# Mid-term Conference of ESA RN22

# COMPLEXITIES OF RISK AND UNCERTAINTY

4 – 5TH October, 2018
Kaunas University of Technology (KTU)

# CONSUMERS FACING UNCERTAINTY AND RISKS: OPERATIONALIZATIONS HERBERT SIMON´S APPROACH


Dr. Jari Kaivo-oja and  Dr. Theresa Lauraéus

Turun yliopisto
University of Turku

FINLAND FUTURES RESEARCH CENTRE

strategicRESEARCH

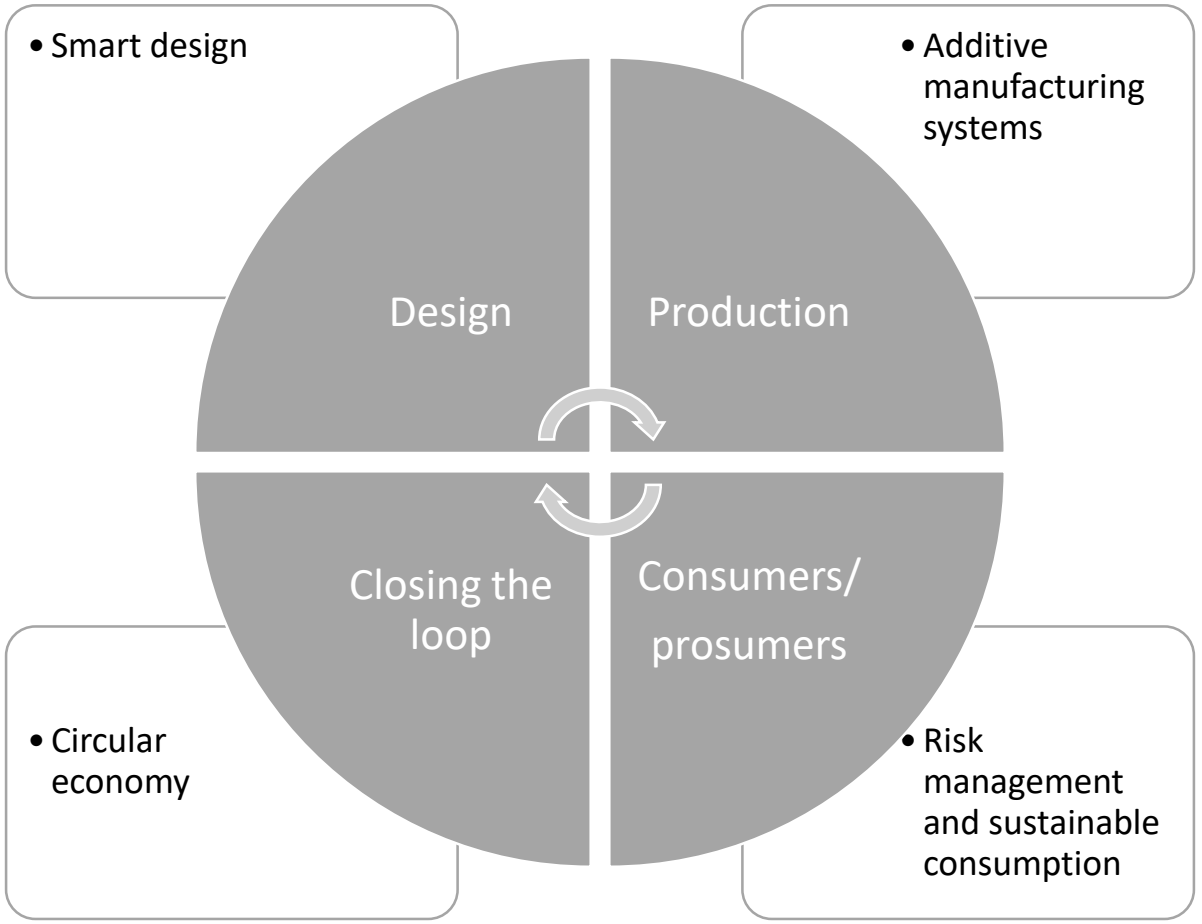
Turun yliopisto
University of Turku

MFG 4.0


# Introduction

- Today Industry 4.0 and Additive Manufaturing approaches require better understanding of modern consumer behaviour
- Future directions of development in the field of consumption: Refigured value chains, Extended product life, Improved resource efficiency, Sustainable consumption
- All these future developments require better understanding of uncertainty aspects and risk behaviour of consumers
- Succes of any project depends on cost, time, performance and risk management in relation to these key success variables
- This study focus on empirical and operational assessment of consumer risk behaviour

# Integration of Industry 4.0/Manufacturing 4.0 approaches in modern production and consumption systems



# Digitalization: Main Streams

**In digitalization, there are some main streams:**

1) Internet, e-commerce and social media.
2) Digital business disruption and business model restructuration.
3) Robotization, AI (artificial intelligence) and IoT.
4) Nowadays, one of the most significant challenge is to move forward from E-commerce to A-commerce.

