ANNO NINETIES / ZEROS / TENTIES: IMAGING, MONITORING INTRA & EXTRAMURAL
INCREASING DEMAND ON HEALTH CARE & DECREASED CAPACITY

“Om aan de zorgvraag te voldoen zou in 2040 1 op de 4 Nederlanders in de zorg moeten werken”

Bij ongewijzigd beleid lopen zorguitgaven in 2020 op tot bijna 18% van het BBP

(Schippers, 2011) (Sneller Beter, 2006)
CONTENTS

• learning goals

• context and issues of telemedicine services

• design methods:
  Traditional, Agile, User-based
  PACT-FICS-MVC

• architecture and building blocks:
  high level architecture, UML diagrams for behaviour, functionalities, and data

• component judgement
  impact value, MVP

• cases & take away messages
LEARNING GOALS

• know how to come to a design of a service, w. end users
  • learn basic building blocks of telemedicine service
    • know how to decompose a service into building blocks
      • frequent architectures
        • actual project cases
CONTEXT AND ISSUES OF TELEMEDICINE SERVICES
SERVICE DESIGN

• what is a service?
SERVICE DESIGN

• An act of assistance

• Availability is key

• Non-physical component = inherent value

• ICT component is means to achieve above
applications
processes
infrastructure
• Telemedicine: providing healthcare at a distance, supported by means of ICT technologies. Involving professional(s).

• The product designed becomes a service when provided as an availability (e.g. it is not yours). Its value moreover consists of non-physical parts.
TELEMEDICINE

- Telemedicine: providing healthcare at a distance, supported by means of ICT technologies. Involving professional(s).

- The product designed becomes a service when provided as an availability (e.g. it is not yours). Its value moreover consists of non-physical parts.

- Inspiration and foundations should be sound. These are found in actual established health frameworks and guidelines.
International Classification of Functioning, Health and Disability (ICF)

Functioning is an umbrella term for

- Participation
  - Taking care of others

- Activities
  - Manipulating objects

- Body Functions
  - Mobility and stability of joints

- Body structures
  - Joints

Disability is an umbrella term for

- Restrictions
  - Participation

- Limitations
  - Activities

- Impairments
  - Body Functions
  - Body structures
Bio-psycho-social health model
functioning and disability are multidimensional...

encompass human experience at levels of body functions and structures, activities and participation

...and a continuum:

Mild-Moderate vision impairment:
Needs eye glasses, contact lenses...

Severe vision impairment:
Needs operation

Complete vision impairment (blind):
Needs assistance – pension, device, assistant environmental modifications
# Goals

**ICF**

1. Establishes a **common language**

2. Provides a **systematic coding scheme**

3. Provides a **scientific and research basis** for understanding health

4. Enables **data comparison**

5. Stimulates the **development of services**

source: who-fic germany

ICD, ICF, CS

Core Set
- Body Functions
- Body Structures
- Activities
- Participation
- Environmental factors
PILLARS FOR POSITIVE HEALTH

BODILY FUNCTIONS
- Medical facts
- Medical observations
- Physical functioning
- Complaints and pain
- Energy

DAILY FUNCTIONING
- Basis ADL (Activities of Daily Living)
- Instrumental ADL
- Ability to work
- Health literacy

MENTAL WELL-BEING
- Cognitive functioning
- Emotional state
- Esteem/self-respect
- Experiencing to be in charge/manageability
- Self-management
- Understanding one’s situation/comprehensibility
- Resilience

SOCIAL - SOCIETAL PARTICIPATION
- Social and communicative skills
- Social contacts
- Meaningful relationships
- Experiencing to be accepted
- Community involvement
- Meaningful work/occupation

MEANINGFULNESS
- Purpose/meaningfulness
- Striving for aims/ideals
- Future prospects
- Acceptance

QUALITY OF LIFE
- Quality of life/well-being
- Experiencing happiness
- Enjoyment
- Perceived health
- Flourishing
- Zest for life
- Balance

QUALITY OF LIFE/DAILY FUNCTIONING

QUALITY OF LIFE/MENTAL WELL-BEING

QUALITY OF LIFE/SOCIAL - SOCIETAL PARTICIPATION

QUALITY OF LIFE/BODILY FUNCTIONS
Mismatch between what is delivered and what is actually needed by end-users, i.e. professionals and patients. Why? How to solve this?
MISMATCH CAUSED BY ....

