



# Chapter 2



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## Chapter 2: Requirements Elicitation

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DTU course 02264

# Agenda

## Abstract

- Often, domain knowledge (and so requirements knowledge) is predominantly human knowledge, and, as such, by definition subjective rather than objective.
- So, requirements elicitation is not about extracting an objective and eternal truth from some source. Rather, it is about the social construction of explicit consensual knowledge – one could say, requirements elicitation is about organizing truth.
- In the 21<sup>st</sup> century, engineering encompasses tasks that have not traditionally been associated with engineering: we have to inspire collaborators, investors, and clients with our vision.

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3. Objective Techniques for Requirements Elicitation
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5. Conversational Techniques for Requirements Elicitation
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7. Selecting Requirements Elicitation Techniques



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## **Chapter 2.1:**

# **Vision and Engagement**

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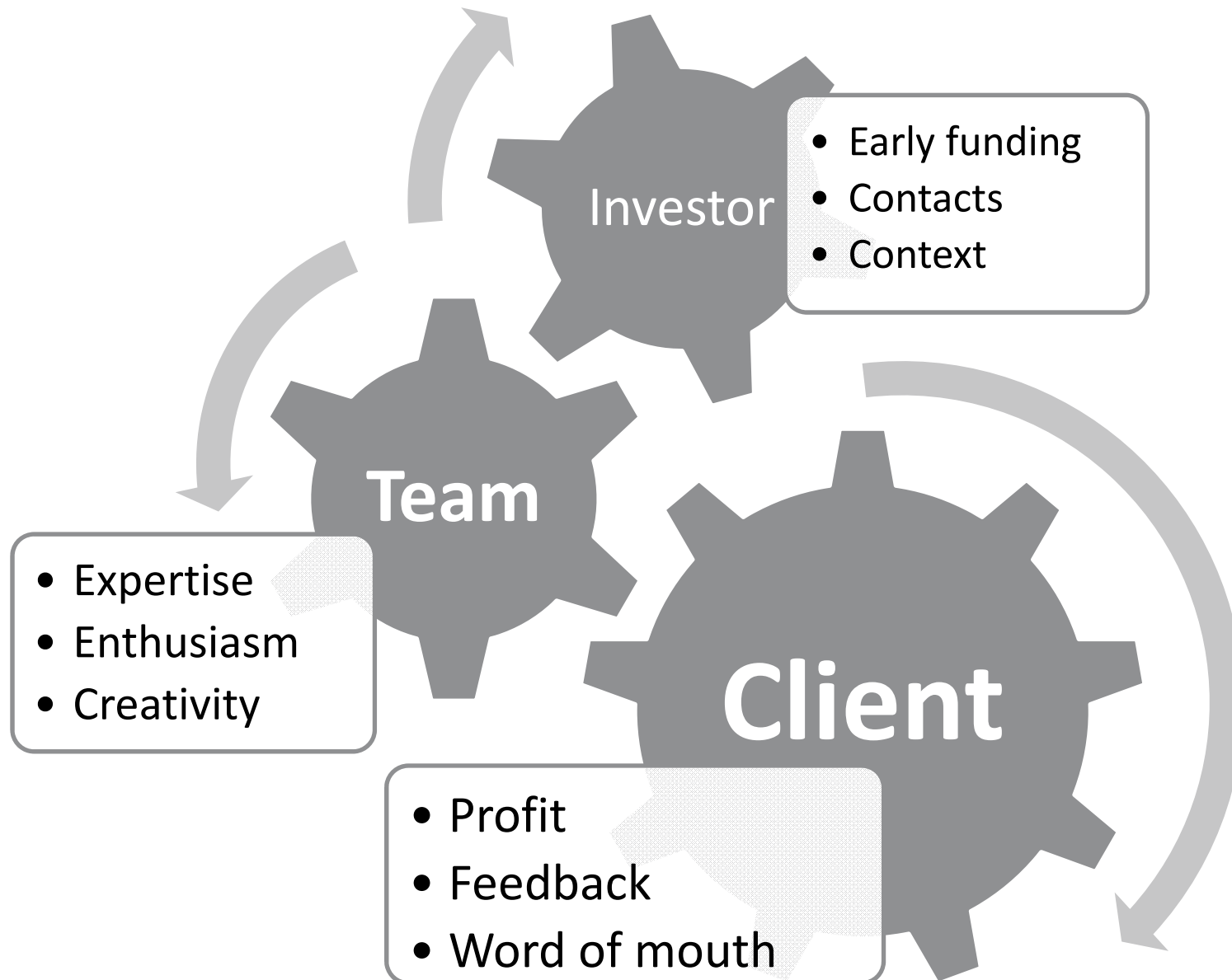
# Engaging Stakeholders by a Vision

- **A Vision is the concretization of strategic goals at the enterprise level into concrete products, designs, and features.**
  - Visions often comprise elements of several domains (e.g., economic, technological, social and political viewpoints).
- **The purpose of a vision is to engage its audience and provide a (rough) direction.**
- **Visions are orthogonal to goals and stakes (see next section).**
  - Goals and stakes are intended to be rational, factual, and sober, while a vision is supposed to inspire, engage, and excite (possibly also to provoke).
  - Compared to “proper” goals, a vision is much looser—but having less concrete detail does not mean that lack of precision or effort.
- **Visions are elusive, yet perfectly reachable.**
  - The point of the vision is to be beyond what people *believe* is feasible.
  - Having said that, it would not be a vision if it would always work out as expected.
  - That is not the point of a vision, though, and most visions are absolutely feasible.

# Audiences in the 21<sup>st</sup> Century

- **Back in the day, it might have appeared enough for a good engineer to do engineering, and ignore “all the rest”.**
  - This is in line with Dijkstra’s “Firewall” dictum, and characterizes the self-image of a good deal of the first five decades of software development.
- **Times have changed – today, that is no longer an option.**
  - Technology drives progress today, and sets the agenda. We are in charge.
  - We can really make a difference, every one of us can change the world.
- **The down side is that we now also have the responsibility.**
  - Engineering is no longer just about technical feasibility, rational planning, and cost-effective execution, it is just as well for sustainability, responsible use, and the greater good of the world and humanity.
  - We need to engage and communicate just as much as we need to design and construct.
- **And most importantly, there is a much larger and more diverse audience that we as (software) engineers need to take into consideration.**

# Important Stakeholders to Engage



## Vision purpose (1/3): Excite Investors

- **Each development requires resources: time, people, and money.**
  - Different ways of financing a project have serious impact on how to elicit, trace, and, eventually implement requirements.
- **In the good old days, development was billed by the hour with as effort progressed over time.**
  - This model puts the risk on the client who is often not in a position to appreciate the business of software, its risks and costs.
  - Much professional software is still created “in house”, in particular where software is decisive for the product.
  - Which, today, comprises almost each industry.
- **Other funding models include**
  - standard software, usually based on initial clients who funded “version 1” in the by-the-hour fashion;
  - classic investments (e.g., Business Angels, personal funds, bank loans, stocks);
  - and more recently, crowdfunding (e.g. Kickstarter, IndieGogo).
- **Either way, the investor must buy into the idea.**



## Vision purpose (2a/3): Excite Team

- **Every project is a team effort, many groups contribute, including collaborators from other companies, or even a loosely coupled community of practice.**
- **First, there is of course the team proper, the people directly and heavily involved in the development and production.**
- **Second, there are people in support functions.**
  - Support functions include IT admins, administrative staff (payroll, team assistants, HR, ...). They can be every bit as crucial as the engineers self.
  - In particular, consider that they do not get any of the self-realization benefits.
- **Third, collaborators are also found up- and downwards the supply chain.**
  - Suppliers provide essential parts for our solution, any failures on their part may negatively affect our schedule, quality, or margin.
  - Business clients (not consumers) are holding substantial stakes in our product/project.
- **Informing collaborators is essential, and the vision may be just the right tool to get them out of their corner.**

## Vision purpose (2b/3): Keep team on course

- **In the course of any project there come times when people on the team at large disagree about minor or major parts of the project.**
  - Engineers sometimes get quite worked up about technological issues.
  - It is particularly easy to get upset about ideas in the abstract, i.e., plans before realization—and requirements specification fit that description.
- **It can help at times to call to memory the vision that everybody has bought into, one way or another.**
  - Having a shared vision as a bearing point is not a panacea, but not having one is certainly detrimental:  
*“if you don’t know where you’re headed, any direction is fine”.*
- **Also, initial excitements may get diluted or lost over time.**
  - Calling back to mind the true purpose and reinvigorating the passion for a project is essential for motivating people.