Thus, the Herbert Simons´model of purchase decision making phases is still relevant.

# Some information processing depictions of consumer choice

| Author(s) | Year | Sequence |
|---|---|---|
| Starch | 1925 | Seeing → Reading → Believing → Remembering→ Acting |
| Strong | 1925 | Awareness → Interest → Desire → Action |
| Lionberger, Rogers | 1960<br>1962 | Awareness → Interest → Evaluation → Trial → Adoption |
| Colley | 1961 | Unawareness → Awareness → Comprehension → Convicti<br>Action |
| Lavidge and Steiner | 1961 | Awareness → Knowledge → Liking → Preference → Conv<br>→ Purchase (i.e. cognition → affect → conation) |
| McGuire | 1969 | Exposure → Attention → Comprehension → Yielding →<br>Retention → behaviour |
| Howard and Sheth | 1969 | Attention → Brand Comprehension → Attitude → Intentior<br>Purchase |
| Rogers and Shoemaker | 1971 | Knowledge → Persuasion → Decision → Confirmation |
| McGuire | 1976 | Exposure → Perception → Comprehension → Agreement -<br>Retention → Retrieval → Decision making → Action |
| Engel, Blackwell and Kollat | 1978 | Perceived information → Problem recognition → Search [-<br>Evaluation of Alternatives → Beliefs → Attitudes → Intent<br>Choice |
| Britt | 1978 | Exposing → Attending → Perceiving → Learning and<br>Remembering → Motivating → Persuading → Desired Acti |
| Foxall and Goldsmith | 1994 | Environment → Attentional and perceptual filter → Interpr<br>(involving experiences, beliefs, attitudes and goals held in s<br>and long term memory) → Brand beliefs → Brand attitudes<br>Brand purchase intentions → Response |
| Rossiter and Percy | 1997 | Need arousal → Information and evaluation → Purchase → |

Source: (Foxall 2005, p. 27)

# Some key references relevant to modern consumer behaviour


- Arrow, K. J. (1982) Risk perception in psychology and economics. Economic Inquiry, 20, 1–9.
- Lee, M. D., & Cummins, T. D. R. (2004) Evidence accumulation in decision making: Unifying the “Take-the-best‟ and the “rational‟ models. Psychonomic Bulletin Rev.11, 343-352.
- Newell, A., & Simon, H. A. (1972) Human problem solving. Englewood Cliffs, NJ: Prentice-Hall.
- Raab, M., & Gigerenzer, G. (2005) Intelligence as Smart Heuristics. In R. J. Sternberg & J. E. Pretz (Eds.), Cognition & Intelligence (pp. 188-207). Cambridge, UK: Cambridge University Press.
- Raiffa, H. (1968) Decision analysis. Reading, MA: Addison-Wesley.Simon, H. A. (1955) A behavioral model of rational choice. Quarterly Journal of Economics, 59, 99–118.
- Reyna, V. F. (2004) How people make decisions that involve risk: A dual process approach. Current Directions in Psychological Science, 13, 60-66.
- Simon, H. A. (1956) Rational choice and the structure of the environment. Psychological Review, 63, 129–138.
- Simon, H. A. (1957) Models of man, social and rational: Mathematical essays on rational human behavior. New York: Wiley.
- Simon, Herbert A., (2009) An Empirically-Based Microeconomics. Cambridge Books, Cambridge University Press, Cambridge.
- Tversky, A., & Kahneman, D. (1974) Judgment under uncertainty: Heuristics and biases. Science, 185, 1124-1131.
- Tversky, A., & Kahneman, D. (1981) The framing of decisions and the psychology of choice. Science, 211, 453–458.
- Tversky, A., & Kahneman, D. (1986) Rational choice and the framing of decisions. Journal of Business, 59, 251-278.