- Difficult to market and capitalize care innovations

- “Technicians do not understand clinical working practices”

- “Clinicians are usually not acquainted with all the technological solutions, are not used to specifying functional needs”
MISMATCH CAUSED BY ....

- “Technicians do not understand clinical working practices”

- “Clinicians are usually not acquaintant with all the technological solutions, are not used to specifying functional needs”

- “Think big, start small”

- (Berg, 1999, Broens, 2007)
METHODS
How to bridge ‘gap’ between clinical and technical expertise?
CHALLENGE IN USER NEEDS ASSESSMENT?

How to bridge ‘gap’ between clinical and technical expertise?
DESIGNING TELEMEDICINE SERVICES
= MULTIDISCIPLINARY COLLABORATION!
DESIGNING TELEMEDICINE SERVICES
= DIFFERENT LEVELS OF TECHNICAL FAMILIARITY

Clinicians versus Technicians
Clinicians, technicians, assessors speak different ‘languages’
SYSTEM DESIGN

- Philosophy
- Push/pull
- 3 Methodologies
TRADITIONAL DESIGN PHILOSOPHY

Traditional innovation route:
Technology first, meaning second

© Anna Kirah, 2008
Sociotechnical centered innovation route

→ Understanding nature of health care practices should be the starting point of design (Berg, 1999)
TECHNOLOGY PUSH VS. DEMAND PULL


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DESIGN METHODOLOGIES – AN OVERVIEW

1. Traditional
2. Agile
3. User Based
1 - ‘TRADITIONAL’ DESIGN METHOD

- Domain analysis
- Req.s analysis
- Architectural Design
- Realisation
- (Acceptance) Testing
- Implementation & Maintenance
2 - AGILE

- Eg. ‘Scrum’
- product owner essential

[Diagram: Workflow diagram showing stages of Analysis, Design, Realisation, Test, then Implement / Maintain. Key stages: Product Backlog -> Sprint Backlog -> Sprint -> Working increment of the software. Time frames: 24 h, 30 days.]
3 - MORE USER INVOLVED, ‘SOCIOTECHNICAL DESIGN’ APPROACHES

Participatory Design (PD)

User Centered Design (UCD)

Cooperative design (CD)

Empathic design: imagine you are an end-user


- Beyer & Holzblatt, Contextual Design, Kaufmann 1998
USAGE OF SCENARIOS

USAGE OF SCENARIOS
FROM SCENARIOS TO FUNCTIONAL REQUIREMENTS:
A CRITICAL REFLECTION

The reflective cycle (Beynon-Davies, 2002)

FROM SCENARIOS TO FUNCTIONAL REQUIREMENTS:
USER REVIEWS

• Primary end-users
  - Patients
  - Therapists
  - ...

• System developers
  - Biomedical engineers
  - ICT engineers
  - ...

![Diagram showing the cycle of Scenarios, Prototyping, Design Breakdowns, and User Reviews]
USER-BASED SERVICE DESIGN...

Components of scenarios:
- user-oriented scenarios
- system-oriented scenarios

From Scenario corpus to Service decomposition

<table>
<thead>
<tr>
<th>User perspective</th>
<th>Designer perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PACT approach</td>
<td>FICS approach</td>
</tr>
<tr>
<td>– People</td>
<td>- Functionalities</td>
</tr>
<tr>
<td>– Activities</td>
<td>- Interactions</td>
</tr>
<tr>
<td>– Context of use</td>
<td>- Content</td>
</tr>
<tr>
<td>– Technology</td>
<td>- Service</td>
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<tr>
<td>Context approach</td>
<td>System approach</td>
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<tr>
<td>Early stages Dev. Cycle</td>
<td>Later stages Dev. cycle</td>
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FROM SCENARIOS TO FUNCTIONAL REQUIREMENTS: USER REVIEWS

- **Qualitatively** = refine on the motivations of end-users with respect to design choices, input, possible similar innovations, test for consistency, plausibility etc.

- **Quantitatively** = if possible quantify/illustrate consequences of the innovation (type of sensors needed, amount of data to be collected, amount of data to be send)
### Story line (=> beginning – end!)

Lisa is 35 years old patient. She is working at a large administrative company. She suffers from neck-shoulder pain which is, to Lisa’s opinion related to the computerwork she performs. Because of this, she was allowed to have a new treatment approach; the MyoTel myofeedback treatment service that allows her to be treated at the workplace without the attendance of a therapist. By means of the MyoTel service subjects are taught to relax their neck-shoulder muscles (so-called trapezius muscle). Therefore, she wears a garment during work that registers her muscle activation. Every week she has a teleconsultation with the myofeedback therapist to discuss the progress.