## Vision purpose (2c/3): Inform Elicitation

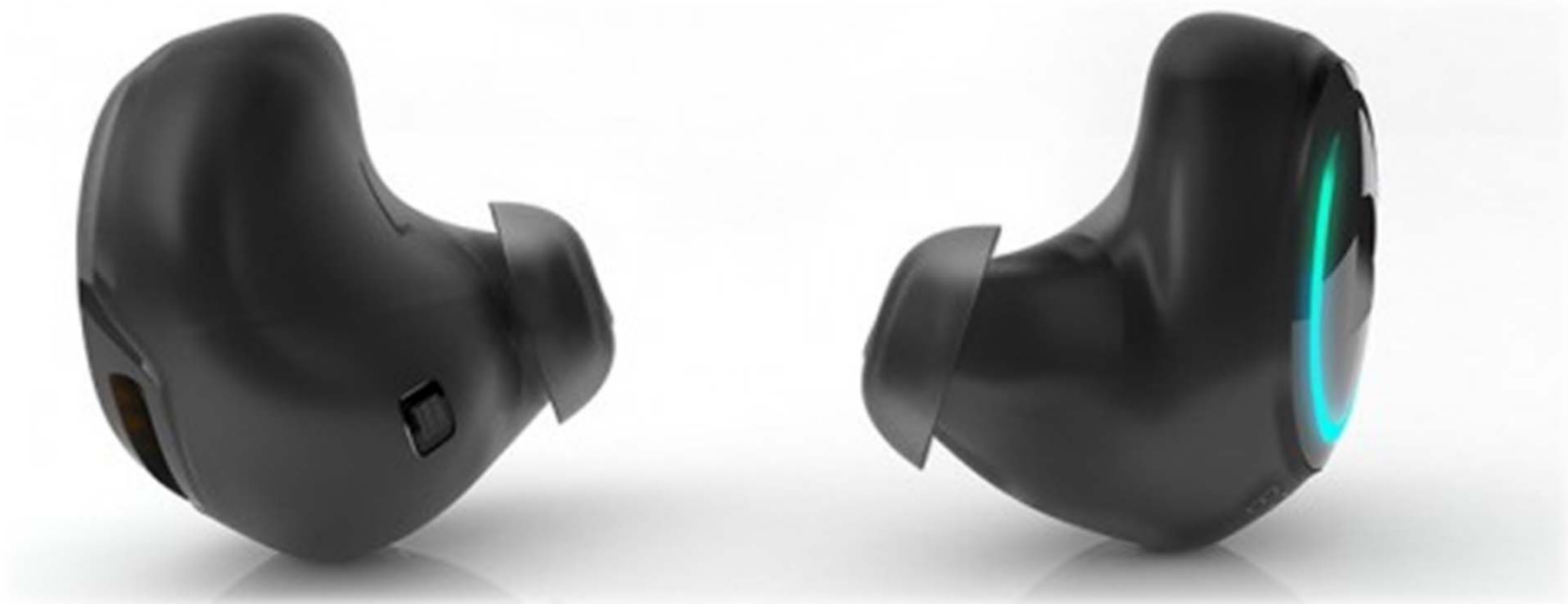
- **Inspiring individuals and the team, a vision is the first step towards refining the requirements: imagination is your best tool.**
- **Imaginative requirements elicitation has fundamental advantages.**
  - For advanced and innovative systems, the processes of design and requirements elicitation are necessarily intertwined.
  - Exploring opportunities offered by technology often allows for new options beyond those initially considered by the client-side.
  - These opportunities arise in the process, not beforehand, so they have to be realized as you go along, requiring imagination.
- **Imagination is only way to “think out of the box” and arrive at creative solutions to new problems.**

## Vision purpose (3/3): Excite Clients

- **The client is the group of persons actually using the system under construction.**
  - In the classic case of enterprise software, clients are decision makers in a client company, whereas users would be employees of the client.
  - For end-user products, client and user may or may not be identical.
  - For instance, a mobile phone user may be both client and end user of an app.
  - However, the app may also be provided to the end user on behalf of an OEM, such as a company for which the end user is working.
  - Another case is a company that assembles contributions into a product.
- **The first and foremost goal of all development projects is to excite and engage the client—who may or may not be the end user.**
  - The client is not always identical with users, but unhappiness on behalf of the users may backfire on the client sooner or later.
  - After all, the clients pay for the product in the end, and even if it takes a while to trickle down the chain, it does reach each supply chain link at some point.

## Vision 1: Bragi/The Dash

- Bragi ([www.bragi.com](http://www.bragi.com)) develops a new kind of in-ear headphone.
  - It is called “The Dash” and combines the features of an MP3 player, a fitness tracker, a Bluetooth headset, and more.
  - It is the most successful European Kickstarter campaign up to date.
  - It does come with an excellent [trailer](#) communicating their vision.



## Vision 2: The MS Workplace Vision

- Microsoft has developed a vision of tools, interaction, and modes of collaboration in the future workplace and produced a trailer to communicate it.



Part of the vision is now discussed under the name "Continuum".



## Vision 3: The Ulstein Bridge

- **Ulstein is a Norwegian-based company that designs and builds ships that are used e.g. in off-shore oil drilling enterprises.**
  - They have developed a vision of a bridge which is quite different than current technology (see the [Ulstein vision](#)).
- **Here is what a bridge looks like in fairly modern ships.**













# A Demonstrator

- The vision is within reach



# Elements of a Vision

- **A vision contains several distinguished elements.**
  - A **Mission Statement** is a brief description of the mission, not unlike an “elevator pitch”.
  - The **Expectations** describe the value of the expected outcome
  - Every mission comes with **Opportunities** and **Challenges**, i.e., the chances and risks associated to the mission.
  - Oftentimes, there are dedicated **Sponsors** and possibly also **Adversaries** that will support or oppose the mission
  - In the day to day work, **Group Values** characterize and guide the team – theses are non-negotiable.
  - Finally, there are usually some **Beliefs** or underlying assumptions behind the mission, which are unquestioned (but may change as insight grows).
- **It is not always easy to identify these, and it may be some time into the journey before all of these are quite clear.**
  - It is, however, always worthwhile to stop and think about these variables.



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## **Chapter 2.2:**

# **Overview of Requirements Elicitation**

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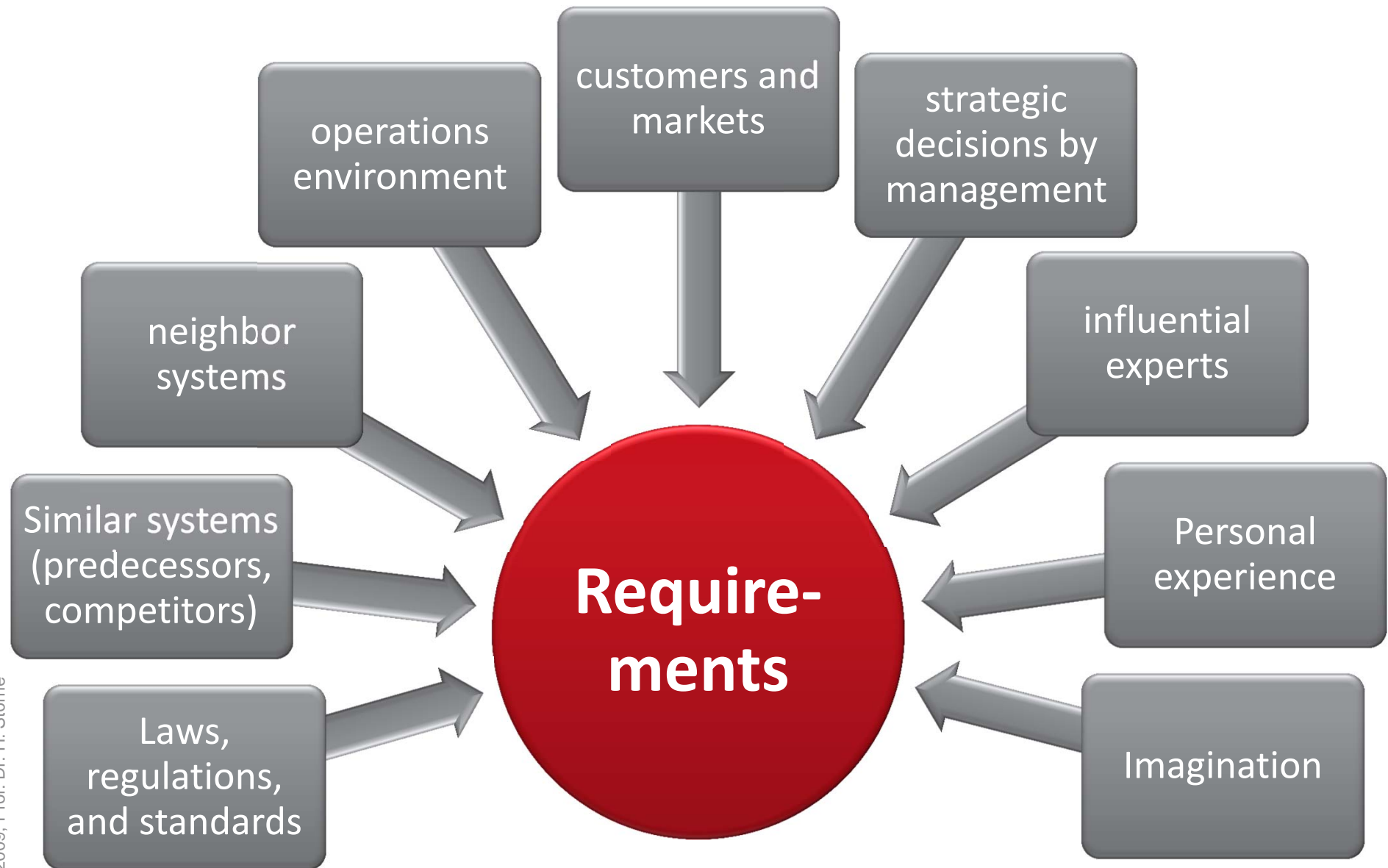
# Organizing Truth

