DETERMINING USER REQUIREMENTS OF FIRST-OF-A-KIND INTERACTIVE SYSTEMS: AN IMPLEMENTATION OF COGNITIVE ANALYSIS ON HUMAN ROBOT INTERACTION
Outline

• Introduction
• Research Question
• Literature
• Implementation
• Concluding Remarks
“technology can make us smart”
“technology can make us dumb”

(Norman, 1993, p.3)
Introduction

Requirement Determination in System Development

SYSTEM DEVELOPMENT PROCESS

Determine Requirements
“designing the right thing”*

Design
“designing the thing right”*

Verify Requirements
verifying if design is the right thing and the design is right

Introduction

System Development Process Through
System-Technology Centered Design Requirements

SYSTEM DEVELOPMENT PROCESS

Determine Requirements

Design

Verify Requirements

Design Team

Inform

Fulfill

Determine

Fulfill

Verify

User

Industrial Designer

User Needs, Preferences, Capabilities

System-Technology Centered Design Requirements
Introduction

System Development Process Through User-Centered Design Requirements
Introduction

**First-of-a-kind interactive systems:**
- no similar systems
- no experienced users
- no Subject Matter Experts (SMEs)
Introduction

First-of-a-Kind System Development Process Through User-Centered Design Requirements
Research Question

How can user-centered design requirements of first-of-a-kind interactive systems be determined?
“Practitioners have great difficulties specifying usability requirements and often end up stating that the system shall be easy to use”

(Lauesen & Younessi, 1998, p.1)
Literature

Requirement Determination Approaches

Performance Based Requirements
Outcome Based Requirements
Training Based Requirements
Defect Based Requirements
Subjective Requirements
Help Request Based Requirements

Process Based Requirements
Guideline Based Requirements

Design Based Requirements
Requirement Determination Approaches

- Performance Based Requirements
- Outcome Based Requirements
- Training Based Requirements
- Defect Based Requirements
- Subjective Requirements
- Help Request Based Requirements

Process Based Requirements
Guideline Based Requirements
Design Based Requirements

require measurements
from early similar systems
Literature

**Requirement Determination Approaches**

- Performance Based Requirements
- Outcome Based Requirements
- Training Based Requirements
- Defect Based Requirements
- Subjective Requirements
- Help Request Based Requirements

- Process Based Requirements
- Guideline Based Requirements

*require measurements from early similar systems*

*complementary with other approaches*

- Design Based Requirements
Literature

Requirement Determination Approaches

- Performance Based Requirements
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- Process Based Requirements
- Guideline Based Requirements

require measurements from early similar systems
complementary with other approaches
first-of-a-kind interactive system requirement determination
require measurements from early similar systems
complementary with other approaches
first-of-a-kind interactive system requirement determination

“...involve us in activities such as the study of users’ needs, the choice of user interface styles and structures, and the use of analytical methods. ... What we have achieved, during the requirements process, is a reduction of the original problem to something that can be designed by routine methods” (Newman & Lamming, 1995, p.159)
Literature

Requirement Determination Techniques
The Implementation Domain: Human Robot Interaction

MAGIC 2010

supervisory control of heterogeneous multiple autonomous robots

• Maintaining Situation Awareness
• Supporting Decision Making
Implementation

The Implementation Domain: Human Robot Interaction

MAGIC 2010

supervisory control of heterogeneous multiple autonomous robots

- Maintaining Situation Awareness
- Supporting Decision Making
The Implementation Methodology: **Hybrid Cognitive Task Analysis (CTA)**

**WHY?**

**MAGIC 2010**

*Domain*

*Target user profile*

*Level of innovativeness*
The Implementation Methodology: **Hybrid Cognitive Task Analysis (CTA)**

**WHY?**

**MAGIC 2010**

- Domain
- Target user profile
- Level of innovativeness

**Hybrid CTA**

(Nehme et al., 2006)
The Implementation Methodology: **Hybrid Cognitive Task Analysis (CTA)**

**Methodology**

- Scenario Task Overview
- Event Flow
  - Situation Awareness Requirements
  - Decision Ladders for Critical Decisions

*User-Centered Design Requirements*

*Hybrid CTA Process* adopted from Nehme et al. (2006)
The Implementation Methodology: Hybrid Cognitive Task Analysis (CTA)

Discussions

enables the analyst to generate functional and information requirements from a representative scenario description of a futuristic task domain
Implementation

The Implementation Methodology: **Hybrid Cognitive Task Analysis (CTA)**

**Discussions**

enables the analyst to generate functional and information requirements from a representative scenario description of a futuristic task domain

[Compensation]

**compensates for the lack of SMEs** through the decision ladder generation which helps **replicate a potential operator’s thought processes**
The Implementation Methodology: **Hybrid Cognitive Task Analysis (CTA)**

**Discussions**

- enables the analyst to generate functional and information requirements from a representative scenario description of a futuristic task domain.

- compensates for the lack of SMEs through the decision ladder generation which helps replicate a potential operator’s thought processes.

- provides the analyst with a clear mapping of any generated requirements backwards and forwards through each phase, should any revisions need to be made (Nehme et al., 2006, p.5).
User-centered requirements should be determined early in the system development process.
Concluding Remarks

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Design based approaches are appropriate for determining user-centered requirements of first-of-a-kind interactive systems.
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Cognitive analysis techniques, specifically Hybrid CTA, can be utilized to determine user-centered requirements of first-of-a-kind interactive systems.
User-centered requirements should be determined early in the system development process.

Design based approaches are appropriate for determining user-centered requirements of first-of-a-kind interactive systems.

Cognitive analysis techniques, specifically Hybrid CTA, can be utilized to determine user-centered requirements of first-of-a-kind interactive systems.

It is difficult to compensate the lack of Subject Matter Experts (SMEs) by analytical cognitive analysis methodologies.
Further Research

The Design Process Supported by User-Centered Requirements
Further Research

The Design Process Supported by User-Centered Requirements

Empirical Evaluation of the Design/Outcomes of User-Centered Requirements
Further Research

The Design Process Supported by User-Centered Requirements

Empirical Evaluation of the Design/Outcomes of User-Centered Requirements

The Comparison of Empirical and Analytical (User-free) Cognitive Analysis Methodologies for the Requirement Determination of First-of-a-Kind Systems
Thank you.