A human-centered design process for the research project aceMedia

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Fraunhofer FIT investigates human-centered computing in a process context. The usability and usefulness of information and cooperation systems is optimized in their interplay with human work practice, organization and process. The three departments of FIT:

- Life Science Informatics – LIFE
  - Complex image-based biomedical systems that compensate disabilities, or support micro surgery and protein analysis in molecular biology.
- Cooperation Support – CSCW
  - Internet-based groupware and community systems for virtual teams and organizations
  - Augmented reality systems for collaborative planning.
- Information in Context – ICON
  - Human centered information and communication systems considering the current context of use
- Usability Competence Centre
- Accessibility Competence Center

Fraunhofer FIT - ICON

◊ Contextualized information and communication systems for mobile activities, learning, planning, decision making that adapt the services to the context of use

User-oriented Software Engineering

Analysis of user requirements
- Scenario-based Design
- Participatory Design
- Usability Evaluation

Nomadic Information Systems

Context Modelling
- Prior knowledge
- Interests and preferences
- Location and surroundings

Adaptive Learning Systems

Knowledge Management

Meta models of processes and domains
- Adaptation to learning strategies
- Text mining
- Information brokering
- Information visualization

Micro-simulation Models

Modelling tax and welfare legislation
- Statistics
- Analysis of income distribution

Content

- Human-centred design process (ISO 13407)
  - Principles
  - Four essential activities
- Experiences from aceMedia
  - Scenario-based requirements analysis
  - User evaluation

Developers Dream:

To design for success,
i.e. for user acceptance.

How to do this systematically, in a way that will not fail ?

ISO 13407

"Human-centred design processes for interactive systems"

Guidance on
human-centred design activities
throughout the life cycle of
computer-based interactive systems.

Clause 4 - Reasons

Clause 5 - Principles

Clause 6 - Process implementation

Clause 7 - Four essential human-centred activities

Clause 8 - Documentation

Not included: recommendation of concrete methods and techniques.

Complementary to other standards, e.g. ISO 9241 on usability.

Clause 4: Reasons

- Do it right from the start, late changes are much more expensive
- Human-centred development has social and economic benefits:
  - System becomes easier to understand and use
    => reducing costs for learning and support
  - Improved user satisfaction, reduced discomfort and stress
  - Improved productivity of users, improved overall efficiency of organizations
  - Improved user-perceived quality of system
    => competitive advantage of system on market

Clause 5: Principles

- Active involvement of users and clear understanding of user and tasks requirements
- Appropriate allocation of function between user and technology
- Iteration of design solutions
- Multi-disciplinary design

Principle 1 – User involvement

Active involvement of users and clear understanding of user and tasks requirements

- Users are a valuable source of knowledge about context of use, tasks, and how users are likely to use the product
- The more involvement – the more effective
- Nature of user involvement varies, depending on design activities (more later)
- Choose appropriate representatives of user groups, e.g.
  - Custom-made products -> users from customer organization
  - Generic or consumer products -> representatives of target user groups

Principle 2 – Allocation of functionality

Appropriate allocation of functionality between users and technology

- Wise decision about the extent to which a given job, task, function or responsibility is to be automated
  - Not simply determine what can be automated, and allocate the rest to users, relying on their flexibility to make the system work
  - Resulting human functions should form a meaningful set of tasks

Principle 3 – Iteration

Iteration of design solutions

- Iterations combined with user feedback
  - Reduced risk to detect problems (too) late, reduced risk to fail;
  - Meet user and organizational requirements, also such requirements that are hidden or difficult to specify;
  - Testing design solutions against real world scenarios, use test results to progressively refine solutions.
- Iteration can take place for all levels of design, from concepts, then early artefacts such as scenarios, mock-ups and prototypes, to fully implemented system versions

Principle 4 – multi-disciplinary design

Multi-disciplinary design team, to consider all aspects of a socio-technical system

- End user
- Purchaser, manager of user
- Application domain specialist, business analyst
- System analyst, systems engineer, programmer
- Marketing expert, salesperson
- User interface designer, visual designer
- Human factors and ergonomics expert, human-computer interaction specialist
- Technical author, trainer, support personnel