- Many application domains are strongly influenced by their human users.
  - Often to a lesser degree for ERT-systems, but in the end, there is always a human user.
- Knowledge about an application domain is, thus predominantly concerned with a human view of the world
- So, objective truth doesn't exist, and we cannot "find" it or "extract" it.
- Consequently, requirements elicitation means constructing consensus which is made explicit as a software application.





# Sources of Requirements





# Elicitation Technique Overview

## Objective Techniques

- Data Analysis
- Background Reading
- System Archaeology
- Laws & Regulations

## Observational Techniques

- Ethnographic field studies
- Protocol Analysis
- Apprenticing
- Participant Observation

## Conversational Techniques

- Interviews
- Surveys, Focus Groups
- Group dynamics
- Role Playing

## Introspective Techniques

- Storytelling
- Personas
- Brainstorming
- Mind-Mapping

# Difficulties of Elicitation

## ■ Thin Spread

- Knowledge on application domains is often spread rather thinly: many people know little individually; collectively, they know a lot.

## ■ Tacit Knowledge

- Most knowledge is not explicit but implicit and people will find it hard to describe knowledge they regularly use.

## ■ Limited Observability

- The problem owners might be too busy solving it using the existing system.
- Also, the presence of an observer as such may have an effect (→Hawthorne).

## ■ Bias and Error

- People may have different understandings of the problem,
- their account may be an inaccurate rationalization of expert behavior,
- they may not be free to tell you (climate & organizational factors),
- they may not want to tell you (hidden agendas).

## ■ It is often impossible to obtain objective truths.

## Example

- **Assume a requirements analyst is trying to elicit the rules and procedures for approving a loan at a large bank.**
- **Here are some problems that might occur.**
  - There is a document in which the rules for approving loans are written down, but the management has issued an email recently modifying the rules.
  - Some people feel the older rules are better, or the rules should be more flexible to account for individual cases.
  - The official rules (either version) does not match what is done in practice
  - While being observed, an accountant sticks very precisely to the rules, since she's afraid of getting fired for not respecting the rules.
  - At the same time, she's afraid her job might be automated, so she's exaggerating the effort and problems in assessing the individual case to convince the analyst that it has to be done by a human.
- **Which of the problems mentioned before are there?**
- **Which of these problems might occur in the library case study?**



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## **Chapter 2.3:**

# **Objective Techniques for Requirements Elicitation**

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# Background Reading

## ■ Sources of information:

- company reports, organization charts, policy manuals, job descriptions, reports, documentation of existing systems, etc.

## ■ Advantages:

- Helps the analyst to get an understanding of the organization before meeting the people who work there.
- Helps to prepare for other types of fact finding
  - e.g. by being aware of the business objectives of the organization.
- may tell you the detailed requirements for the current system.

## ■ Disadvantages:

- written documents often do not match up to reality.
- Can be long-winded with much irrelevant detail

## ■ Appropriate for

- Whenever you are unfamiliar with the organization being investigated.

# Collection of “Hard” Data

## Identify existing collections of hard data

- Facts and figures, financial information,...
- Reports used for decision making,...
- Survey results, marketing data,...

## Mine existing data sources

- Select representative data sets from a population. Relevant factors include:
- Sampling method  
(type of sample, elicitation method)
- Data set selection  
(which data source, which attributes)
- Population selection  
(method of extracting population from data source, sample size )

## Example

- **Suppose we want to find out about the prototypical library user and their usage of the library.**
- **We might first decide to randomly sampling 5% of all library users.**
- **This could be done by selecting every 20th user in the existing database.**
- **We may want to get the following data:**
  - *How many media of which type has the reader lent during the last year?*
  - *How often did the reader prolong what kind of media?*

- **Reengineering projects replace software for technology reasons.**
  - Prolonged maintenance may have led to architectural degradation, so that changes even small changes in functionality are excessively.
  - Some piece of hardware or system software the application relies on can not or shall not be used any more, e.g. it is not manufactured any more, maintenance costs are excessive, built-in technical limitations interfere with company strategy and so on.
  - A custom-made application shall be replaced by standard software which needs to be customized to provide the same functionality as before.
  
- **In such cases, an old system is replaced by a new system with essentially the same features, but different qualities.**
  - The desired qualities must be elicited with “green field” methods.
  - The features must also be elicited, e.g. for defining a tender, estimating effort, and planning the project, but the old system may provide input to the process.

# Laws & Regulations

- **Many administrative systems implement some kind of law or regulation.**
  - For instance, all procedures related to taxes, social benefits, public administration fall into this category.
  - Also, all business administration procedures that are somehow regulated (from accounting and statistical reporting to human resource management), and are largely affected by laws and regulations, e.g. data protection, accounting laws.
  - In particular in embedded systems, there are also market standards that must be implemented, e.g. bus and protocol specifications.
  - Finally, there are many regulations at the level of international treaties that define interfaces and procedures, e.g. SEPA or SWIFT.
- **If such rules apply, the respective norm will be a valuable source of information.**
  - Typically, the norm as such is ambiguous and interpretation is needed.





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## **Chapter 2.4:**

# **Observational Techniques for Requirements Elicitation**

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# Ethnographic studies

- **An ethnographic study tries to observe subjects in their usual environment doing the things they usually do.**
  
- **Weaknesses**
  - The presence of an observer and the fact that an observation is being conducted may influence the observation (Observer effect, Hawthorne).
  - Imagine you are having dinner with your new girl friend's parents for the first time.
  - Ethnographic studies require extreme effort: analyzing 5 minutes of video may take a whole day for a group of experts.
  - It is often not clear how the raw data are to be interpreted, and there are several alternative interpretations. In order to disambiguate, we would have to ask.
  
- **Strengths**
  - Provides extremely powerful insight if successful (→ SMS-usage)

# Protocol Analysis

- **Domain experts are asked to do their regular tasks as usual, but keep speaking out aloud what they are thinking.**
  - After a short while, this becomes very natural to most people
  - Alternatively, the subjects may be asked afterwards to report on their behavior (“retrospective protocols”).
  
- **Strengths and Weaknesses**
  - cognitive activities are directly verbalized, embedded in the work context
  - Good at revealing interaction problems with existing systems (i.e. usability testing)
  - introspection is intrinsically unreliable
  - This method lacks the social dimension relevant for many processes.
    - For instance, the process of returning books cannot be examined this way, while the process of creating a new librarian account can.

- **The analyst accompanies an experienced and representative user through his/her daily work for a while.**
  - The idea is that the apprentice learns the job, all the relevant concepts
  - Being fresh to the job, many things obvious and not worth mentioning to the expert will cause the apprentice to ask, and to learn.
  - Depending on the size and complexity of the task, the apprentice will spend days or weeks on the job.
  
- **Strengths and Weaknesses**
  - May provide detailed data on implicit/tacit knowledge, but does not provide deep understanding.
  - An apprentice may come up with new and unconventional ideas most of which will be not useful. Still, it might inspire the experts.
  - Apprentice is not objective and may easily overload.
  - Critically depends on the grasp of the apprentice and the relationship between apprentice and mentor.

# Participant Observation

- **Observer spends a long time with the subjects.**
  - The observer effectively becomes a group member, that is, the observer's presence is no threat to validity anymore (contextualization).
  - Imagine a consultant who is present in a group as a kind of intern, but overtly as an observer, not as an apprentice (who subjects him/herself to the environment).
  
