DESIGN SCIENCE IN NFC RESEARCH

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Outline

- Near Field Communication (NFC)

- Our Motivation and Purpose

- Research Strategy

- NFC Research Framework and Classification

- Design Science Research

- Results and Conclusion

Near Field Communication

- Many Reliable Applications; payment, ticketing, loyalty services, identification, access control, content distribution, peer-to-peer data/money transfers …

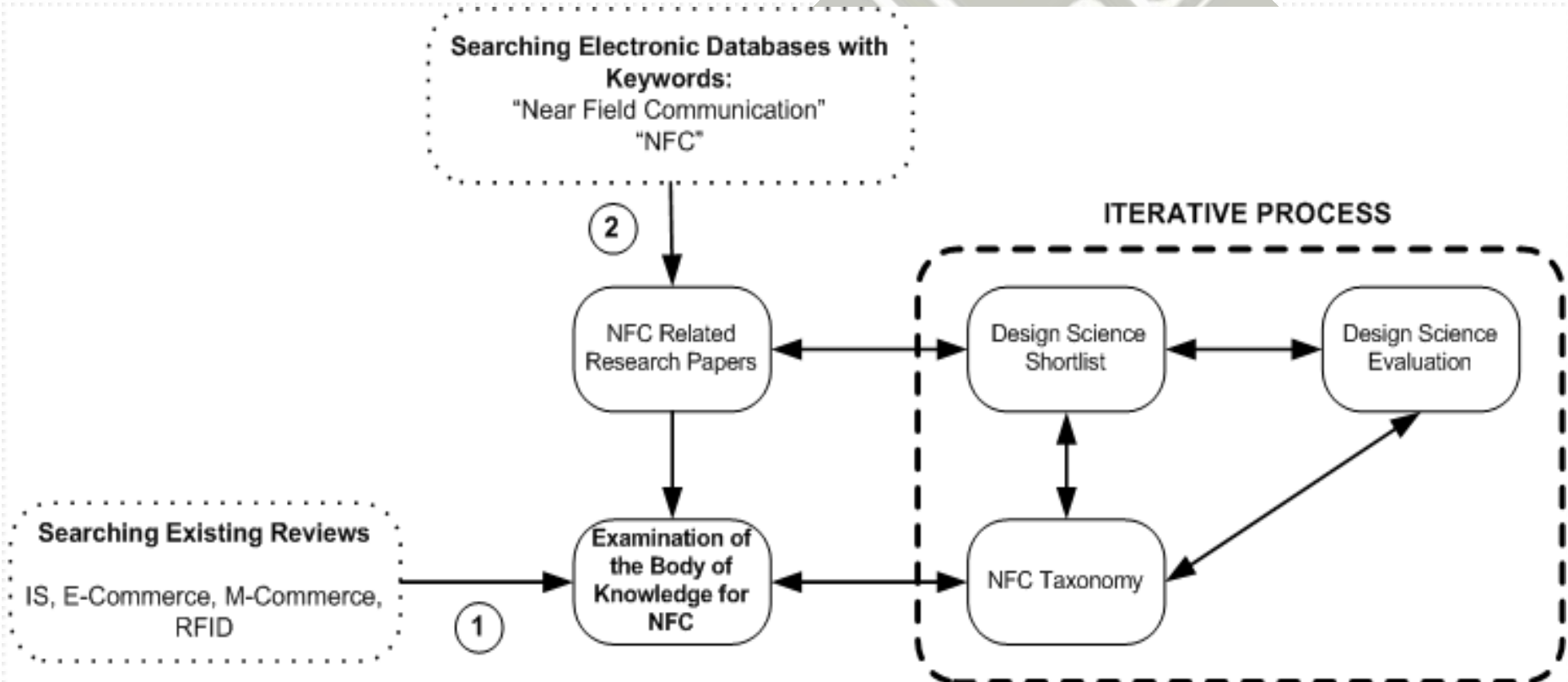- New and exciting area for practitioners