Clause 6 – implementing a human-centred design process

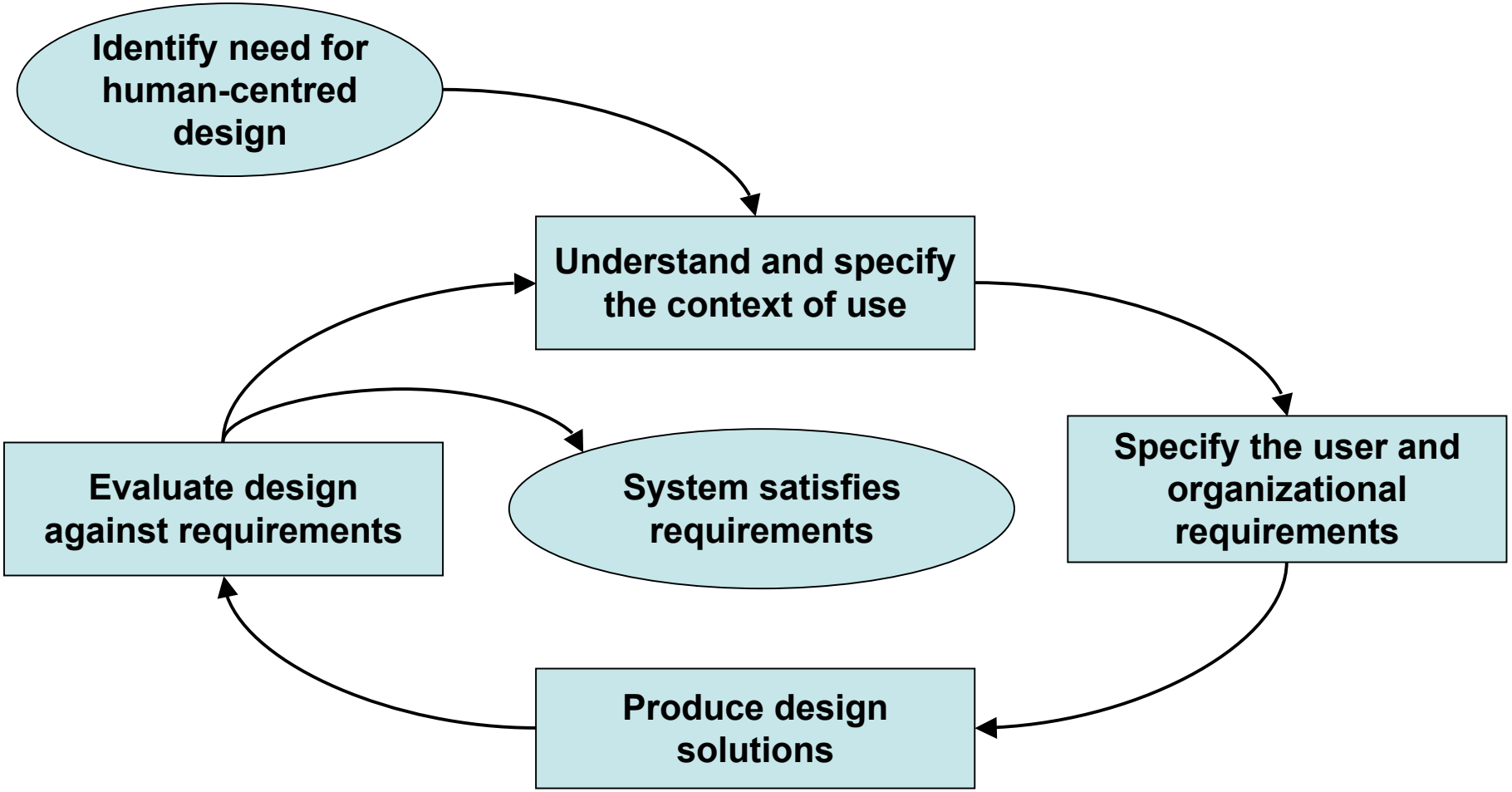
- Implement the recommendations of 13407 into the overall project plan, e.g.
  - Integrating these activities with other development activities, set appropriate milestones
  - Assign responsibilities
  - Establish procedures of feedback, affecting design activities, documenting activities and results
  - Workplan and timescale to allow user feedback, feedback to developers, and iterations
  - Get management support

Clause 7: Essential activities

- Understand and specify the context of use
- Specify the user and organizational requirements
- Produce design solutions
- Evaluate design against requirements

- Start at the earliest possible stage of the project
- Iterative development, until goals are met

Human-centred design process



Context of use

- Understand and specify the context of use
  such as
  - Characteristics of the intended users (knowledge, skills, experience, education, training, physical attributes, habits, preferences, capabilities)
  - Tasks the users are to perform (including overall goals of the use of the system),
  - Environment where the system will be used
    - both physical/technical (existing systems, location, physical characteristics of a place, existing infrastructure and platforms)
    - and social/organizational (social and cultural conditions, organizational structure, legal conditions, standards)

Requirements

Explicit statement of user and organizational requirements in relation to the context of use description, including

- Functional requirements
- Requirements covering aspects such as
  - Users' jobs, including allocation of tasks and motivation;
  - Human-computer interface
  - Required performance; feasibility of operation and maintenance
  - Statutory or legislative regulations, including health and safety;
  - Cooperation and communication between users;

Produce design solutions

- Develop design proposals using existing knowledge from relevant disciplines (e.g. HCI, SE, web design)
- Make solutions more concrete using simulations, scenarios, models and mock-ups

- Present solutions to users and let them perform tasks
- Use user feedback to improve the design solution
- Iterations until goals are met
- Manage iterations of design solutions.

Evaluate design against requirements

- Evaluation at all stages of the design process
  - Early: get user feedback to improve design solutions
  - Late: measure, to what degree objectives have been met
- Evaluation plan, including
  - Goals and criteria; Methods, procedure
  - Basis, i.e. which artefact to evaluate
  - How to document and analyse results
- Provide design feedback
  - How well does system meet organizational goals?
  - Diagnosis of potential problems, identify needs for improvement
  - Select design option that best fits requirements
  - Elicit feedback and further requirements from users
- Assess whether objectives have been achieved

Conformance to ISO 13407

- Documentation!
  - Explicit planning of activities
  - Reporting on activities and results
  - Evidence, how results affected design

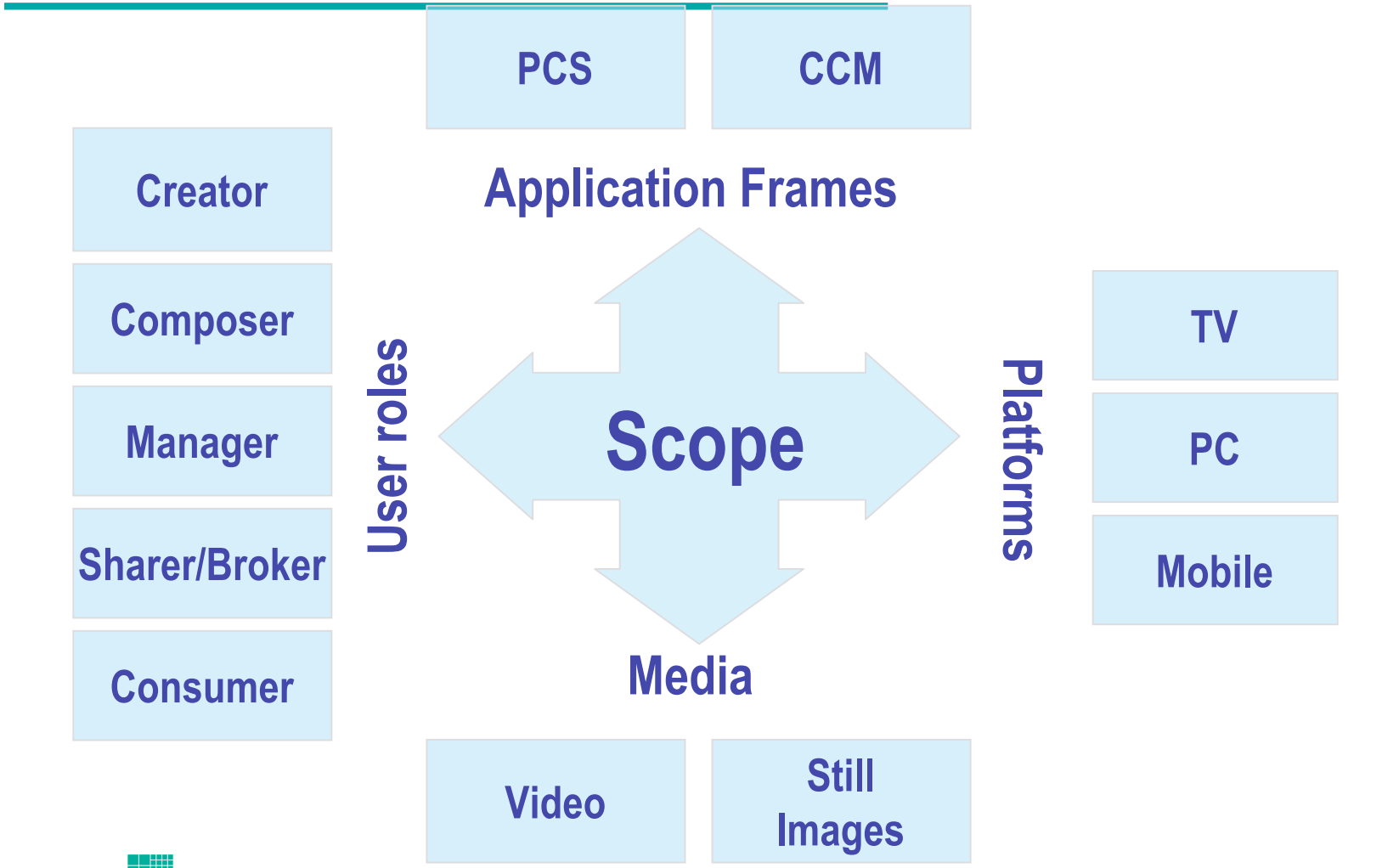
Any questions or comments, so far?