- **Strengths and Weaknesses**
  - produces very rich data – but hard to analyze
  - very time consuming
  - difficult to maintain observer's independence (“going native”)
  - appropriate for longitudinal studies

# The Hawthorne-Effect

- **In the 1920'es, Mayo, Roethlisberger, Dickson et al. studied productivity job satisfaction and staff fluctuation at a company called Hawthorne.**
  - One of their questions was: „How does lighting and Brightness at the workplace affect productivity?“
- **First results showed that ANY change increased performance and satisfaction.**
  - Further studies revealed that the presence of the experimenter gave subjects a feeling of importance and appreciation („Somebody important in a white lab coat is paying attention to me and my work, which so far have been regarded as unworthy by everybody“). This apperantly motivated the workers and thus lead to the results.
- **This is probably the single most influential result of labor studies in the last century.**
  - Closer scutinization in the 1970'es revealed however, that the original experiments had been manipulated.



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## **Chapter 2.5:**

# **Conversational Techniques for Requirements Elicitation**

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# Conversational Techniques

- **Asking people (stakeholders, users, clients) is the simplest possible way of gathering data.**
  - Even if the data is highly subjective, it is a good starting point and we may obtain valuable hints and directions very early, and very easily.
  - As a side effect, if people are being asked for their opinion, they have the feeling their point of view is being taken into account and are less likely to oppose the project.
- **The more structure is put into a conversation, the more structured the results will be, and the less bias is introduced by the people being asked.**
  - However, the people asking also bias the outcome, e.g. by the way they are asking, the questions they ask, the question ordering and so on.
  - Also, if a lot of structure is put into a conversation the partners may not feel their position is appropriately represented in the result and may feel disconnected to the campaign.



# Interviews

- **There are two types of interviews.**
  - Structured interviews have a set of predefined, but rather open questions
  - Qualitative (open) interviews just set the topic but not the questions.
- **An interview campaign consists of three stages.**
  - Suitable interview partners must be identified (and agree).
  - The interview schema must be prepared, evaluated, and optimized.
  - The interviews are held, recorded, and transcribed.
  - The transcriptions must be evaluated, compared, and aligned terminologically.
- **Strengths and Weaknesses**
  - Interviews provide fairly rich data, allow to elaborate and probe deeper at any point.
  - Interviews are good for an initial examination to prepare follow-up work (more structured interviews, surveys).
  - Qualitative data may be hard to analyze, however, and it may be difficult to generalize the results from several interviewees.
  - Interviewees are not objective, Interviewers may cause bias

# Interviewing Tips

- **Make sure that the interview partner knows what is going on, why he is being interviewed, by whom, and to what end.**
- **Before the interview proper starts, small talk (weather, sports, lunch) helps relax the atmosphere.**
- **Obtain interview partners permission to record and process data, explain how anonymity will be guaranteed.**
  - Usually there will be a form to sign by both parties, each getting a copy.
- **Ask demographic questions first.**
- **For open ended interviews, try to reduce interview bias by letting subjects talk first, and only ask questions when they stop speaking.**
  - Some interview partners are very talkative, there, the problem is different...
- **Follow up interesting leads.**
  - E.g. if you hear something that indicates your plan of action may be wrong.
- **Ask open-ended questions last**
  - e.g. “Is there anything else you would like to add?”

# Surveys and Questionnaires

- **Surveys are less open than structured interviews but can create a large amount of quantitative data rather quickly and cheaply.**
  - Can even be done online, these days.
- **Strengths and Weaknesses**
  - Results are easy to compare, but you can only get answers to questions you ask.
  - Therefore: test your survey thoroughly before launching to a wider public!
- **Problems**
  - Bias through sample selection
  - Small sample size (lack of statistical significance)
  - Open ended questions (very hard to analyze!)
  - Ambiguity (I.e. not everyone is answering the same question)

# Survey Sources of Error

## ■ Sampling Error & Sampling Bias

- Info not collected from every member of the target population
- Potential Bias in how the population is sampled
  - E.g. web-based surveys exclude non-internet users
  - E.g. Respondents who self-select might not be representative

## ■ Coverage Error

- Occurs when not all the target population is included in sampling
  - E.g. Use of an existing mailing list that is out of date

## ■ Measurement Error

- Occurs when responses are not counted accurately
  - E.g. ambiguous question leads to responses that are hard to classify
  - E.g. question topics do not correspond to the issues being investigated

## ■ Mortality / No Response

- Occurs when significant number of population does not fully participate
  - E.g. a significant special interest group does not complete the survey, or refuses to take part altogether

# Types of Group Elicitation Techniques

## Joint Application Design (JAD)

- Project sponsors, domain experts, and development experts join in a workshop to fix the vision, the context, and the requirements.
  - No reliable empirical results on effectiveness available.
- *said to be effective for small projects with few stakeholders*

## Group Dynamics

- Stakeholders and end users are guided to elicit requirements in a moderated workshop
- *effective in creating consensus / participation*

## Delphi technique

- Each expert submits their judgement
  - All judgements are circulated anonymously to all experts
  - Each expert then submits a revised judgement
  - Iterate until judgements converge
- *Use when contact between experts is difficult*

## Focus Groups

- Assemble experts together and discuss the problem
  - Discussion may be structured (e.g. debate) or unstructured
- *good for product pre-development*

# Focus groups

- **A focus group is a group of 6-10 people which are carefully selected to be representative for a given population of interest.**
  - E.g. certain social, ethnic, or age groups such as: white teenage girls.
- **A moderator leads the group through a predefined set of questions or topics and records opinions and answers.**
  - As an additional aid, the group discussions are often videotaped so that clips with particularly telling moments can be used for follow-up discussions and presentations, possibly even as starters in other focus groups.
- **Data gathered by focus groups are usually qualitative rather than quantitative.**

- **A very common way of eliciting requirements is to get small groups of people to work together on one issue at a workshop.**
  - 5-10 people for 2-5 days, often off-site/isolation
  - The group will develop during this time and, if it works out, becomes highly effective in the end.
  
- **Strengths and Weaknesses**
  - Workshops (in particular at remote sites) are great for team building and participant buy-in.
  - They are also a good way to create consensus.
  - With the right preparation and follow-up work – high quality creative results may be achieved.
  - The effort is considerable, however, and complex technical questions may not be truly solved this way.
  - The success also critically depends on the qualification of the facilitator.

# Collaboration and Group Dynamics

- **When groups grow large, they become very heterogeneous, and it can be very difficult to reach a consensus.**
  - For simple, closed questions we may simply take a vote.
  - We cannot do that for questions that need a creative answer.
- **The goal of group dynamics methods is to stimulate and support process in groups (i.e. group dynamics) in creating creative consensus.**
  - If every member of the group is allowed to contribute in an appropriate way, they will all feel that the result has been influenced by them.
  - Group members will support such results much better than solutions forced upon them.
- **Group Dynamics methods have three key elements**
  - inspire creativity
  - democratic decision making within the group,
  - presentation of results to other people.



# Problems in Group Dynamics

- **There might be several obstacles to an optimal group process.**
  - Differences in seniority, authority, or hierarchy may intimidate weaker group members and reduce their contribution to the group.
    - The opposite may also occur, though rather rarely.
  - Differences in levels of education and/or knowledge may make the advanced group members impatient and could deter shy group members.
  - Different goals (hidden agenda) may lead to different contributions, including the goal to kill the process.
  - Different levels of Motivation and activity, and generally differences in personality will lead to disturbances in the group process.
- **It is the purpose of the facilitator to level the field, support the group, and facilitate the process for reaching the maximum result.**
  - The result, however, must always, strictly, be a group result.
  - The facilitator is a catalyst or counselor rather than a leader.
  - Manipulation of the group is unethical (and doesn't work in the long run).

# Documentation of Group Dynamics

- **Since the process is at least as important as the outcome, it should be documented.**
  - Ideally, there are plenty of movable pin boards that are used throughout the process and present the current state of the work as an aside.
  - Completed pin boards may be glued together and tucked to the wall (just like flip chart pages).
  - There, they can and should stay for good, if the room is a team room.
- **If all that is not possible for some reason or another, the results can still be photographed and the pictures distributed included in a presentation.**
  - The results can be presented using these materials.
  - An unusual but very effective way of communicating a group result might be to turn it into a little play or show, possibly a small movie.
  - More traditional forms might include handed-out documents and slide shows.

