Cognitive Today, Digital Tomorrow
Cognitive Ergonomics Applied to Digital Government

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Today, enterprises and governments are rapidly “becoming digital” as they seek to capture the cost savings, agility, and collaboration enabled by cloud, analytics, mobile, and social technologies.

But digital is not the destination. It is laying the foundation for a more profound transformation - cognitive technologies.
over a century of technology...

1900
- color photography
- Henry Ford's "Model T"
- electric typewriter
- television
- computing machine

1910
- silicon chip
- digital computer

1930
- e-mail & floppy disk
- personal computer, mobile phone

1970
- world wide web (WWW)
- pentium micro
- digital video disc (DVD)
- flat screen
- google goes live

2000
- iPod approved for distribution
- Facebook goes live
- blue ray introduced
- Twitter goes live
- iPhone introduced
- cloud computing introduced

2010
- iPad
- iPad Mini
- Google Glass
- What's next??

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the future is coming – are we ready?
Meet Emma, Our Virtual Assistant

Meet “Emma,” a computer-generated virtual assistant who can answer your questions and even take you to the right spot on our website. Emma is named for Emma Lazarus, who wrote the poem inscribed at the base of the Statue of Liberty about helping immigrants. Inspired by her namesake, our Emma can help you find the immigration information you need.

What Can Emma Do?

Emma answers questions based on your own words; you don’t need to know “government speak”. She also knows a lot of common search terms. She can:

- Answer questions
- Direct you to specific pages
- Explain complex information

Visit uscis.gov/emma today to see how she can help you!
Source: Damai Sciences Virtual Humanoids from The THRUST Project (Trusting Humanoid Robots Undertake Social Tasks), 2014-2017, US Air Force Grant FA2386-14-1-0016
Mixed Human-Robot Partnership

ROOM A

Scripted dialog shown and evaluation performed on laptop. Operator instructing Nao remotely through laptop.

Kinect to record face. Microphone to record voice.

ROOM B

Scripted dialog shown and Client’s evaluation performed on laptop.

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Multi Human-Avatar Partnership

Remote Communication

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Main Technology Shift

Automating the World → Understanding the World

Program → Train/Data Scientist

H-Factor

Knowledge Workers → Learning Workers

Cognitive Informatics and Wisdom Development
Interdisciplinary Approaches

Andrew Targowski
Seven Pillars of Digital Government Can Ensure Successful Transformation

HYBRID IT ENVIRONMENT
that leverages public, private, cloud, and dedicated IT infrastructure assets to deliver IT services through unified management and security.

SECURITY
that extends protection and management controls efficiently into the expanding digital environment.

ADVANCED DATA ANALYTICS
that exploit growing stores of data to improve citizen services, operational efficiencies, and mission performance.

IT SERVICE MANAGEMENT
that provides a comprehensive, unified view of the hybrid IT environment for robust service orchestration and delivery.

APPLICATION SERVICES
that leverage DevOps, reuse of common IT services, and modularity to rapidly deliver innovative solutions.

MOBILITY SERVICES
that ensure rigorous management and security while providing users with seamless access to application and data anytime, anywhere, and on multiple devices.

USER-CENTERED DESIGN
of interfaces and business processes that provide services government workers need to perform their jobs more effectively and citizens need to get quicker and better service.
What is Cognitive Ergonomics?

Study of Human Behaviour

Mediated by Cognitive tools and devices

Knowledge representation Information processing

Cognitive Tools are natural or artificial

Require human ability to process information

HCI is an area in CE that human interaction with computer

Fewer errors, more efficient, increased well being

Purpose to adapt tools and usage to improve HIP

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Cognitive ergonomics is concerned with mental processes (perception, memory, reasoning, and motor response), as they affect interactions amongst humans and other elements of a system. www.iea.cc
Perceptual processor to see and hear

Cognitive processor to think

Motor processor to act

The time to process information is on average: 100, 70 and 70 msec. Note however the large variability in time, depending on the difficulty of the task and individual differences.