aceMedia

- aceMedia: „Integrate knowledge, semantics and content for user-centred intelligent **multi media services**“
- Reasearch funded by EU (FP6-001765), IST TP „Semantic-based Knowledge Systems“
- 13 Partners
  - Industry: Motorola Ltd. (co-ordinator), Philips, Telefónica ID, France Telecom R&D
  - SMEs: Alinari, Belgavox
  - research: INRIA, Fraunhofer FIT, CERTH-ITI, Uni KL, UAM, QMUL, DCU
- Duration Jan 2004 - Dec 2007

aceMedia novel features

- Image / video analysis to create meaningful metadata
- Retrieval, e.g allows natural language text query, search by example for visually similar items, relevance feedback
- Scalable video coding
- Automatic adaptation to personal preferences and device profiles
- Intelligent content, allowing
  - Self-annotation
  - Self-organization
  - Self-governance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Application Frames
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User roles
Scope
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Mobile
Media
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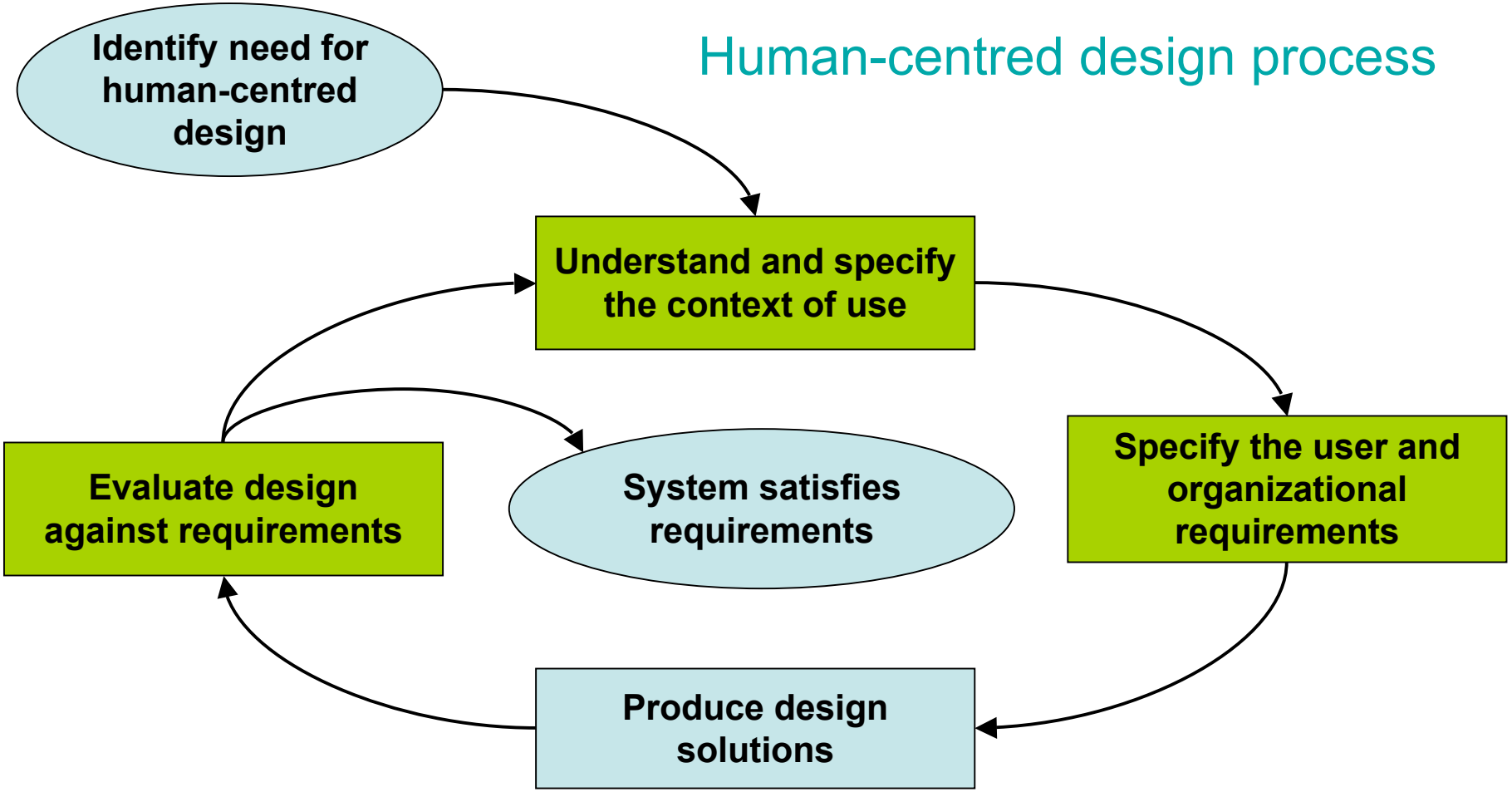
Still Images