## Methods of analysis:

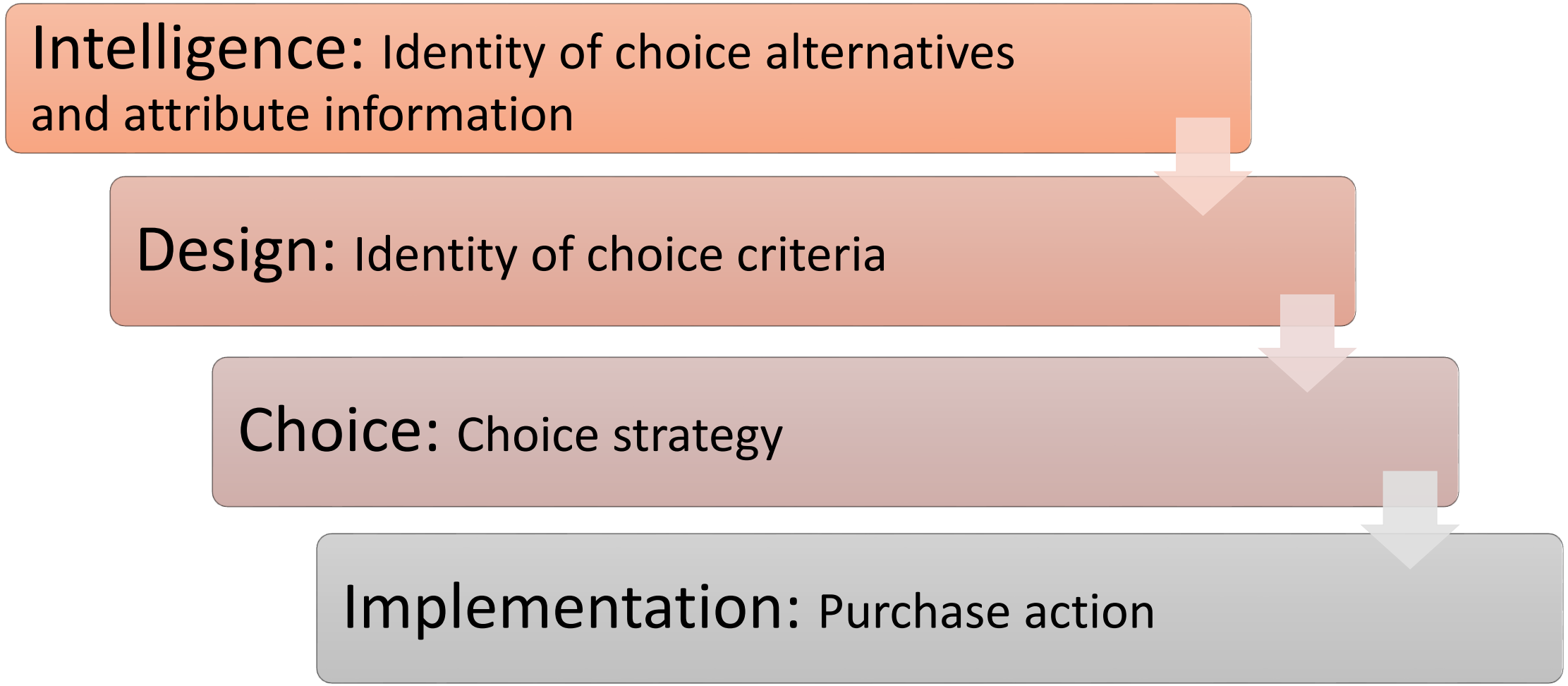
Large literature review, survey, means and standard deviations, correlation matrix, orthogonal varimax rotation, principal component analysis, regression models, pilot study. We send mail-survey to 2000 Finnish people (over 18 year old) and we tallied 639 filled questionnaires. Our respondents were 58.1 % males and 41.9 % females.

## Research:

In this paper, we aim to model the structure of consumer decisions related uncertainty from the decision making perspective. We used the paradigms for measurement development (Churchill, 1979, Nunnally, 1978).