# The Card Collection Exercise

- **In brain storms, group discussions etc., the facilitator takes notes on cards, and collects them on a pin board.**
  - Questions back to the audience are only allowed for better understanding and formulation.
  - In large or very active groups, the facilitator may be supported by one or two scribes who write down the keywords passed on by the facilitator and attach cards to a pin board or similar.
  - This helps the facilitator to concentrate on the group process.
  - In a second stage, cards are grouped under a common heading.
  - Duplicate and irrelevant cards are removed, some cards may be improved.
- **Strengths and Weaknesses**
  - very fast and scalable procedure
  - highly skilled facilitator (group dynamics and language) needed

# The Flashlight Exercise

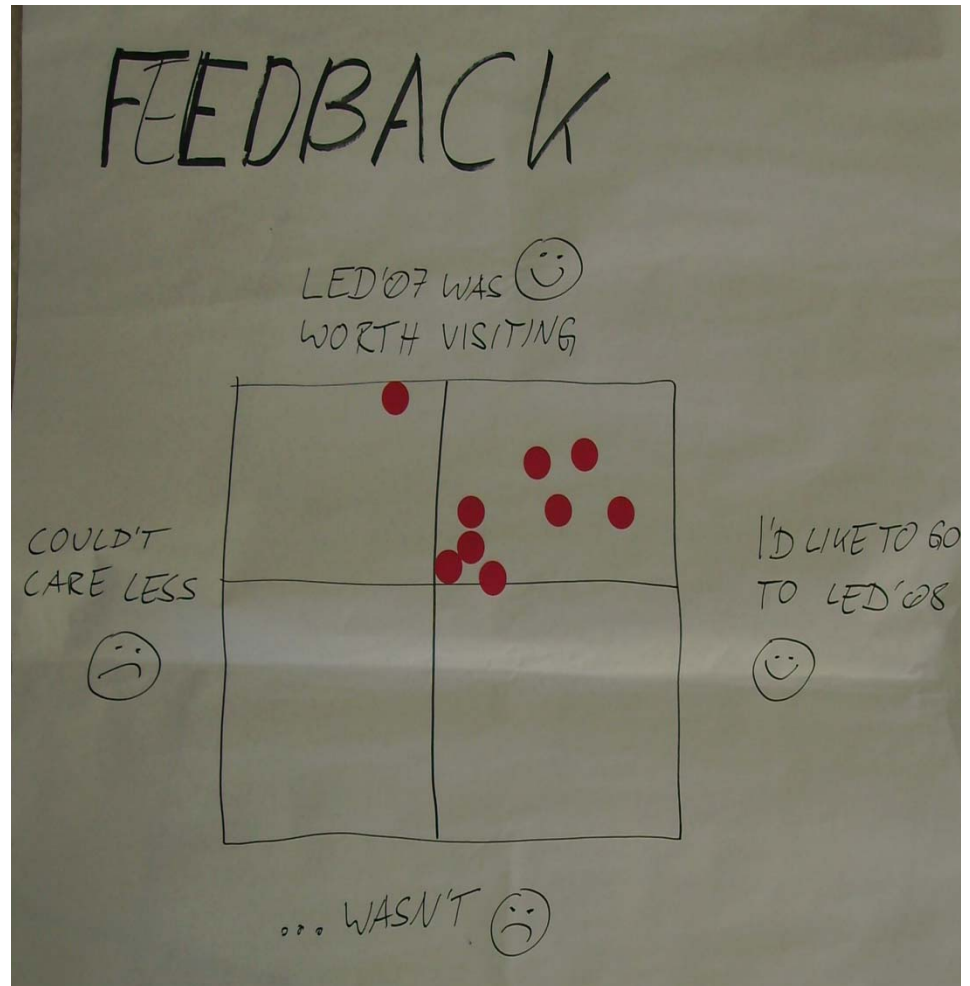
- **The facilitator asks an open and personal question.**
  - „How do you feel right now?“
  - „Which alternatives do you think are feasible?“
- **Every member of the group answers briefly (2-3 sentences).**
  - No reference whatsoever to previous answers are admissible.
  - Takes 5-10 minutes, depending on group size (max. 15..20)
  - The result is summarized by the facilitator.
- **The flashlight exercises obtains a detailed group opinion in preparation of a final decision (e.g. by vote).**
  - It may also help manage and reflect the group process proper.
- **Strengths and Weaknesses**
  - Individual feelings and opinions may be voiced without being suppressed or disturbed.
  - In contrast to a plain vote, there may be alternative, complex answers.
  - Makes process problems obvious

# The Sticky Dots Exercise

- **The facilitator asks the group for a vote on some issue.**
  - A one- or two-dimensional grid is drawn on a A1/A0 size piece of paper (e.g. a Flipchart). The dimensions or grid fields are associated with questions.
  - Every participant gets one sticky dot (or n dots).
  - Using differently colored dots may add another dimension.
  - All participants are asked to put their sticky dots to the grid at the same time.
- **The Sticky Dots Exercise is used for an anonymous multi-dimensional group vote.**
- **Strengths and Weaknesses**
  - In contrast to the flashlight exercise, participants stay anonymous (honest feedback), and language skill does not matter.
  - Every vote counts the same, so the influence of trend setters is minimized.
  - The result of the poll becomes immediately visible.
  - Participants are physically active – acts as a little break.

# Analyzing a Sticky Dot Chart

- The position of dots along the dimensions provides graded answers to one or two questions.
- Outliers and the main focus are immediately obvious.
- If there is no focus but a rather widely distributed cloud of dots, other exercises must be used to find out more (e.g. a Flashlight).
- It all works for different colors, up to three should be no problem.
- The number of dots should not be below 5. Above 100 it gets a bit messy. Using several colors and complex questions reduce the maximal admissible number of dots.



*“It helps to be a genius,  
but you don’t have to be.”  
Anonymous*



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## **Chapter 2.6:**

# **Introspective Techniques for Requirements Elicitation**

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# Classic Individual Creativity Techniques

- Creativity is not (just) a gift or the genes, there is also a considerable amount of technique and practice involved.
- Probably everybody has their own method when creativity is called for. Here are some common examples:
  - Daydreaming – just sitting and doing nothing
  - everyday activities – doing the dishes/laundry, cooking, cleaning, ...
  - some physical activities – running, swimming, climbing, walking the dog, ...

**...really anything that requires little frontal cortex involvement but keeps the rest of the brain busy will do the trick.**
- Commonly used amplifiers include a glass of red wine (or whatever you prefer) and doodling on large (!) sheets of paper.
- Pressure of whatever kind only increases focus, not originality.



# Mind Maps

- **Mind maps are a way of organizing knowledge in a visual and hierarchic way.**
  - They can be created individually, or in groups, for collecting and presenting topics.
  - Mind maps are great for outlines and overviews.
  - Depending on the size of the group and the issue at hand, creating a mind map will take approximately 15-20 minutes.
- **Creating a mind map**
  - The subject matter (called the root) is printed in the middle of the drawing area (A3 sheets, blackboards, ... whatever).
  - Main aspects of the subject matter are added as branches all around the root issue.
    - In contrast to Brainstorming, only relevant contributions are recorded.
  - Minor aspects are added to the main branches (or other minor branches) where appropriate.
    - The result is a tree, but it is easy to add, remove, or elaborate parts of it without changing the rest, in particular without changing the positions of things.
  - The 2d structure supports visual processing.
    - Additional support may be provided by illustrating the branches and twigs with little drawings.
  - Generally, pictures afford better memory recall, but providing a helpful illustration is not always easy.

# The Brainstorming Method

- **Every group member (approx. 10..100 people) may shout an idea to the group.**
  - Depending on group size, this may take anywhere between 5 and 30 minutes, generally smaller groups last longer. A variant requires people to be prepared.
- **The facilitator records it, no matter how crazy or outworldish it may seem – no criticism is a strict rule.**
  - By admitting „crazy“ ideas, others are often inspired and come up with (better) ideas of their own.
- **Brainstorming helps find ideas in groups too large for dreaming.**
  - Brainstorming is particularly suitable as an ice breaker and for unconventional
  - The key point is mutual inspiration and shared results.
- **Now the results are grouped and scrutinized**
- **Strengths and Weaknesses**
  - not useful for complex problems
  - helps with team building, and as an ice breaker

# The 6–3–5–Method

- **6 people sit in a circle with a 3 by 6 table on an A4 sheet of paper in front of them.**
  - Everyone writes down 3 ideas in 5 Minutes, then passes their sheet to the left.
  - The ideas already noted on the now new sheet should be read before writing down 3 more ideas.
- **After 6 rounds, all sheets are placed to the pinboard to be analysed together by the group.**
- **Strengths and Weaknesses**
  - More structure than brainstorming, more effective than Brainstorming when participants have time to prepare
  - diminished danger by overly extroverted people
  - restricted to relatively small groups, comparatively slow