### Problem
- “future” service

### People

### Roles

### Activities

### Functionalities

### Interaction

### Context of use
**Scenario content: check your PACT & FICS**

<table>
<thead>
<tr>
<th><strong>Story line (=&gt; beginning – end!)</strong></th>
<th><strong>Problem</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lisa is 35 years old patient. She is working at a large administrative company. She suffers from neck-shoulder pain which is, to Lisa’s opinion related to the computer work she performs. Because of this, she was allowed to have a new treatment approach; the MyoTel myofeedback treatment service that allows her to be treated at the workplace without the attendance of a therapist. By means of the MyoTel service subjects are taught to relax their neck-shoulder muscles (so-called trapezius muscle). Therefore, she wears a garment during work that registers her muscle activation. Every week she has a teleconsultation with the myofeedback therapist to discuss the progress.</td>
<td>“future” service</td>
</tr>
</tbody>
</table>

**People**

**Roles**

**Activities**

**Functionalities**

**Interaction**

**Context of use**
Example — Myotel system
From Scenario corpus to Service decomposition

PROOF: MVC - IN RAILS
PROOF: MVC - IN RAILS
Which requirements to actually develop?
SERVICE DESIGN (RECAP)

MOSCOW

• Must Have
• Should Have
• Could Have
• Won’t Have (this time / this sprint)

• prioritise & make sure (N)FRs are traceable
## REQUIREMENTS (RECAP)

<table>
<thead>
<tr>
<th>Requirement #</th>
<th>Requirement type</th>
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<tbody>
<tr>
<td>3</td>
<td>functional</td>
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</table>

**Value:** easy access  
**Attribute:** one stop portal for information

**Description:** The system provides access to all (types of) information via one interface.

**Rationale:** Nurses spend a lot of time gathering information from different (types of) sources while performing their antibiotic-related tasks. When all information can be accessed from one interface, one starting point, searching for information is facilitated.

**Source:** Focus group 1 & 2, fragment 1,2,3,10,13

**Fit criteria**

1. **Acceptance testing:** not applicable

2. **Usability testing:** The application allows participants to find the desired information within one minute. Note: time frame to be adjusted upon inspection of the high-fidelity prototype.

3. **Summative evaluation:** Participants feel they have to spend less time on searching information via the app. Searching for information via the app results in an increase in success and a decrease in time, in comparison with searching for information in the traditional way.

**Priority:** High  
**Conflicts:** possible conflict with mobility and real time access and synchronization requirements because access to these databases at all places via the interface may be impossible due to limitations in wireless connections and security options.

**History:** Created on March 9 2012, adjusted on May 8 2012
SEVERAL TECHNIQUES TO ASSESS THE NEEDS OF PATIENTS AND PROFESSIONALS TO GET THE CONTENT FOR YOUR SERVICE

Use of (semi-) qualitative techniques:

• Workshops/seminars
• Observational studies
• Focus groups
• Semi-structured/open interviews
• Questionnaires
• Brainstorm in mind maps
• Empathic design

• And ...
SDT (+) version. Recommendation page:

Figure 4: Screenshot of the recommendation page in the SDT (+) prototype

- SDT + A: Abbreviation for self – determination construct supporting autonomy
- SDT + C: Abbreviation for self – determination construct supporting competence
- SDT + R: Abbreviation for self – determination construct supporting relatedness

1.) SDT + R → strategy: affection. User is addressed directly. Dialogue support: Liking.
2.) SDT + R → strategy: affection. User is addressed directly. Dialogue support: Liking
3.) Primary task support: Tailoring. User is reminded that the advice is based on his interests he
How can physical activity advices be designed to the needs of elderly?

Figure 2.: Self – determination theory in relation to physical activity advises

- Humans three needs
  - Competence
  - Autonomy
  - Relatedness

Follow physical activity advice
- if needs are fulfilled

Don't follow physical activity advice
- if needs are not fulfilled
Ten respondents were chosen from the sample n=14.

Respondents were assigned to one of the two groups.