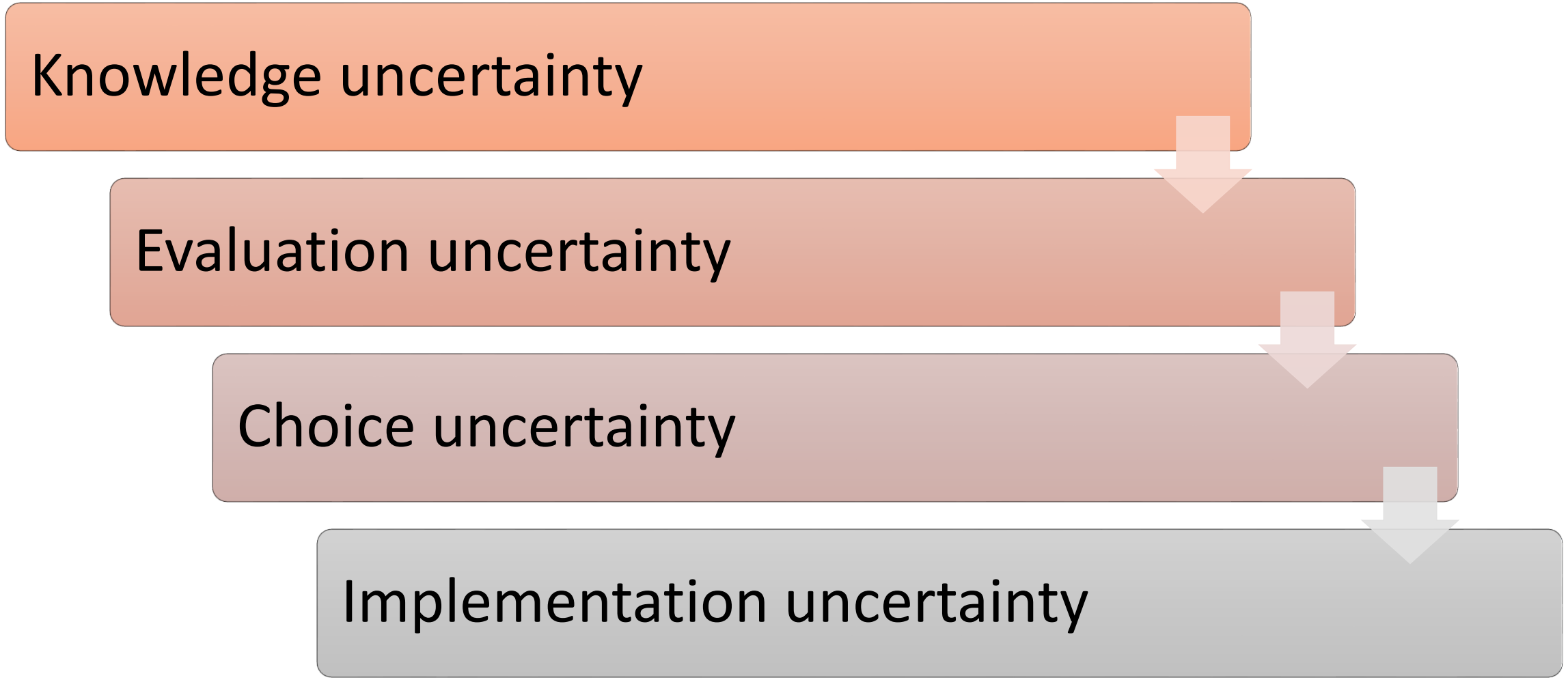
# Methods and research question

# Herbert Simons´ decision making phases (Simon 2009)




**Source:** Simon, Herbert A., (2009) An Empirically-Based Microeconomics. Cambridge Books, Cambridge University Press, Cambridge.

# Uncertainty related to Simons´s decision making phases



# Uncertainty measures in the study

| Var. ID | Variables: Uncertainty Items |
|---|---|
| **Knowledge uncertainty** | |
| KU1 | Uncertainty related to general market information |
| KU2 | Uncertainty related to identity of available alternatives |
| KU3 | Uncertainty related to prices of available alternatives |
| KU4 | Uncertainty related to quality of available alternatives |
| KU5 | Uncertainty related to sellers |
| **Evaluation uncertainty** | |
| EU1 | Uncertainty related to evaluation criteria in general |
| EU2 | Uncertainty related to relevancy of product attributes |
| EU3 | Uncertainty related to importance of criteria |
| EU4 | Uncertainty related to one's own ability to compare information |
| EU5 | Uncertainty related to comparability of information |
| EU6 | Uncertainty related to availability of comparable information |

# Uncertainty measures in the study

| Var. ID | Variables: Uncertainty Items |
|---|---|
| **Choice uncertainty** | |
| CU1 | Uncertainty related to general difficulty of choosing |
| CU2 | Uncertainty related to difficulty in choosing the brand |
| CU3 | Uncertainty related to difficulty in choosing the best alternative |
| CU4 | Uncertainty related to difficulty to choosing where to shop |
| **Implementation uncertainty** | |
| IU1 | Uncertainty related to general difficulty of purchasing |
| IU2 | Uncertainty related to difficulty of reaching the store |
| IU3 | Uncertainty related to in production status at purchase time |
| IU4 | Uncertainty related to stock levels at purchase time |
| IU5 | Uncertainty related to problems in purchasing the chosen product |
| IU6 | Uncertainty related to validity of announced prices |
| IU7 | Uncertainty related to realization of promised quality |

