his weight goal, he can also look forward to a decrease in his tax payments, in an attempt to encourage healthy lifestyles.

[3] NHS: The UK National Health Service's National Programme for IT connects over 30,000 GPs in England to almost 300 hospitals.

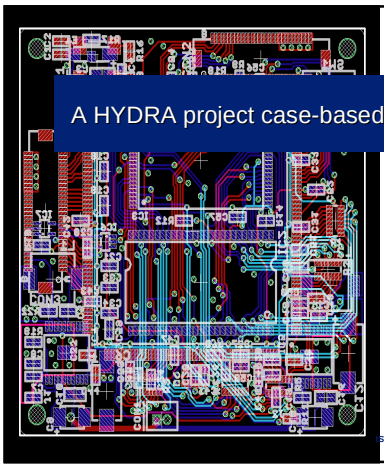
Appendix A: Suggested workshop programme

The following agenda can be used for planning a scenario workshop.

Title	**Future scenarios for future scenarios for pervasive healthcare services using intelligent networked medical devices**	
Agenda	10:00 – 10:05	Welcome
	10:05 – 10:45	Presentation of the Hydra project and its objectives with special focus on healthcare
	10:45 – 11:15	Introduction to IDON Scenario Thinking method
	11:15 – 12:15	Environmental factors affecting future pervasive healthcare and use of intelligent networked medical devices
	12:15 – 13:00	Lunch
	13:00 – 14:00	Environmental factors affecting future pervasive healthcare and use of intelligent networked medical devices
	14:00 – 15:30	Validating and grouping the environmental factors
	15:30 - 15:45	Coffee break
	15:45 – 16:45	Prototype scenarios and multiple images of the future
	16:45 – 17:00	Rounding off the day

Appendix B: Presentation of the IDON method

The following presentation may be used to introduce the IDON methods to the workshop participants or the scenario team.



A HYDRA project case-based training session

HYDRA

Requirements engineering using scenario thinking with the IDON method

<Presenter goes here>

IST-2005-034891

Preface – introduction to the project

HYDRA

IST-2005-034891

Preface from the Hydra Project Team:

- Hydra middleware facilitates application development based on a Service-oriented Architecture (SOA), to which the underlying communication layer is transparent.
- The Hydra platform allows the developers to rapidly develop solutions that are not only technically but also commercially viable.
- Hydra has developed three case-based training courses in which researchers, technology developers and business managers meet to exchange information and jointly create, analyse and augment realistic business models and business cases.

IST-2005-034891

More information: www.hydramiddleware.eu

The HYDRA project

HYDRA

IST-2005-034891

HYDRA

- Middleware for Networked Embedded Systems
  - Embedded intelligence architecture
  - Wireless networks & devices
  - Service oriented architecture (SoA)
  - Trust, privacy and security
- Four year European research project
- Project budget 15 m€
- Co-funded by the EU Commission with 8 m€
- Ends in 2010

Partners in the Hydra project

HYDRA

IST-2005-034891

- 12 partners
- 6 universities and research institutions
- 4 SME's
- 8 countries

CNet SVENSKA AB

IN-JET

FIT

SIT

T-connect

INNOVA

UNIVERSITÄT PADERBORN
Die Unternehmer der Informationsgesellschaft

SIEMENS

Telefónica

The University of Reading

Requirements Engineering

HYDRA

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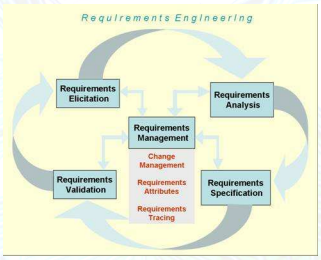

Source: DACS Gold Practices, 2006

Provocations from the Middle Age

HYDRA

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Midway upon the journey of our life
I found myself within a forest dark,
For the straightforward pathway had been lost.