Scenario-based requirements analysis



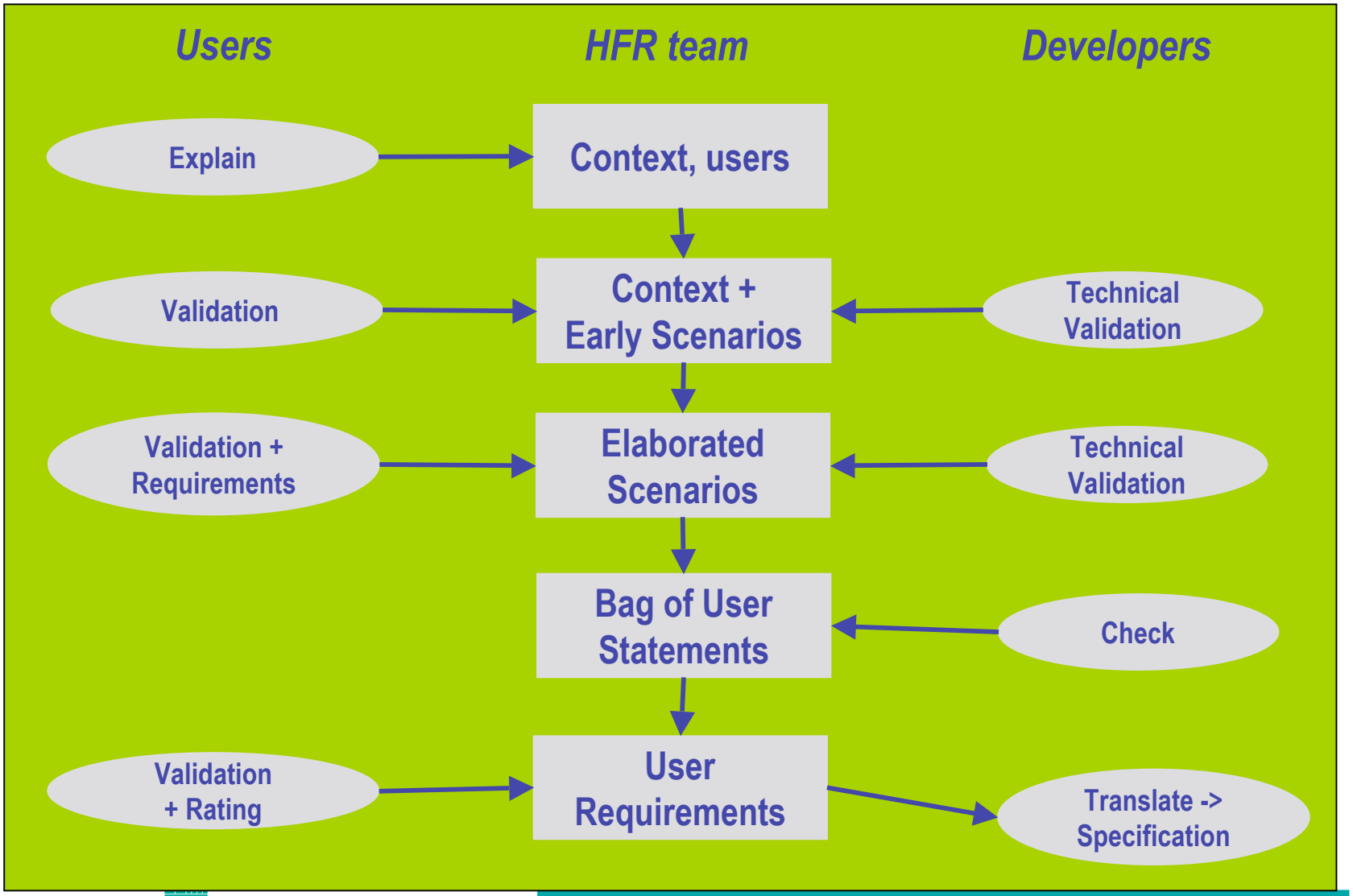
Requirements analysis in aceMedia

- Early requirements analysis based on scenarios
- Iterative requirements analysis based on prototypes and scenarios