## Processing Times and Storage Capacities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye movement time</td>
<td>230 ms</td>
<td>70-700 ms</td>
</tr>
<tr>
<td>Decay half-life of visual image storage</td>
<td>200 ms</td>
<td>90-1000 ms</td>
</tr>
<tr>
<td>Visual Capacity</td>
<td>17 letters</td>
<td>7-17 letters</td>
</tr>
<tr>
<td>Decay half-life of auditory storage</td>
<td>1500 ms</td>
<td>90-3500 ms</td>
</tr>
<tr>
<td>Auditory Capacity</td>
<td>5 letters</td>
<td>4.4-6.2 letters</td>
</tr>
<tr>
<td>Perceptual processor cycle time</td>
<td>100 ms</td>
<td>50-200 ms</td>
</tr>
<tr>
<td>Cognitive processor cycle time</td>
<td>70 ms</td>
<td>25-170 ms</td>
</tr>
<tr>
<td>Motor processor cycle time</td>
<td>70 ms</td>
<td>30-100 ms</td>
</tr>
<tr>
<td>Effective working memory capacity</td>
<td>7 chunks</td>
<td>5-9 chunks</td>
</tr>
<tr>
<td>Pure working memory capacity</td>
<td>3 chunks</td>
<td>2.5-4.2 chunks</td>
</tr>
<tr>
<td>Decay half-life of working memory</td>
<td>7 sec</td>
<td>5-226 sec</td>
</tr>
<tr>
<td>Decay half-life of 1 chunk working memory</td>
<td>73 sec</td>
<td>73-226 sec</td>
</tr>
<tr>
<td>Decay half-life of 3 chunks working memory</td>
<td>7 sec</td>
<td>5-34 sec</td>
</tr>
</tbody>
</table>

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**Findings:** Users were not sure where to look first and had trouble identifying the most important aspects of the page.

https://www.fema.gov

- **Navigation that changes with tabs**
- **No obvious order of importance. Participants did not know where to focus their attention.**
- **Colourful Images / Banners**
- **Large Photo**
- **Lots of Links with Red Headings**

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This raises a number of issues for design:
• What mental model might you expect the user to have?
• What mental model should they have?
• How should you convey an appropriate mental model to the user (which may have implications for training)?
• How should you design the interface to reflect the mental model?
• How do you represent the mental model?
Norman’s (1988) model for a human in pursuit of a goal

**problem or goal**

How I’d like to feel, or what I’d like to achieve

**goal evaluation**

Is my goal met or problem resolved?

**action**

take some action

**action evaluation**

Did that action deliver the results I expected?
Findings and Recommendations

Usability Evaluation of Licensing Portal
Research Objectives

Main Objective

- Efficiency is amount of effort required to accomplish a goal
- Satisfaction is level of comfort that users feel when using the portal

Sub-Objectives

- Identify utility of the business information in terms of user needs
- Evaluate process flow in task performance
Browsing Mode

Easy starting points, multiple gateways, provide assistance

- Initial search mode where user’s are looking for something to get them going.
- In this mode, user’s act like tourists
  - they look lost
  - they need assistance
  - trying to find a way to fit in.
- Important to:
  - Quickly help them find a place to start.
  - Reduce their cognitive burden

“I’m trying to fit in...”
Browsing Mode

Easy starting points, have multiple gateways, provide assistance

- Issues
  - Search function
- Problems
  1. **Scope:** Some users feel that they need to know the exact licence name to proceed.
  2. **Spelling:** licence vs license, communications
  3. **Alternative keywords:** Handphone, mobile phone, telcos, KTV
  4. **Abbreviations:** NEA, SPF
- Solution
  1. Show an example
  2. Spell check
  3. Controlled vocabulary and Thesaurus
  4. Support Acronyms
Transacting Mode
Remove obstacles, minimise effort, provide timely information, allay fears

- Users have:
  - Already decided what to do
  - And are ready to act

- Important to:
  - Remove annoyances / obstacles.
  - Minimise effort.
  - Provide the right information at the right time to allay fears.