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## **Chapter 2.7:**

# **Selecting Requirements Elicitation Techniques**






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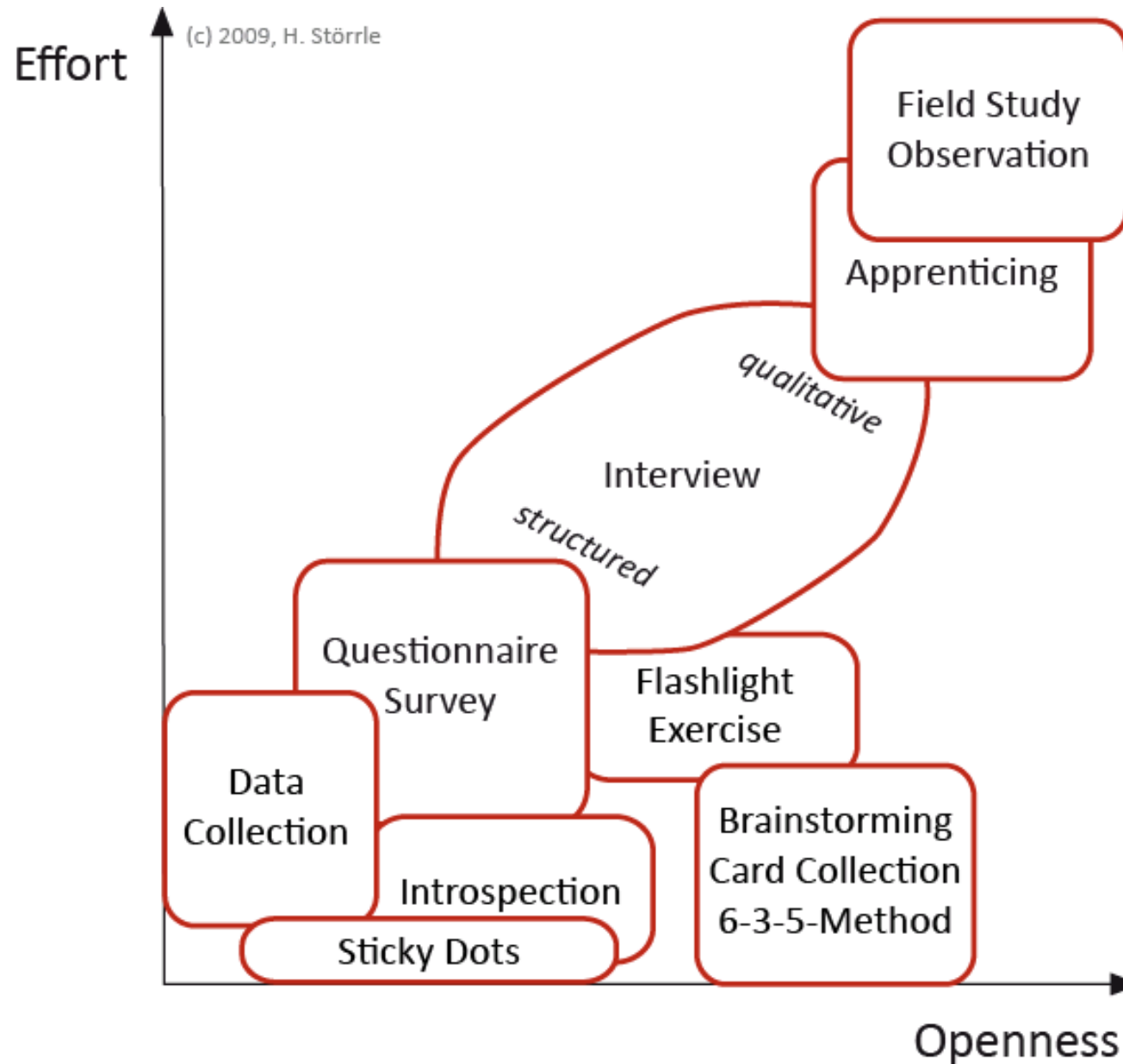
# Comparison of Methods

Technique	Good for	Kind of data	Advantages	Disadvantages
<b>Questionnaires</b>	Answering specific questions	Quantitative and qualitative data	Can reach many people with low resource	The design is crucial. Response rate may be low. Responses may not be what you want
<b>Interviews</b>	Exploring issues	Some quantitative but mostly qualitative data	Interviewer can guide interviewee if necessary. Encourages contact between developers and users	Time consuming. Artificial environment may intimidate interviewee
<b>Focus groups and workshops</b>	Collecting multiple viewpoints	Some quantitative but mostly qualitative data	Highlights areas of consensus and conflict. Encourages contact between developers and users	Possibility of dominant characters
<b>Naturalistic observation</b>	Understanding context of user activity	Qualitative	Observing actual work gives insights that other techniques can't give	Very time consuming. Huge amounts of data
<b>Studying documentation</b>	Learning about procedures, regulations and standards	Quantitative	No time commitment from users required	Day-to-day working will differ from documented procedures

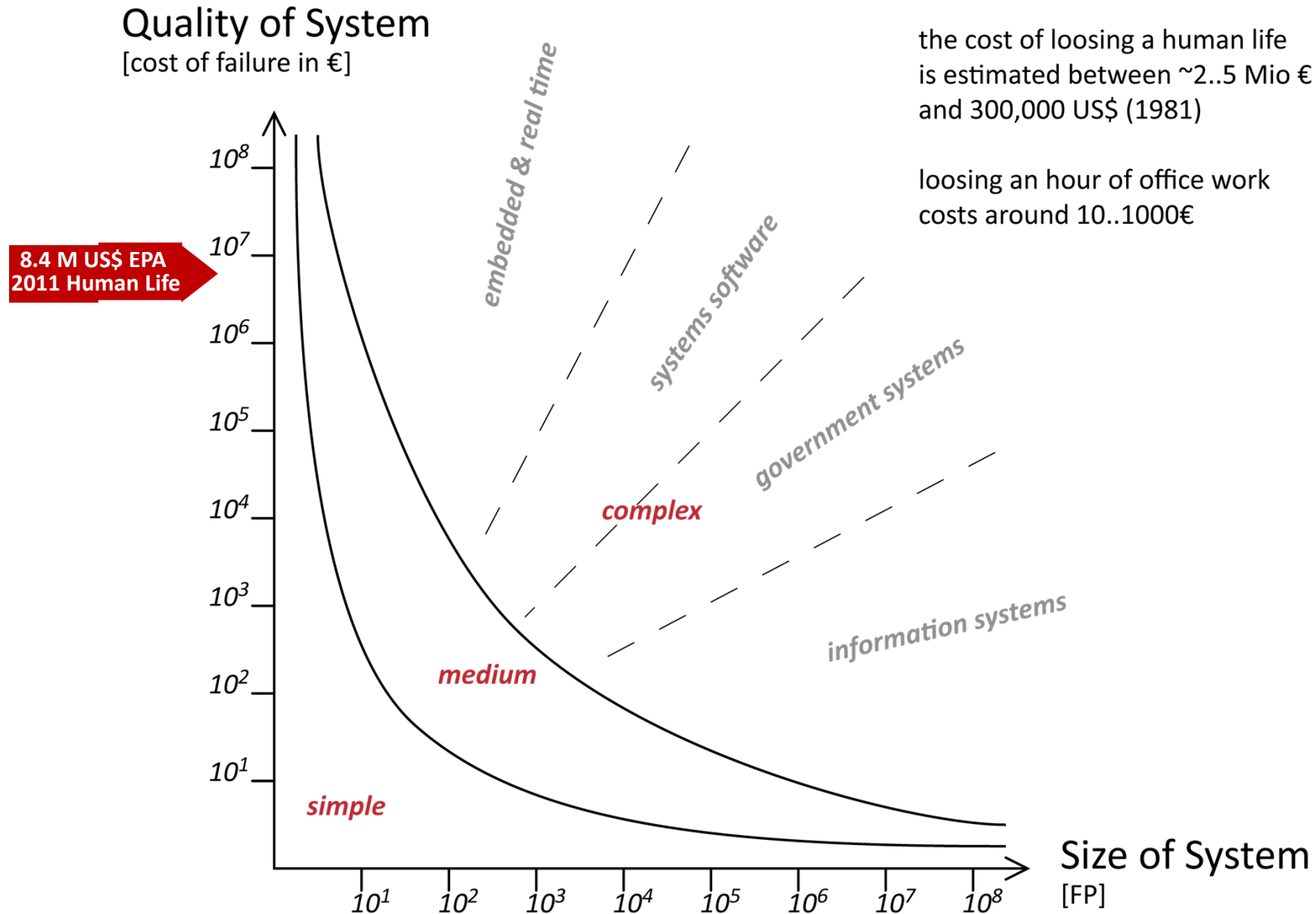
# Methods vs. Project Constraints

<div>Legend:</div> <div><div>-</div> not at all suitable</div> <div><div>-</div> not very suitable</div> <div><div>o</div> usually suitable</div> <div><div>+</div> suitable</div> <div><div>++</div> very suitable</div>	Creativity								Obs.	Interaction					Past	Methods and Tools										
																										