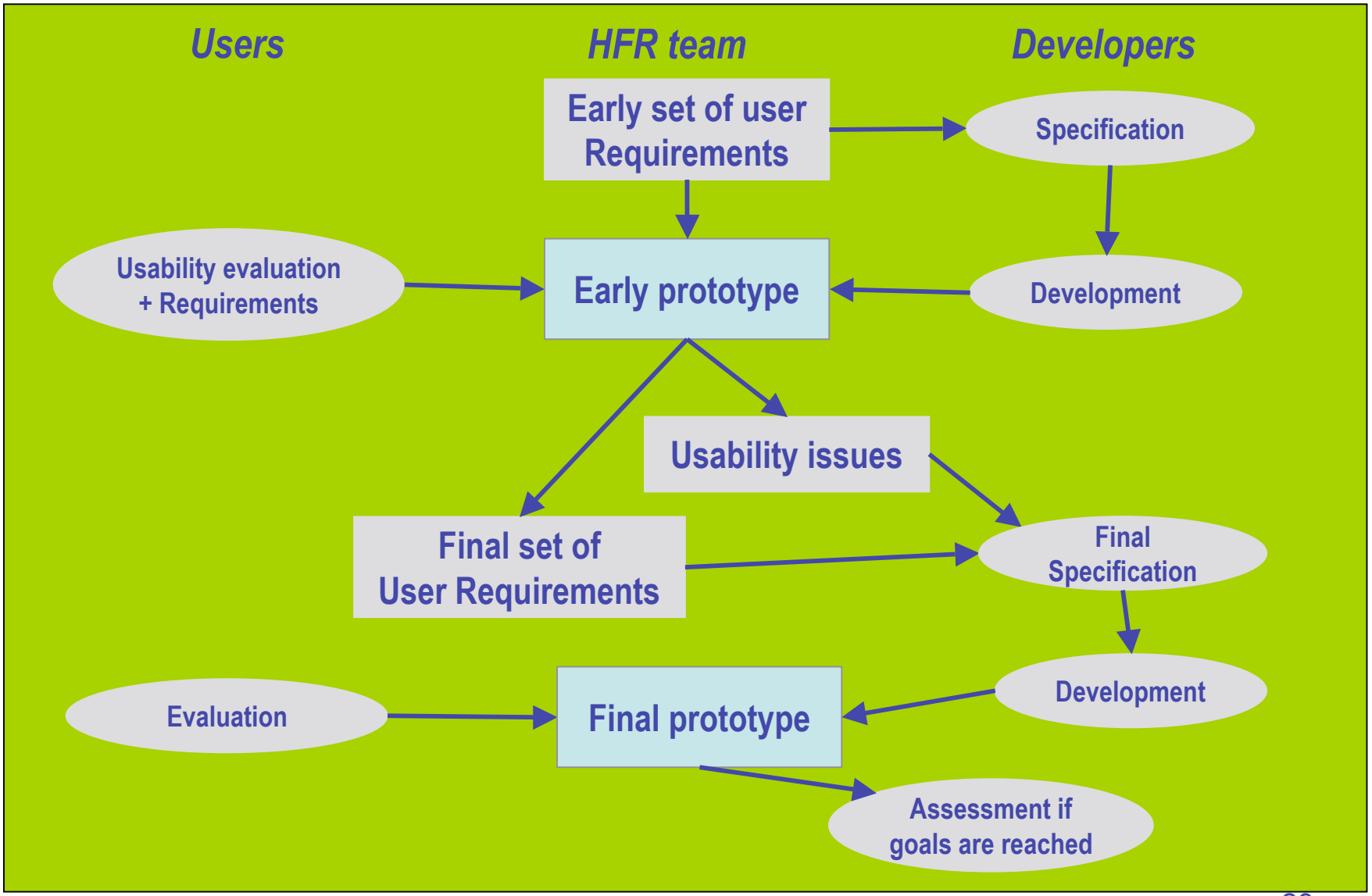
Scenario-based requirements analysis

- Scenarios are the earliest artefacts your project can provide
- Scenarios are “tangible”, they translate project objectives and technical description to users, illustrating what the results of the project will mean for peoples lives and work.
- Scenarios support communication among the project team and with prospective users

Scenario-based requirements analysis in aceMedia



Evaluation of Prototypes



Scenarios to capture context of use

- Start with a few explorative interviews asking users about their jobs, tasks, context,...
- Create context scenarios describing typical users and their tasks, not yet technology
- Validate context scenarios with users

Elements of Scenarios: Context Scenarios

- "Persona": a typical user, with a role (job, profile)
- "Setting": where and when, organizational environment, context
- User goal (task at hand)
- How users proceed to achieve the goal
  - Steps, triggers, desired outcome, conditions of success or failure

Elements of Scenarios: use of technology

- Elaborate context scenarios
- Illustrate how a certain technology (existing or future) will support users to achieve their goals
  - Functionality provided by the (future) system
  - Workflow
  - Handling of the system
- Maybe, illustrate story with sketches, e.g. paper prototype

Example scenario - context

- Liz likes to take photos and sometimes video clips, with her digital camera and sometime with her camera phone. She takes photos mainly when travelling, when she spends a holiday with her family. She also takes photos of events, such as birthdays or parties, and among her favourite topics are her children, the pets, and landscape with water.
- Liz just came back from a holiday trip, with some 200 new images, and some 20 video clips.
- Liz uploads the new content to her PC,...

Example scenario - elaborate

- Liz uploads the new content to her PC,
  - The system automatically creates a new collection, and starts displaying a thumbnail overview of the collection, while images and videos are uploaded.
- Liz is waiting for the upload to be completed, and enjoys the first look at thumbnails.
  - In the background, the system already starts a fast analysis, looking for clusters of similar images. In the overview, each cluster is represented by one image, but user can easily expand each cluster.
- Liz tends to take photos in bursts, so
  - the overview of her 200 images will show only 110 items, 30 of which are clusters of 2 or more photos.

Using scenarios to gain requirements

- Discuss scenarios with real users
  - **Validate** user role, task, context of use
  - **Evaluate** intended system functionality, its usefulness, model workflow, ask for missing functions, ...
  - Ask users about their **requirements**: How should system be in order to be useful, usable, trustworthy, fun, ...
- Record interviews, write down individual results

Requirements analysis

- Aggregate all statements from all individual users
- Translate user comments to requirements
- Rating:
  - Validity of each requirement
  - Importance of each requirement for users
- Document requirements and deliver them to the developers
  - Classify, relating to system aspects
  - Present outcome to developers, workshop