“I want to complete the process quickly but there are too many obstacles...”
Transacting Mode

*Remove obstacles, minimise effort, provide timely information, allay fears*

- **Issues**
  - Navigation and orientation
- **Problem**
  - Users seem lost in the process
  - Users do not understand the difference between “Save” and “Save and Proceed”
- **Solutions**
  - Provide a progress map to show what was completed and what’s next.
  - Eliminate “Next” and “Previous” if there are only TWO pages.
  - More prominent title.
Outcome of Usability Evaluation

Generated design principles for short-term fix of user interface

Identified user profile and future research to increase online transactions via licencing portal
1. Identify the users and their characteristics - Know thy user and thy user isn’t you.

2. Identify the usability requirements:
   (1) What will be measured
   (2) How it will be measured
   (3) What level of the measure is required

3. Recording and analyzing users’ tasks. Everyone has 15 mins of fame.

4. Understanding users’ mental models: “All our ideas and concepts are only internal pictures.”

5. Identify appropriate styles and guidelines

6. Design the interface

7. Prototype the interaction and interface

8. Evaluate.
Usability Attributes (LEEERS Model)

- **Learnability**: Time and effort to reach proficiency.
- **Effectiveness**: Accomplishing goal-directed tasks to criterion performance.
- **Efficiency**: Level of performance relative to resources.
- **Errors**: Errors committed, and how to design for recovery.
- **Retention**: Memorizing a system for better performance next time.
- **Satisfaction with the experience**: User attitude during and after use.

ISO 9241-11 Usability: efficiency, effectiveness, user satisfaction
A LANDSCAPE OF USER RESEARCH METHODS

BEHAVIORAL

- Eyetracking
- Clickstream Analysis
- A/B Testing
- Usability Benchmarking (in lab)
- Usability Lab Studies
- Moderated Remote Usability Studies
- Unmoderated Remote Panel Studies
- Unmoderated UX Studies
- Ethnographic Field Studies
- True Intent Studies

ATTITUINAL

- Participatory Design
- Diary/Camera Studies
- Customer Feedback
- Concept Testing
- Focus Groups
- Desirability Studies
- Email Surveys
- Interviews
- Card Sorting

QUALITATIVE (DIRECT)

- Natural use of product
- De-contextualized / not using product
- Scripted (often lab-based) use of product
- Combination / hybrid

QUANTITATIVE (INDIRECT)

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Design the interface

“A picture is worth a thousand words. An interface is worth a thousand pictures.” – Ben Shneiderman
- Responsive
- Personalized
- Transparent
- Data-driven
- Engaged
Problem with Iconic Interface

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Problem with Colour
Blue on Black background is NOT allowed. This is because the centre of the eye is “blue-blind”.

PART ONE: History of The Game

Tradewars was invented in the early 1980's by Chris Sherfield. Back then, the game was a very simple affair, one type of ship, 36 planets, etc. Approximately 10 years ago, Chris sold the software source code to several individuals, one of whom was Glen Fredericks of Chili, NY. Glen developed the game for several years, and created the popular server version 3.0 that today the game on Chris’s BBS, having a lot of the working code, but lacking detailed (WV) and interface of the server version. Various versions available in different directions, become of options were eventually abandoned.

About 1990, the dominant editor became Clary Marks. The 1.3 version that has arrived to this day Clary added most of the features that are present in the current game including the Perps, all the different ship types, planets, and the wonderful graphics that make the game so nice.

Today, Clary’s product is available in 2 games. There is the single-player game for MS-DOS (MBBS) and the DOS version used by other BBS types such as an IBM card that runs as a “server” generally at a single player game. The DOS version can be run at home without a BBS. Most features are found in both games, though many differences do exist. Most of the development work is done on the MBBS Version, the DOS version is lagging behind.

The MBBS Version has much greater display for a Macintosh and has all the latest bugs left in the DOS Version.

The DOS version is available as shareware and the MSBS version is obtainable only from the author at costs starting at $7.00 or so (yagh).

PART TWO: BEGINNER’S BASICS
Sacramento County
http://www.saccounty.net/
User Experience

“...No product is an island. A product is more than the product. It is a cohesive, integrated set of experiences...”

- Don Norman, Former User Experience Architect, Apple
User experience goals

- Satisfying
- Fun
- Enjoyable
- Entertaining
- Helpful
- Motivating
- Aesthetically pleasing
- Rewarding
- Support creativity
- Emotionally fulfilling
Affective Engineering

• Affect is the judgmental system.