(Dante Alighieri, La Divina Commedia, Inferno, 1306)

***FOREST DARK* = COMPLEXITY**

INNOVA

HYDRA

IST-2005-034891

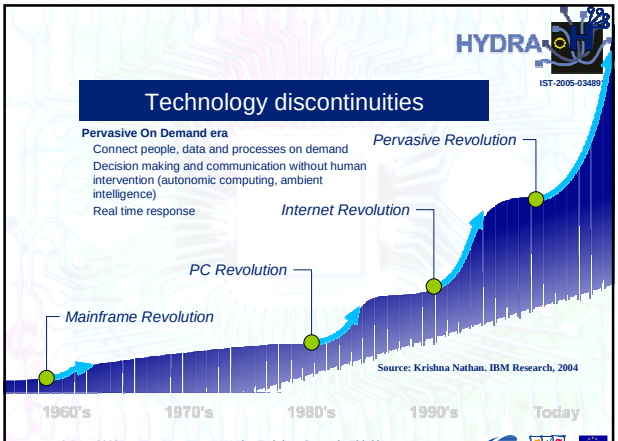
Technology discontinuities

Pervasive On Demand era

Connect people, data and processes on demand

Decision making and communication without human intervention (autonomic computing, ambient intelligence)

Real time response



HYDRA

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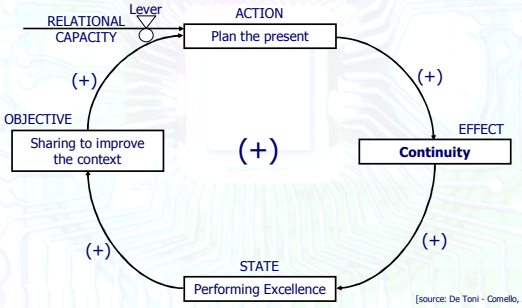
Continuity - the 'Excellence' Circle



[source: De Toni - Comello, 2005]

HYDRA

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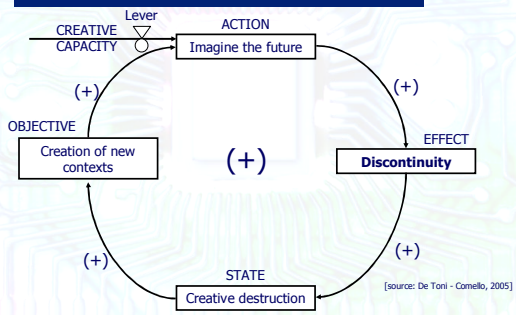
Discontinuity - the 'Creation' Circle



[source: De Toni - Comello, 2005]

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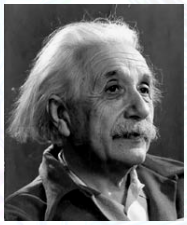
Continuity vs. discontinuity



Logic takes you from A to B.

Imagination takes you everywhere.

(Albert Einstein, 1955)

HYDRA

IST-2005-034891

Imagine the future

- Strategic analysis
- Forecasting methods
- Scenario thinking methods
  - Brainstorming
  - "What if?"
  - IDON method
  - …

HYDRA

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Scenario Thinking

Pierre Wack, the originator of scenario thinking as it is commonly used today, described it as:

A discipline for encouraging creative and entrepreneurial thinking and action "in contexts of accelerated change, greater complexity, and genuine uncertainty."

- Scenario Thinking is not about predicting the future and not about choosing the best way forward.
- The process of Scenario Thinking is as a tool for creating requirements specifications under uncertainty.

Scenario thinking

Scenario thinking achieves its purpose because of three fundamental principles:

- The long view
  - Scenario thinking requires looking beyond immediate demands and peering far enough into the future to see new possibilities
- Outside-in thinking
  - Thinking from the outside-in means pondering external changes that might profoundly affect your case
- Multiple perspectives
  - The introduction of multiple perspectives—diverse voices that will shed new light on your strategic challenge—helps you better understand your own assumptions about the future, as well as the assumptions of others

The IDON methodology

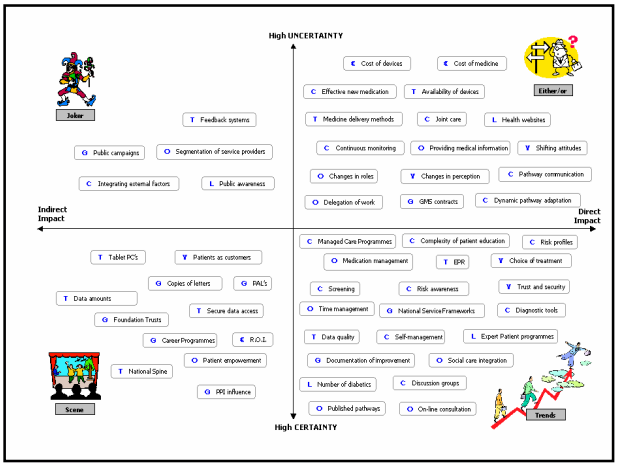
- Its primary value lies in the development of new skills for improving the definition and planning of future user requirements *(the long view)*
- We come to know the right questions to ask, where to look for missing pieces and how to spot unique opportunities *(outside-in thinking)*
- Deploying our skills enables us to acquire consistency and robustness in coherent long-term user scenarios *(multiple perspectives)*