	Brainstorming	Paradoxical Brainstorming	6-3-5 Method	Change of Perspective	Walt Disney Method	Bionik / Bisociation	Osborn Checklist	Scenario Technique	Field Study / Ethnography	Apprenticing	Sophist rules	Questionnaire	Interview	Specification by User	Customer On Site	Systems Archaeology	Reuse	Workshop	Mind Mapping	Snow-Cards	CRC-Cards	Audio Capture	Video Capture	Use Cases	Essence Extraction	Imagination
People (Client Side)																										
low motivation	-	--	--	--	--	--	-	-	+	-	o	+	+	--	--	o	o	+	-	+	o	o	+	o	o	++
low communication skills	-	-	-	-	o	o	-	-	-	++	++	o	-	--	-	o	o	-	o	-	-	o	o	+	o	+
implicit / tacit knowledge	+	++	++	+	+	+	+	+	++	++	++	--	o	--	+	o	o	o	+	o	o	o	o	o	o	++
low abstraction capabilities	-	--	-	-	-	--	-	++	++	++	+	+	+	-	-	o	o	o	-	-	o	o	o	-	--	+
diverging stakeholder forces	-	+	-	-	-	o	+	+	-	-	+	++	o	-	--	o	o	+	-	+	+	o	o	+	++	o
difficult group dynamics	--	--	--	o	--	o	+	-	--	++	-	o	o	+	+	o	o	--	-	o	-	--	--	o	o	o
Organization and Process																										
Green field development	++	+	++	++	++	+	+	++	o	o	o	+	+	+	+	--	o	+	++	++	++	o	o	o	+	+
Maintenance	o	+	o	o	o	o	++	-	+	+	o	+	+	+	+	++	o	+	o	+	+	o	o	o	o	+
Individual software	o	o	o	o	o	o	+	+	+	+	o	+	+	++	++	+	o	+	o	o	+	o	o	o	o	+
Software product development	++	+	++	++	++	+	+	++	-	--	o	+	-	-	--	o	+	o	++	-	o	-	-	o	o	+
fixed /static budget	o	o	-	o	o	--	-	++	-	--	+	+	+	+	-	--	++	o	o	o	o	++	-	o	o	++
distributed stakeholders	--	--	--	-	-	-	o	-	o	o	o	+	-	++	-	o	o	--	-	--	--	o	o	o	o	o
low availability of stakeholder	-	-	-	-	-	-	-	+	++	--	o	+	-	--	--	o	++	--	-	--	--	++	++	o	o	--
large number of stakeholders	-	-	-	o	o	-	-	-	-	--	o	+	--	--	--	o	o	--	o	--	--	-	-	+	+	o
Systems and Requirements																										
high criticality	o	o	+	+	+	-	+	+	+	--	++	+	+	+	++	++	-	+	o	+	+	++	+	o	+	-
large /very large system	o	o	o	o	o	o	--	o	++	+	o	--	+	+	+	+	++	+	o	+	+	o	o	++	++	+
high complexity of processes	+	-	o	+	+	-	+	o	--	--	o	--	+	+	+	+	+	+	++	o	o	o	o	+	o	o
low observability	+	o	o	+	o	++	+	+	--	+	o	+	+	+	+	+	+	+	+	o	o	o	--	o	+	o
significant non functional requirements	-	-	+	+	o	+	o	-	-	+	o	--	-	-	-	+	+	-	o	o	+	o	+	o	o	o
lack of domain knowledge	o	o	+	o	-	-	o	-	+	++	o	--	+	++	+	++	--	+	o	o	o	o	o	+	o	--
abstract (coarse) requirements	+	+	+	+	+	+	++	-	--	-	+	++	++	+	+	-	o	+	+	++	++	o	o	++	++	-
detailed (fine) requirements	-	-	-	-	-	-	o	--	+	++	++	o	++	+	++	++	++	o	-	-	-	+	+	-	o	+

# Effort vs. Openness



# Complexity of RE of software systems





# Differences between types of systems

- In Embedded/Real Time (E/RT) systems, deployment is extremely expensive compared to patches and updates for desktop software.
- The respective organizational cultures make a huge difference, i.e., compare engineers, military, officials, business people from different branches.
- When team sizes increase, teams also spread out geographically, often across the world which leads to new classes of problems.
- Different markets have different drivers, e.g.
  - mobile communication → time to market and innovation
  - finance and insurance → security and mass data processing
  - embedded systems → safety, reliability
  - ...
- Similarly, the people in those areas have different mindsets.
- Also, there are different risks and regulations.

# Development activities vs. project size

		System Complexity		
		simple	medium	complex
Development Activity	Analysis & Design	10-20%	20-30%	30-45%
	Implementation, Integration & Deployment	60-80%	40-60%	10-40%
	Test, Verification & Validation	10-20%	20-30%	30-45%

The more complex a project (and a system) is, the less important is coding.  
N.b.: Size contributes directly to complexity.

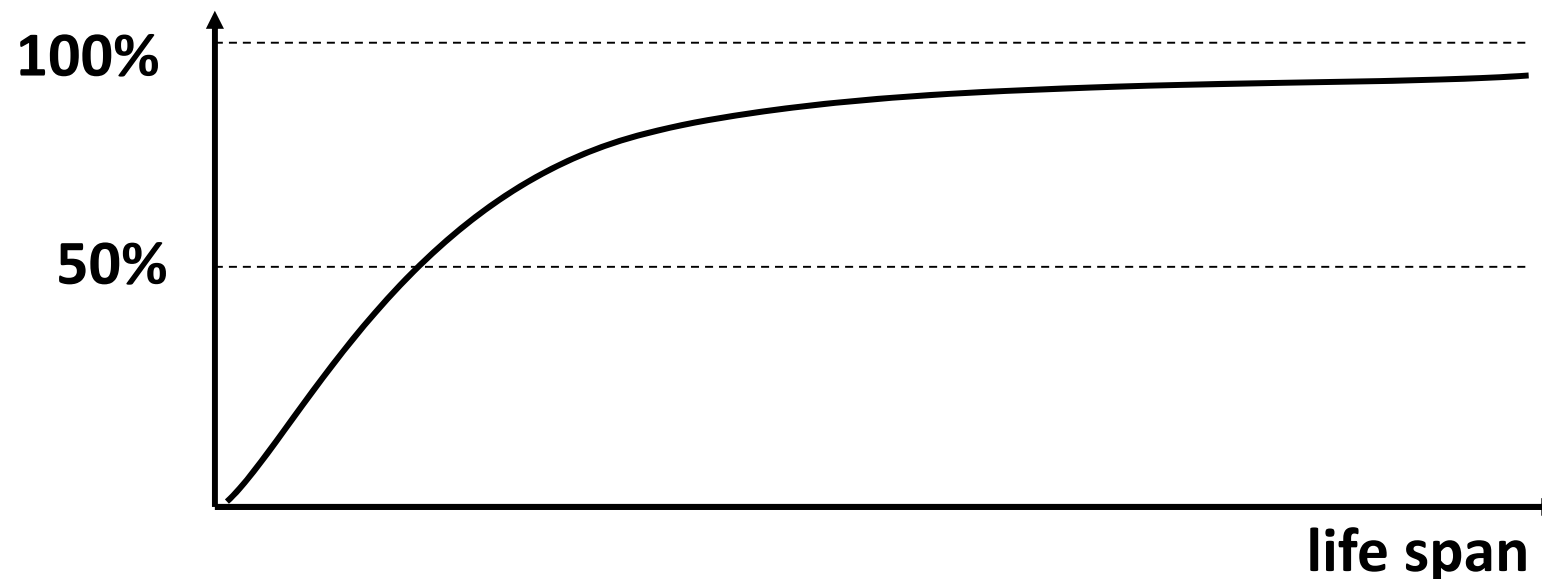
# Large systems vs. small systems

- **Small systems are not the challenge today.**
  - Errors made there are due to lack of diligence and individual qualification, but not unavoidable.
- **Large systems, on the other hand, are still problematic.**
  - Even small errors add up and may have enormous consequences.
- **There are different aspects of the “size of software”, relating to the process as well as to the product:**

■ lines of code	$10^5 \dots 10^8$
■ life span	years, decades
■ number of developers	50...5.000
■ number of concurrent users	100...10.000
■ number of interacting systems	10...10.000
■ number of components	10...100

## Operational cost vs. life span

- The cost of operating and maintaining a system are often underestimated or completely neglected.
- Similarly, the life expectancy of application systems is often grossly underestimated (cf. the Y2K bug).
- Over time, the operations cost are easily larger than the initial development cost and approximate 100%.



# System size categories

FP	LoC (approx.)	Order	Example
1	100	tiny	Mashups, Macros
10	1,000	very small	Applet, student project
100	10,000	small	Application, embedded system
1,000	100,000	medium	small desktop application, middleware
10,000	1,000,000	large	major desktop application, operating system, fighter plane
100,000	10,000,000	very large	small ERP system, war ship
1,000,000	100,000,000	ultra large	large ERP system, the cloud

Information systems of up to 1.000FP may be "hacked" by clever individuals by applying pure intellectual force and heroic effort.