• Emotion is the conscious experience.

• The role of amygdala in emotional experience. It reacts faster than you can think!

• Affective Engineering is about understanding user’s needs and designing products/systems that meet user’s affective requirements.

• Explore what and why product attributes affect user’s emotions, feelings.
Core Affect Circle (Russell 2003)

- Activation
- Deactivation
- Positive Affect
- Negative Affect
- Displeasure
- Pleasure
- Deactivation
- Reactive
- Unpleasant foreground
- Pleasant foreground
- Unpleasant background
- Pleasant background
- Calm
- Chaotic
- Eventful
- Uneventful
- Proactive
- Monotonous
Kano Model of User Satisfaction

Maslow Theory of Needs

- Physiological
- Safety
- Belonging
- Self Esteem
- Self Actualisation

Kansei

Chisei

Positive quality
- Error Feedback
- Personalization
- Expected quality region

Negative quality
- Must-be attributes
- Processing Delay Complex language
- Expected quality region

Basic quality region
- Visible Search

Customer Satisfaction vs. Customer Dissatisfaction

- Exciting quality region
- Attractive attributes
- Performance Attributes
- Must-be attributes
CATER Data Sheet

- **Full Name**
  - Computerized Automotive Technology Reconfiguration System for Mass Customization

- **Contract n°**
  - IST-5-035030

- **Instrument**
  - STREP (Specific Targeted Research Project)

- **Programme**
  - FP6-2005-IST-5

- **Strategic Objective**
  - 2.5.8 (ICT for Networked Businesses objective of the IST priority)

- **Start date & duration**
  - 01/09/2006 - 36 months

- **Consortium**
  - Coordinated by Fraunhofer IAQ
  - 14 European / Asian key players from the whole automotive field

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Supported by the European Commission

CATER Workshop on Mass Customization of Vehicles - Kuala Lumpur, March 2000

Manfred Dangelmaier

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Citarasa Engineering

**Citarasa** [Sanskrit origin, used widely in the Malay world – Indonesia, Malaysia, etc]

Cita denotes intent, hope, aspiration and expectation

Rasa indicates taste and feel

Citarasa = emotional intent

**Citarasa Methodology**

Integrates cognition and emotion in identifying and evaluating affective design

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Why-why-why method for identifying affective design

Which of the three websites do you prefer? Hong Kong WEBSITE

Why do you like the website? Because it is vibrant

Why is it vibrant? Colour

Why do you like the colour? Because lime green

I like this website

Laddering Technique
Online Citarasa Data Gathering

Replace with Digital Gov. Portal Colour
Differential Citarasa of Customers and Designers

https://www.norge.no/en/

Offline Citarasa Data Gathering

- **Field survey – probe elicitation**

- **Citarasa Descriptors for Colour**

<table>
<thead>
<tr>
<th>Colour</th>
<th>Europe</th>
<th>Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maroon red</td>
<td>Happy/Cheerful; Sporty</td>
<td>Happy/Cheerful</td>
</tr>
<tr>
<td>Navy Blue</td>
<td>Calm/Sober/Peaceful, Boring</td>
<td>Calm/Sober/Peaceful, Boring</td>
</tr>
<tr>
<td>Lime Green</td>
<td>Happy/Cheerful; Modern</td>
<td>Young</td>
</tr>
<tr>
<td>Black</td>
<td>Elegant; Executive; Cool</td>
<td>Elegant; Executive; Boring</td>
</tr>
<tr>
<td>Dove Grey</td>
<td>Boring/Dull; Calm Sober</td>
<td>Boring/Dull; Common/Ordinary</td>
</tr>
<tr>
<td>Beige</td>
<td>Boring/Dull; Old; Calm</td>
<td>Boring/Dull; Modern; Disgusting</td>
</tr>
</tbody>
</table>

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## UC#2.1 Interactive Configuration

<table>
<thead>
<tr>
<th>UC Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context of use</td>
<td>The customer uses the Interactive Configuration process to interactively design and order a vehicle that is close to his/her needs.</td>
</tr>
<tr>
<td>Primary actor</td>
<td>Customer</td>
</tr>
<tr>
<td>Input (trigger)</td>
<td>The Customer starts a new configuration using the CATER Citarasa user interface.</td>
</tr>
<tr>
<td>Output</td>
<td>The Interactive Configuration process ends with the finalization or the cancellation of the order.</td>
</tr>
</tbody>
</table>

### Main success scenario

1. The customer starts a new configuration
2. The “citarasa user modeling use case” proposes an initial configuration.
3. The customer selects a new element from the list of options.
4. The configuration engine recalculates the configuration options. Only relevant options are presented to the customer.
5. The customer may use the “similarity search use case”.
6. The final configuration may be saved or forwarded to the “order use case”.