Walk-through the IDON method

- Use a facilitated group of experts with widely different backgrounds selected from each user domain
- Identify and group environmental factors
- Extract pivotal uncertainties and group them as either/or
- Extract strong associations and connections and group them accordingly
- Generating multiple images of the future
- Writing up the scenarios

Environmental Factors

- Technology trends
- Market trends
- Economic futures
- Social values and life-styles
- Ethical and value questions
- Production and logistic systems
- Ecological and environmental issues
- Global political influences



Flip-flopping the pivotal uncertainties

Cost of devices	+	Medical devices will generally be affordable for all.
Will the cost of medical devices help patients getting the optimal treatment?	-	Medical devices will to be very expensive, only for the few.
Availability of devices	+	Plug & play devices and terminals will be available OTC.
Are there devices and terminals available for patients and healthcare workers?	-	Devices are rare and must be specially adapted to every patient.
Effective new medication	+	New, combination medication is available.
Will we have new medicine that only needs to be taken once a day or once a week?	-	Only traditional forms of medication are available.
Cost of medicine	+	Medication cost will be under control in most domains.
Will insulin and other essential medication be too expensive?	-	Medication costs are spiralling and treatment is expensive.
Medicine delivery methods	+	New delivery methods (e.g. implants) are available.
Are new efficient ways of medicine delivery / intake available to the public?	-	Medication is taken in the traditional form.
Joint care	+	Joint Care is very popular and the family are well educated.
Will family members be involved in the care management and how will we educate them?	-	It has proven too difficult to implement Joint Care in large scale.
Health websites	+	Health websites are natural supplements to GP for most people.

Extract associations and connections

- Search for connections and associations between the various factors (uncertainties)
- Uncertainty areas connect because of the impact of their influence of each other, either because if one “flips” the other will “flop” or because they are likely to align by association
- Give the two clusters appropriate names
- Writing up the scenarios

Clustering the uncertainties

Ways and means

- € Cost of medicine
- € Cost of devices
- C Effective new medication
- G GMS contracts
- T Medicine delivery methods
- O Delegation of work
- C Continuous monitoring
- T Availability of devices
- C Dynamic pathway adaptation
- T Feedback systems

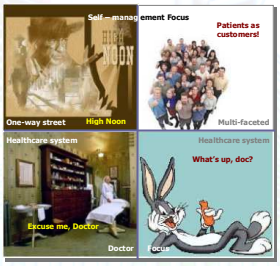
Attitudes

- L Health websites
- C Joint care
- C Pathway communication
- O Changes in roles
- V Shifting attitudes
- V Changes in perception
- O Providing medical information
- O Segmentation of service providers

Naming the sub plots

Big Flip Cluster “Ways and means”	Big Flop Cluster “Ways and means”
• Medication cost will be under control • Medical devices will be affordable • Plug & play devices and terminals will be available OTC • New delivery methods are available • New, combination medication is available • GMS contracts will continue to define some work procedures • Doctors will increasingly delegate responsibility to others • Patients are being remotely monitored for early warning • Pathways are dynamically adjusted to the actual needs • All sorts of health related information will be collected and kept	• Medication costs are spiralling • Medical devices will to be expensive • Devices are rare and must be specially adapted to every patient • Medication is taken traditionally • Only traditional forms of medication are available • GMS will gradually fade out and loose their importance. • Doctors will retain full control and responsibility for the patient • Patients go occasionally to the doctor’s office for check-up • Doctors adjust pathways after careful examination and control • Only journal data and medical notes will be stored in the EPR
which leads to the name:	which leads to the name:
MULTI-FACETED HEALTH SYSTEM	ONE-WAY STREET HEALTH SYSTEM

Create multiple images of the future



Discussion and action plans

- Selecting the third user domain
- Plan and arrange workshops
- Roles and assignments
- User requirements derived from scenarios?
- User requirements – who are the users?
- User validation

Conclusion on training

We hope you enjoyed this training session.
Please fill in the questionnaire & attendance list.
Any questions?

Additional Courses & Training material is available.
For further queries regarding the project please contact the project co-ordinator.

Thank You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19 June 2009
Hydra Training: Scenario Thinking

Slide 25

JT1 You should replace this with your own organisation
Jesper Thestrup; 20-06-2008