For mere mortals, anything from 10 FP upwards will need a dedicated systematic development effort.

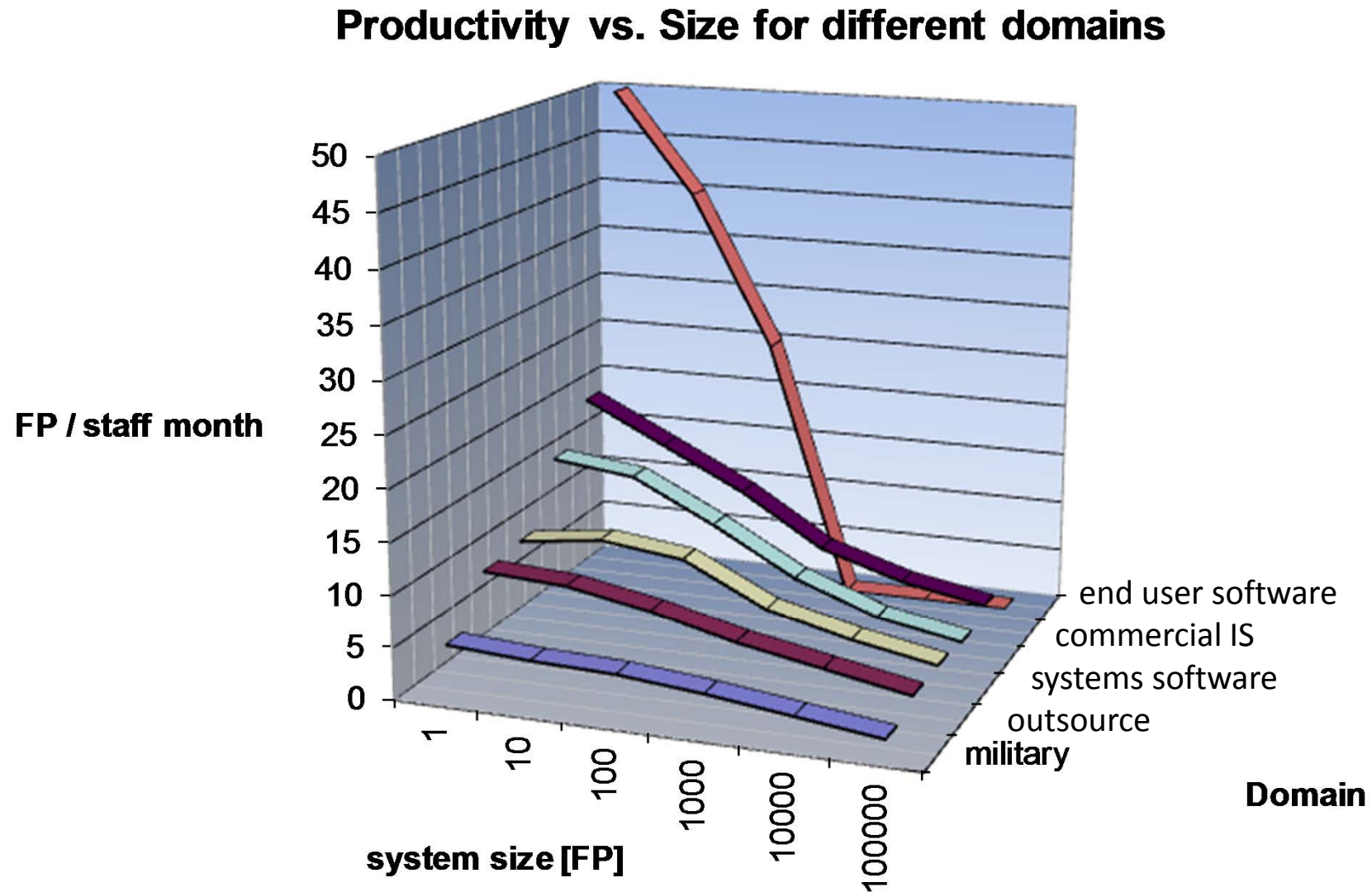
# Number of large systems

**Table 9.1 U.S. Systems and Embedded Software Projects circa 1999**

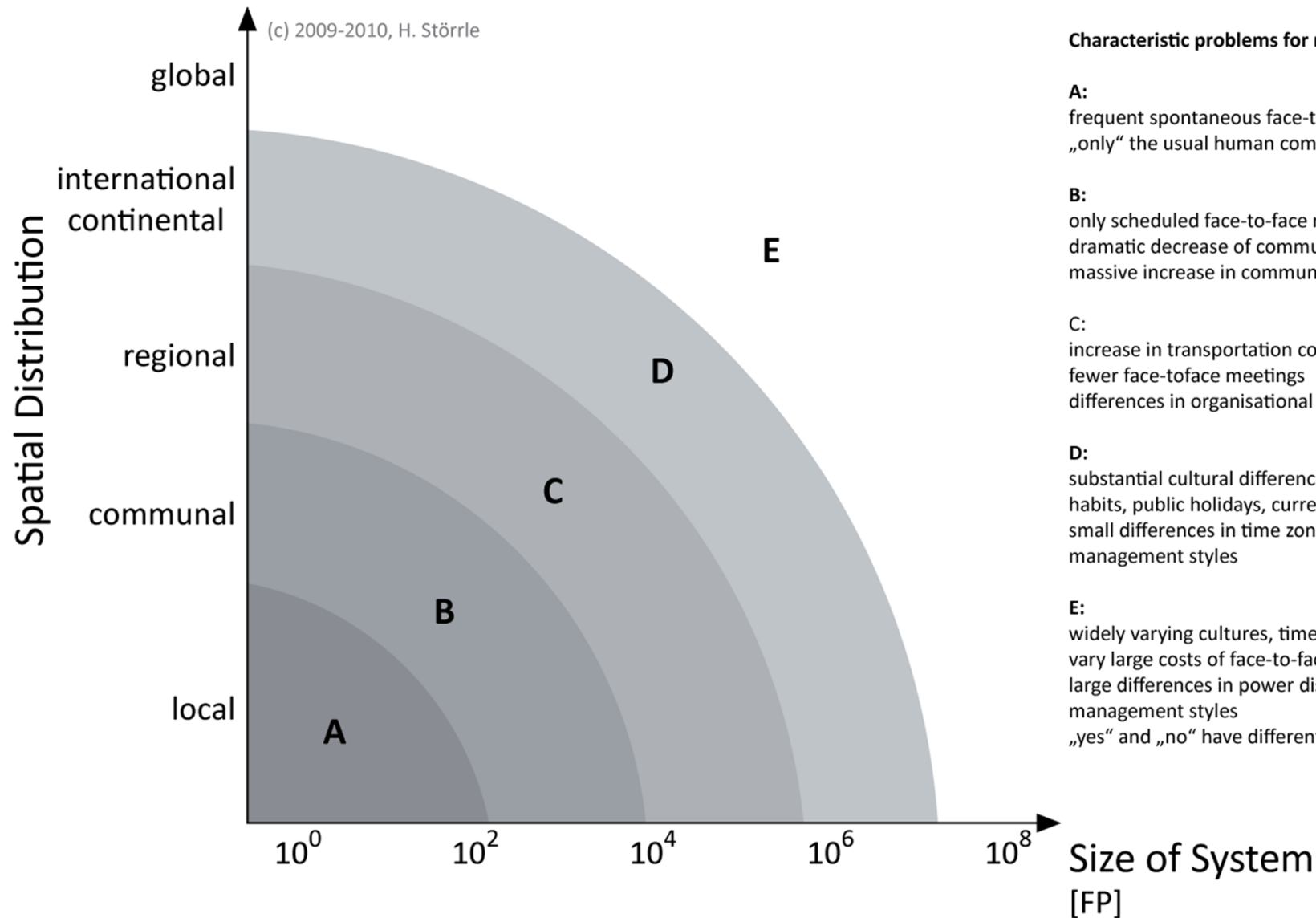
<u>Size, function points</u>	<u>No. of Legacy Applications</u>	<u>No. With- drawn in 1999</u>	<u>No. Under Develop- ment</u>	<u>No. Completed in 1999</u>	<u>No. Updated in 1999</u>
100	850,000	297,500	85,000	170,000	467,500
1,000	450,000	67,500	40,500	16,875	270,000
10,000	95,000	7,600	2,375	1,900	57,000
100,000	250	10	13	4	150
Total	1,395,250	372,610	127,888	188,779	794,650

**N.B.: Only two types of software are considered, and those are the types that are usually rather smaller than larger.**

# Productivity vs. size for different domains



# Problems of distributed teams







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