Our Motivation

- An attractive research area for academicians

- Better understanding of the current status of NFC research area is necessary to maintain the advancement of knowledge in NFC research

- Identification of the gap between theory and practice

- Such a work about NFC research area has not performed so far in a discipline and rigorous way
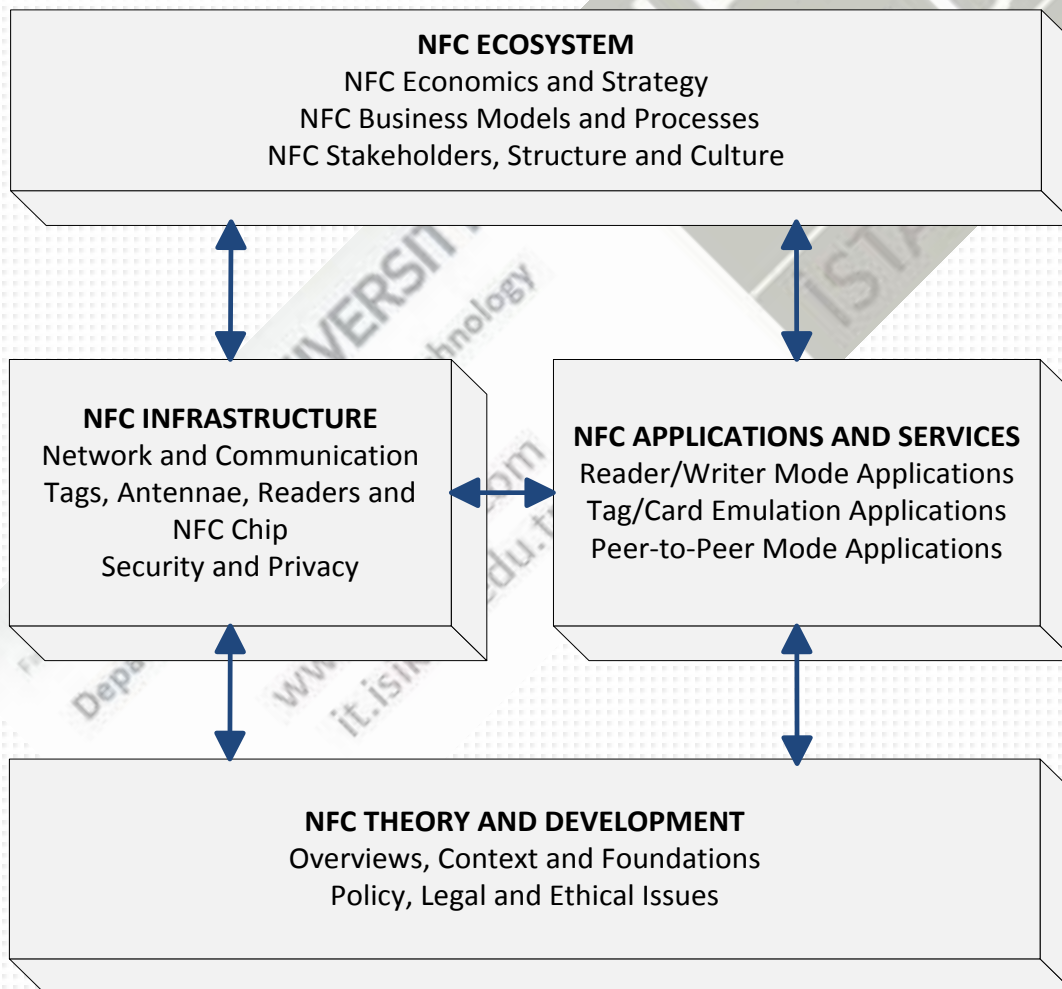
Our Purpose is to...