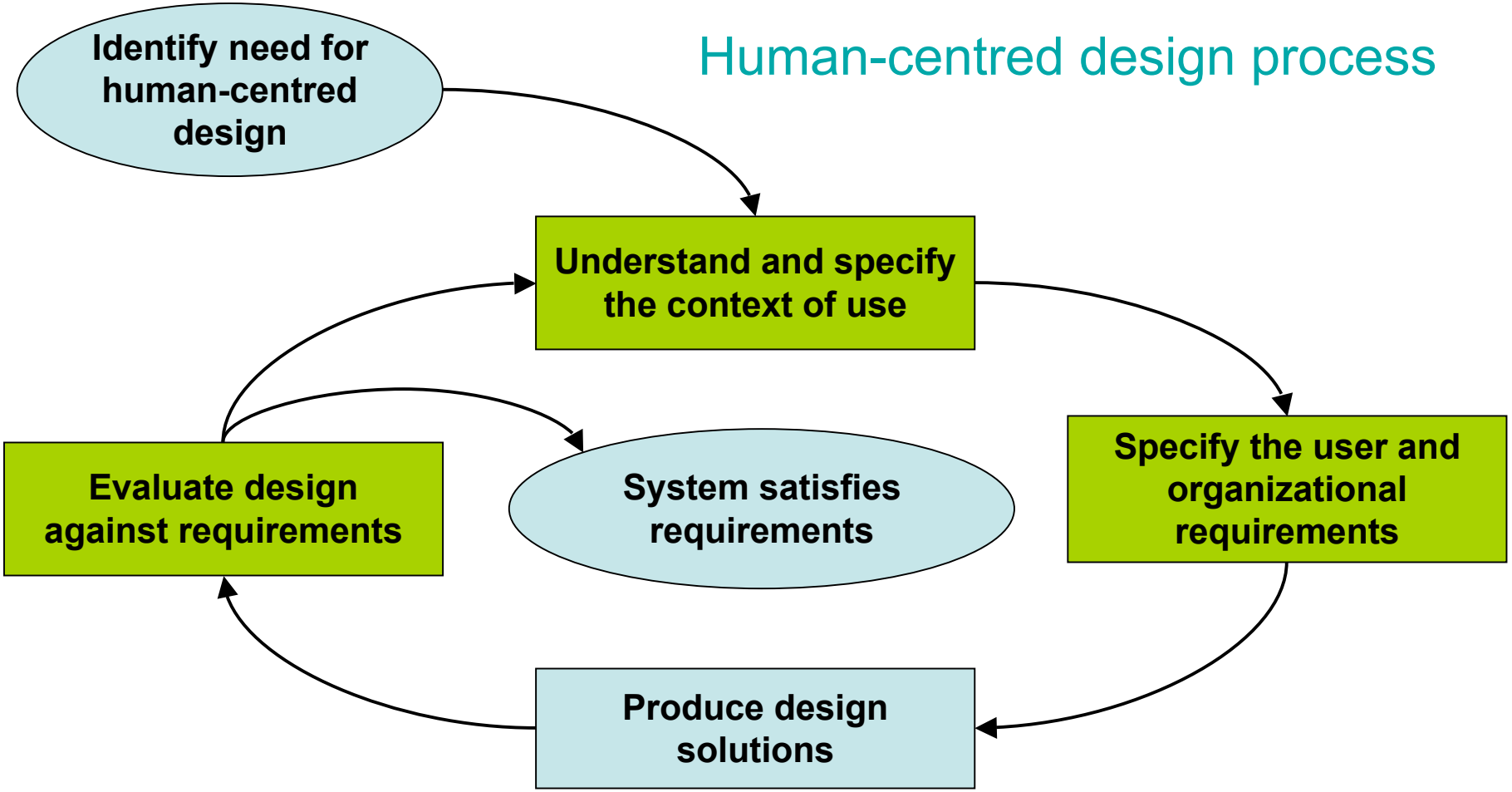
Example aceMedia

- Simple DB (Excel) to allow various ways of exploitation
- Structure:
  - ID for reference, indicating area of concern
  - Requirement + Rationale
  - Source (user, expert, KANO)
  - Classification which aspect of system concerned
  - Rating

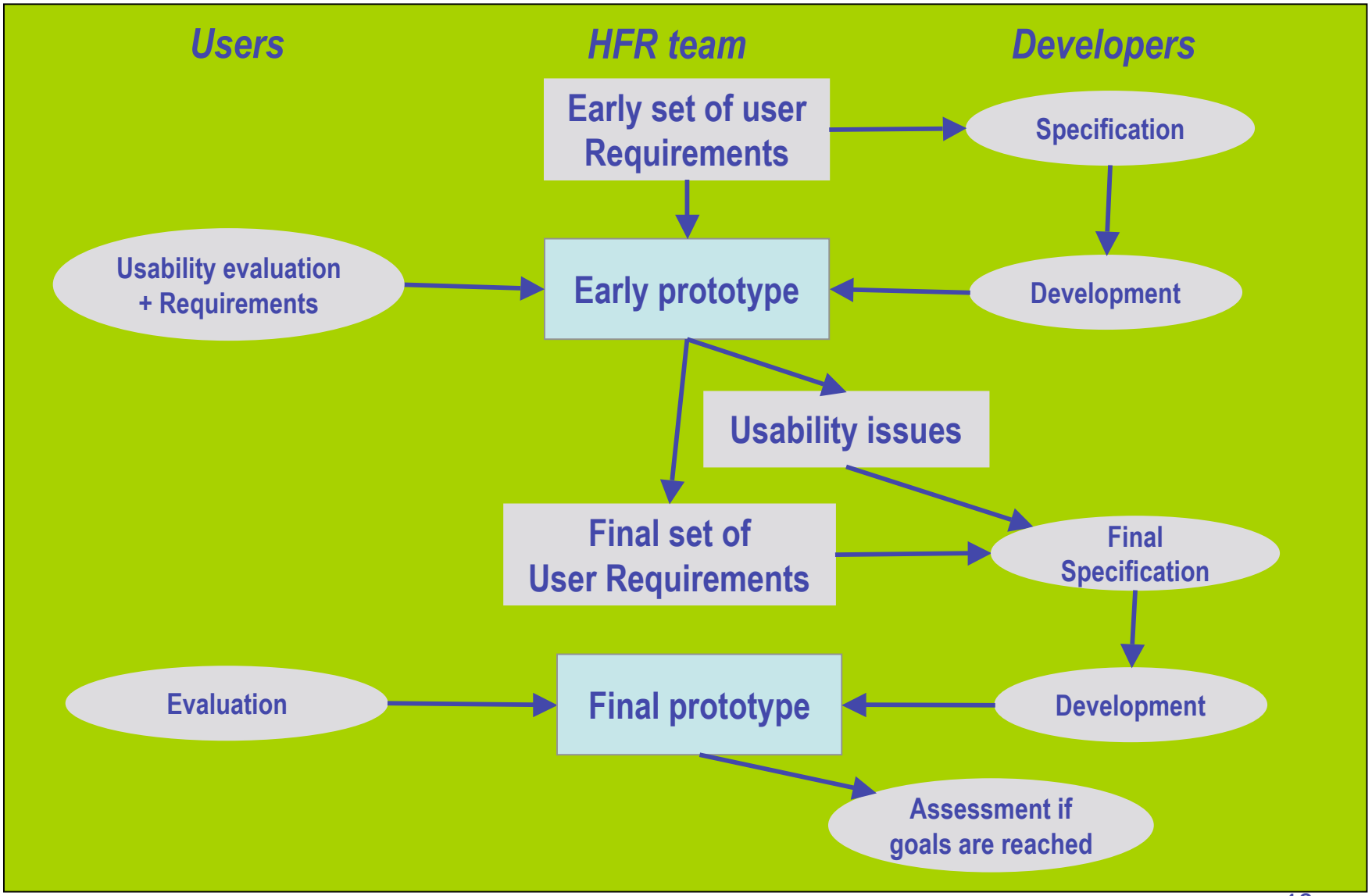
	A	B	C	D	E	F	G	H	I	J	K
1	Requ ID	PCS	CCM	Requirement	Rationale	Source	Source ID	PC Prio	Mob Prio	Web Prio	TV Prio
2	R-ACE-001	X	O	For automatic organisation of content various metadata should be considered.		expert		A	A	./.	A
3	R-ACE-001-1	X		For automatic organisation of content, user wants to be informed about the criteria that were used to assign content to a collection.		user	3004	A	A	./.	A
4	R-ACE-001-2	X		For automatic organisation of content the "date" should be considered in which the content was captured.	"Date" when content was captured is the most important aspect in PCS.	user	1217 3058	A	A	./.	A