# The rotated principal component solution with 22 uncertainty variables

| | | Principal Component Loadings | | | |
|---|---|---|---|---|---|
| **Uncertainty Items** | | **PCEU** | **PCCU** | **PCKU** | **PCIU** |
| | **Uncertainty related to …** | | | | |
| KU1 | General market information | **0.502** | 0.214 | 0.383 | 0.108 |
| KU2 | Identity of available alternatives | 0.355 | 0.126 | **0.783** | 0.184 |
| KU3 | Prices of available alternatives | 0.200 | 0.138 | **0.821** | 0.269 |
| KU4 | Quality of available alternatives | 0.303 | 0.120 | **0.809** | 0.212 |
| KU5 | Sellers | 0.215 | 0.223 | **0.762** | 0.174 |
| EU1 | Evaluation criteria in general | **0.582** | 0.368 | 0.254 | 0.096 |
| EU2 | Relevancy of product attributes | **0.709** | 0.293 | 0.230 | 0.074 |
| EU3 | Importance of criteria | **0.786** | 0.239 | 0.222 | 0.059 |
| EU4 | One's own ability to compare information | **0.698** | 0.264 | 0.269 | 0.208 |
| EU5 | Comparability of information | **0.794** | 0.235 | 0.168 | 0.214 |
| EU6 | Availability of comparable information | **0.692** | 0.274 | 0.238 | 0.221 |
| CU1 | General difficulty of choosing | 0.413 | **0.657** | 0.108 | 0.114 |
| CU2 | Difficulty in choosing the brand | 0.151 | **0.827** | 0.175 | 0.191 |
| CU3 | Difficulty in choosing the best alternative | 0.239 | **0.784** | 0.201 | 0.169 |
| CU4 | Difficulty to choosing where to shop | 0.314 | **0.750** | 0.224 | 0.171 |
| IU1 | General difficulty of purchasing | 0.358 | **0.589** | 0.060 | 0.393 |
| IU2 | Difficulty of reaching the store | 0.324 | **0.617** | 0.046 | 0.344 |
| IU3 | In production status at purchase time | 0.036 | 0.203 | 0.253 | **0.733** |
| IU4 | Stock levels at purchase time | -0.073 | 0.102 | 0.300 | **0.742** |
| IU5 | Problems in purchasing the chosen product | 0.275 | 0.312 | 0.184 | **0.672** |
| IU6 | Validity of announced prices | 0.349 | 0.252 | 0.047 | **0.685** |
| IU7 | Realization of promised quality | 0.429 | 0.122 | 0.148 | **0.544** |

Our tests suggest **four dimensions of uncertainty**:

*Knowledge uncertainty, Evaluation uncertainty, Choice uncertainty, and Implementation uncertainty*

Against previous scientific wisdom, ***evaluation and implementation uncertainties*** seem to exercise strongest impact on consumer decisions in innovative technology and electronic commerce context.

# Conclusions of the study

In additive manufacturing/production sites, we should identify consumers perceived uncertainty in decision making. Thus, we are able to produce new and innovative products and services for real consumers needs.

Consumers might perceive uncertainty about AI, IoT, robotics or intelligence products. Uncertainty might be a critical barrier to purchase decision. Customer transformation from E-commerce to A-commerce is challenging, even without uncertainty barriers.

# Conclusions

# General conclusions

The implementation of Additive manufacturing and Industry 4.0 approaches require deeper understanding of uncertainty and risk behaviour of modern consumers.

Herbert A. Simon´s approach to uncertainty analysis of decisions provides a fruitful platform for modern risk behaviour/analysis of consumers

# We thank you for attention!

**Doctor of Administrative Sciences, D.Sc. (Admin.)**
**M.Sc. (Econ.)**
**Adjunct prof. Jari Kaivo-oja,**
**FFRC, Turku School of Economics,**
**University of Turku**


**Doctor of Science (Business Administration), M.Sc. (Econ.)**
**Theresa Lauraeus**
**Aalto University, School of Economics, Department of Information and Service Economy, Information System Sciences,**
**Helsinki, Finland**