Presented SDT (+) prototype

Presented SDT (+) prototype

Comparison of both prototypes

Presented SDT (-) prototype

Presented SDT (-) prototype

Evaluation of 1. prototype

Evaluation of 2. prototype
SEVERAL TECHNIQUES TO ASSESS THE NEEDS OF PATIENTS AND PROFESSIONALS TO GET THE CONTENT FOR YOUR SERVICE

Use of (semi-) qualitative techniques:

- Workshops/seminars
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- Brainstorm in mind maps
- Empathic design

- And ...
SPECIFICATION OF USER NEEDS TO EASE SYSTEM REALIZATION

User needs
  ↓
  Analysis    validation

Specification
  ↓
  Realization  verification

System
LOGICAL MODELLING OF SYSTEM AS-A-WHOLE AND SUBSYSTEMS DISTINGUISHES 5 ASPECTS:

1. Interaction with user
2. Functions
3. Behavior
4. Data
5. Location
UNIFIED MODELLING LANGUAGE (UML)

Functions:
use case diagram

Behavior:
flow chart, state transition diagram, activity diagram

Data:
Class diagram
Use Case Diagram

Use case

Actor

U1: Use case

<<actor>>

Klok

U2: Use case
Flow chart

1. Start
2. Estimate the square root of 91
3. Square the estimate
4. Is the estimate close enough?
   - Yes: Done
   - No: Replace the current estimate with the average of the estimate and 91/estimate
Class Diagram

- **Screening**
  - **Part**
  - **Question**
    - **Answer**
      - **Result**
MOCKUPS, INTERACTIVE SCENARIOS
BUILDING BLOCKS
Technical architecture
EXAMPLE CASES

E-HEALTH / SENSING / SELF-MANAGEMENT
Valorisation of screening and coaching

<table>
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<th></th>
<th>Vitaal</th>
<th>Risico</th>
<th>Kwetsbaar</th>
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<td></td>
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### Alle deelnemers

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<tr>
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<td>86.3%</td>
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<tr>
<td>Voedingsstatus</td>
<td>89.3%</td>
<td>10.7%</td>
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### Risicogroep

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<tr>
<td>Cognitieve status</td>
<td>71.4%</td>
<td>28.6%</td>
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<tr>
<td>Voedingsstatus</td>
<td>81.4%</td>
<td>18.6%</td>
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### Kwetsbare groep

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<tbody>
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<tr>
<td>Cognitieve status</td>
<td>53.0%</td>
<td>47.0%</td>
</tr>
<tr>
<td>Voedingsstatus</td>
<td>58.0%</td>
<td>42.0%</td>
</tr>
</tbody>
</table>
DONEC QUIS NUNC

Head movements

Execution

- Stand straight or sit down and look straight ahead
- Slowly turn your head to the right, as far as you can
- Then turn your head to the left, as far as you can

Number of repetitions
Repeat this exercise 5 times for both sides.

Start time: 07:19:21 | Duration: 00:03:00

Stop training | Exercise done
"How to design a feedback system providing feedback to frail older adults on their performance, regarding the squeeze exercise, using the Myo Armband?"
USER TEST
PERFORM SQUEEZE EXERCISE WITH BOTH SYSTEMS

- Usability (SUS)
- Stimulation (1-5)
- Insecurity (1-5)
- Pleasure (1-5)

- \( N = 8 \)
- Above 65

UNIVERSITY OF TWENTE.
Collaboration Society Solutions & RRD
enabling screening and video-based physical activity exercise
Tracking activity to confront users and provide means to cope
WHICH BUILDING BLOCKS?
What to put in your service: development strategy

importance

Realization time
What to put in your service? 2/2
(Impact/Value framework, Hammer & Manguarian 1987)

Value

Impact

- Time
  - Efficiency (Things right)
  - Accelerate Business processes
  - Reduce information load

- Distance
  - Effectiveness (Right thing)
  - Increase reach
  - Ensure control

- Relation
  - Innovation
  - Bypass brokers
  - Open up knowhow
  - Create service excellence
  - Cover new areas
  - Build networks/chains
  - telemedicine
Not like this....

1

2

3

4

Like this!

1

2

3

4

5

by Henrik Kniberg
Minimum Viable Product

- Emotional design
- Usable
- Reliable
- Functional

Not this

This

September 2014 | With compliments to Aarron Walter
RECOMMENDATIONS

- Keep the user in mind
- Gather the right people
- PDCA
- Think big, Start small
80/20
IREHI 2017 LOME - TOGO
15 DECEMBER 2017

DESIGN OF TELEMEDICINE SERVICES: METHODS, BUILDING BLOCKS AND EXAMPLES.

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