Any questions or comments, so far?

User evaluation



Evaluation of Prototypes



Method of usability evaluation

- Evaluation of a prototype; this may be paper prototype, mock-up, or functional prototype
- Real users, i.e. representatives of target user groups
- Let user perform typical tasks using the system
- Ask users to think aloud while using the system
- Observe and listen, record.

Analysis of user evaluation sessions - 1

- Identify usability issues “critical incidents”
  - Where does it occur (task, screen, function)
  - What happens to user (describe incident)
- Diagnosis: what is wrong, why is this an issue
  - Refer to established usability principles, e.g. ISO 9241 - 110 “Design principles for dialog systems”
- Attention: do not rush at recommendations

Analysis of user evaluation sessions - 2

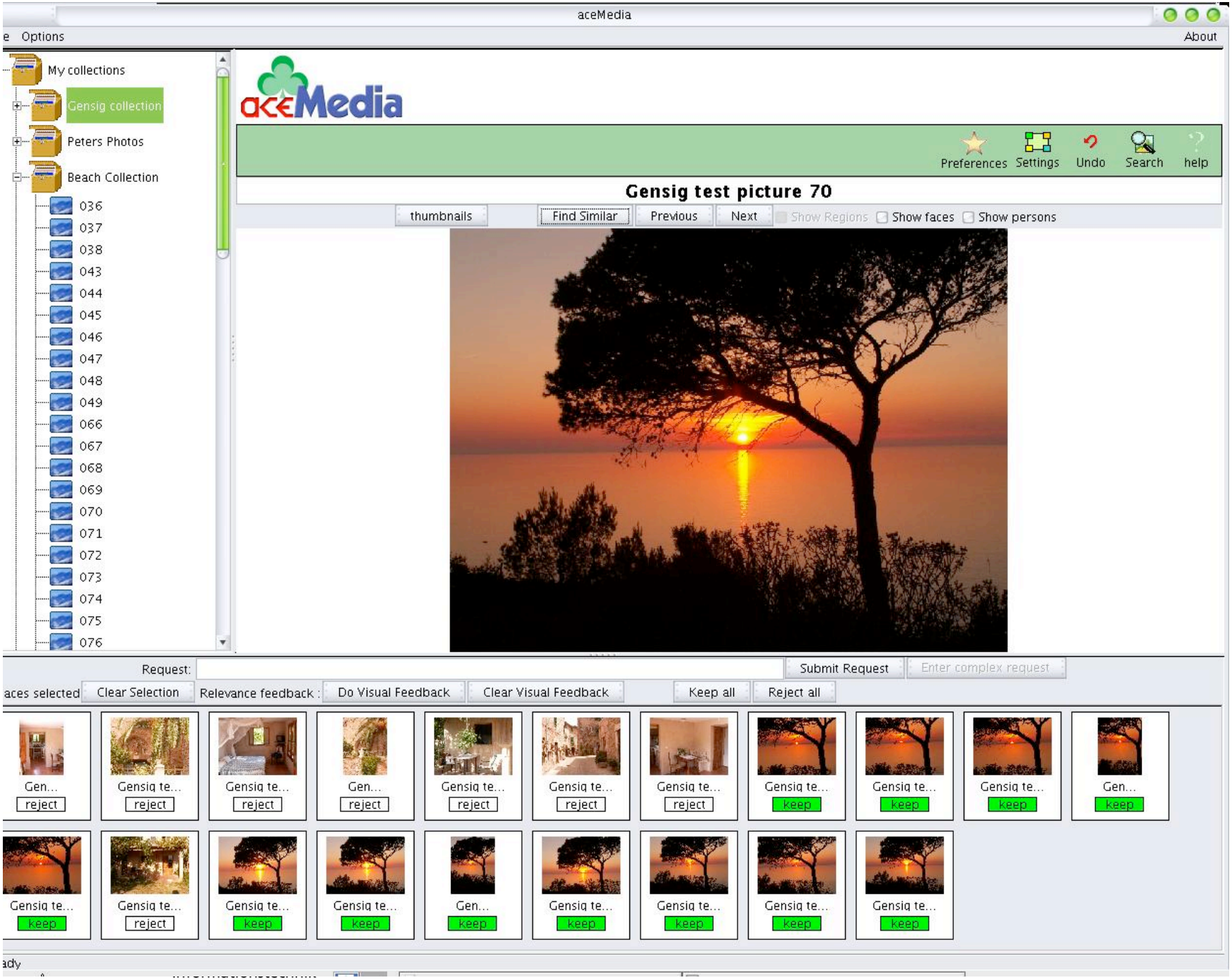
- Validate and rate issues:
  - Does issue inhibit the completion of task?
    - If yes: catastrophe
  - If not:
    - does issue seriously hamper the completion of task?
    - Is there a work-around to achieve goal in spite of issue
    - How frequently would issue occur in real life?
- Give recommendations of improvements (in cooperation with developers)