### Connected Ucs or extensions

UC#2.2, UC#2.3, UC#2.4
Design Thinking

**Empathize**

Learn about the audience for whom you are designing, by observation and interview. **Who is my user? What matters to this person?**

**Define**

Create a point of view that is based on user needs and insights. **What are their needs?**

**Ideate**

Brainstorm and come up with as many creative solutions as possible. **Wild ideas encouraged?**

**Prototype**

Build a representation of one or more of your ideas to show to others. **How can I show my idea? Remember: A prototype is just a rough draft!**

**Test**

Share your prototyped idea with your original user for feedback. **What worked? What didn’t?**
The Ergonomics Quality in Design (EQUID) document began initially under Lena Bonapace’s leadership and subsequently under Ralph Bruder from Germany. In May 2007, this document was circulated to Federated Societies as a resource for designers, design managers and manufacturers to reflect the ergonomics requirements in product design.

Major global companies participated in benchmarking the EQUID document. This provided feedback on the EQUID processes and criteria used to assess the user requirements. The International Organization for Standardization (ISO) was consulted to investigate opportunities for the ISO to disseminate the EQUID process as Guidance document or to integrate it into their Standards documents. In total, there were 12 versions of the EQUID design document.
Product Development Process and EQUID

Product Development Process
- Generating New Ideas
  - Identifying and evaluating new ideas
- Concept Stage
  - Analyzing requirements
  - Specification and evaluation of concepts
- Technical Development
  - Development of technologies and components
- Test and Optimization
  - Prototyping
  - Technical and user-oriented tests
- Product Launch
  - Commencement of production
  - Marketing
  - Market penetration
- After Sales
  - Customer service
  - Collecting customer feedback

EQUID Design Process
- Requirements for succeeding product models
- Initial User Requirements (§2)
- Requirement Changes (§2.2)
- Final Ergonomic Evaluation (§4)
- User Satisfaction Evaluations (§5)
- Mock-ups and Design Reviews (§3)
- Management Commitment to Ergonomics Quality in Design (§1)

User Integration Opportunities during Product Development
- Use of creativity methods
  - Idea competitions
- Requirement analysis
- Incorporating customer feedback
- Selection of concepts
- Evaluation and selection methods
  - Testing of products, packaging, manuals...
- Detailed planning of marketing
- Testing and optimization of marketing
- Methods for collecting customer feedback
- Market tests
ROI of User Centred Design

- **Improves Credibility**
  - Increases user satisfaction
  - Increases trust in the system
  - Increases number of visits referral

- **Improves Performance**
  - Reduce number of user errors
  - Increase ease of use
  - Increase ease of learning

- **Increases Exposure**
  - Increase traffic/audience size
  - Increase return visitors
  - Increase visits from search

- **Reduces Resource Burden**
  - Reduce development costs
  - Reduce development time
  - Reduce maintenance costs
  - Reduce redesign costs
  - Decrease support costs
Benefits

- Enhance productivity and safe use of service offerings
- User-centred design of software interface.
- Design of feedback for users to understand and act in an intended manner.
- Design of safer tools and devices so that users will not make catastrophic errors.
- Design of information technology systems that support cognitive tasks.
Takeaway Message
Every citizen interface, the application and interactivity must be:

- Easy to understand and learn
- Error tolerant
- Flexible and adaptable
- Appropriate and effective for the task
- Powerful and efficient
- Inexpensive
- Portable
- Compatible
- Intelligent
- Support social and group interactions
- Trustworthy (secure, private, safe, reliable)
- Information centred
- Pleasant to use

https://www.malaysia.gov.my/public/
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