Some recommendations

- User evaluation lightweight:
  - 5-7 users (per user group) will discover 75% of usability issues
- Agile process: do several iterations of lightweight user evaluations and subsequent design improvements
- Optional: heuristic evaluation by usability experts if users are “expensive”
  - Can reduce but not substitute user evaluations
- Optional: focus groups to clarify special issues (e.g. trade-offs, choice among optional solutions)

Example: impact of user evaluation (1/3)

- Scenario: Relevance feedback will allow iterative search, if user not satisfied with result s/he can indicate pos/neg examples, and will get better results.
- Users liked it.
- First version delivered, solution:
  - If not satisfied with retrieval results, user had to decide for all items in result set whether they are good or bad, then ask for relevance feedback.
  - improved result set contained all different images. (if user did not find what s/he looked for in previous result set, why show some again?)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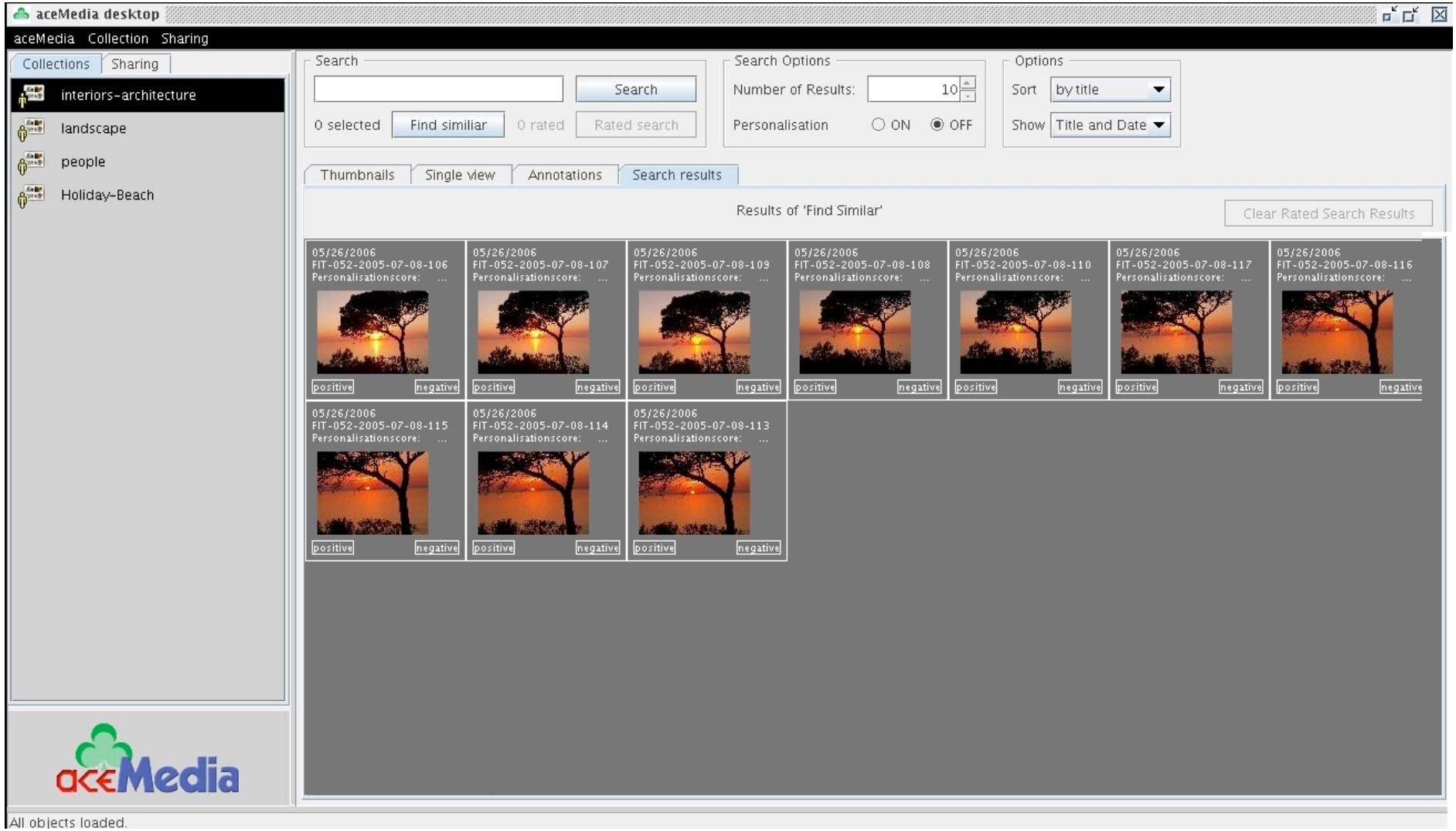
Example: impact of user evaluation (2/3)

- User evaluation identified major issues:
  - Too much effort to decide for each image if keep or reject
    - Some images were not visible unless user scrolled, but if unsatisfied user would not scroll
  - After relevance feedback, user expects good examples to be included in next result set.
    - User expects to get a retrieval result that matches query (good recall, good precision).
    - Goal is not (as developers relevance feedback had assumed) to retrieve one particular item.

Example: impact of user evaluation (1/3)

- Improved version:
  - If result set is not satisfactory, user has to indicate 2+ good and 2+ bad examples, then ask for another search.
  - New result set will contain good examples, and more like those, and none of the bad examples.

- Improvement required
  - Algorithm had to be changed!
  - Improved layout, improved labels on buttons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aceMedia Collection Sharing
Collections Sharing
interiors-architecture
landscape
people
Holiday-Beach
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Number of Results: 10
Personalisation ON OFF
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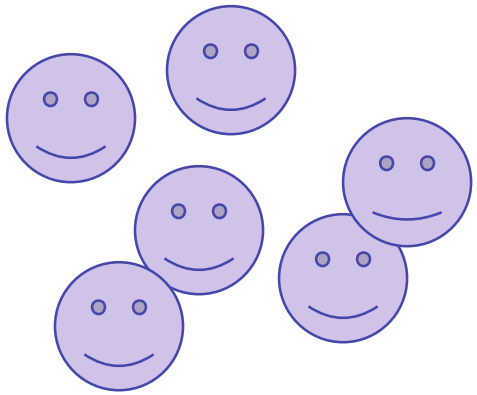

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