- Conduct a holistic review by analyzing the NFC literature from a design science research point of view

- Complement our earlier work; NFC research framework and NFC literature classification

Research Strategy

NFC Research Framework

[Ozdenizci et.al, 2010]

NFC ECOSYSTEM
NFC Economics and Strategy
NFC Business Models and Processes
NFC Stakeholders, Structure and Culture

NFC INFRASTRUCTURE
Network and Communication
Tags, Antennae, Readers and
NFC Chip
Security and Privacy

NFC APPLICATIONS AND SERVICES
Reader/Writer Mode Applications
Tag/Card Emulation Applications
Peer-to-Peer Mode Applications

NFC THEORY AND DEVELOPMENT
Overviews, Context and Foundations
Policy, Legal and Ethical Issues

Classification of Reviewed NFC Literature

[Ozdenizci et.al, 2010]

Classification Criteria	Number of Papers	References	Percentage by subject	Percentage by all subjects
NFC Theory and Development				
NFC Overview, Context and Foundations	12	[5, 6, 18, 22, 37, 39, 49, 50, 62, 64, 72, 82]	80,00	16,22
NFC Policy, Ethical and Legal Issues	3	[19, 38, 69]	20,00	4,05
Total	15		100,00	20,27
NFC Applications and Services				
Reader / Writer Mode Applications	19	[9, 10, 13, 21, 22, 26, 32, 33, 34, 35, 36, 48, 54, 55, 56, 68, 71, 74, 77]	63,33	25,68
Card Emulation Mode Applications	10	[3, 12, 17, 24, 41, 52, 53, 57, 63, 73]	33,33	13,51
Peer To Peer Mode Applications	1	[70]	3,33	1,35
Total	30		100,00	40,54
NFC Infrastructure				
Network and Communication	7	[14, 25, 40, 46, 79, 80, 81]	31,82	9,46
Tags, Antennas, Readers and NFC chip	7	[15, 23, 29, 47, 51, 67, 75]	31,82	9,46
Security and Privacy	8	[1, 30, 31, 42, 43, 45, 65, 66]	36,36	10,81
Total	22		100,00	29,73
NFC Ecosystem				
NFC Economics and Strategy	0	[-]	0,00	0,00
NFC Business Models and Processes	3	[4, 7, 44]	42,86	4,05
NFC Stakeholders, Structure and Culture	4	[2, 8, 20, 57]	57,14	5,41
Total	7		100,00	9,46

Design Science Research [Hevner et. al 2004]

| Guidelines	Keywords
Guideline 1: Design as an Artifact	Constructs, Models, Representations, Methods, Instantiations, Prototypes
Guideline 2: Problem Relevance	Problem Solving, Optimization, Profit Maximization
Guideline 3: Design Evaluation	Observational, Case Studies, Analytical, Experimental, Functional or Structural Testing, Descriptive (Scenarios)
Guideline 4: Research Contributions	New Metrics, System Development Methodologies, Design Tools, Prototypes or Improvement of Existing Foundations
Guideline 5: Research Rigor	Applicability, Generalizability, Appropriateness, Feasibility of the Design Artifact, Well Design Evaluations
Guideline 6: Design as a Search Process	Iterative Process, Searching for The Best, Optimal Design, Future Studies
Guideline 7: Communication of Research	Managerial and Technology Oriented Audiences

An Example

Guidelines	Paper 77
Guideline 1: Design as an Artifact	Platform to securely manage smartcard applications in NFC devices
Guideline 2: Problem Relevance	Clearly mentioned; need for secure management
Guideline 3: Design Evaluation	Not evaluated, only implications of the platform
Guideline 4: Research Contributions	Contributes due to its nature
Guideline 5: Research Rigor	Not highly rigorous; not satisfactory design evalautions
Guideline 6: Design as a Search Process	Facilitates search process
Guideline 7: Communication of Research	Communicates all audiences

Results (1/4)

- Need more journal publications to provide business related and rigorous research papers on NFC technology

- Most of them were related to NFC Applications and Services
  - Especially in reader/writer mode
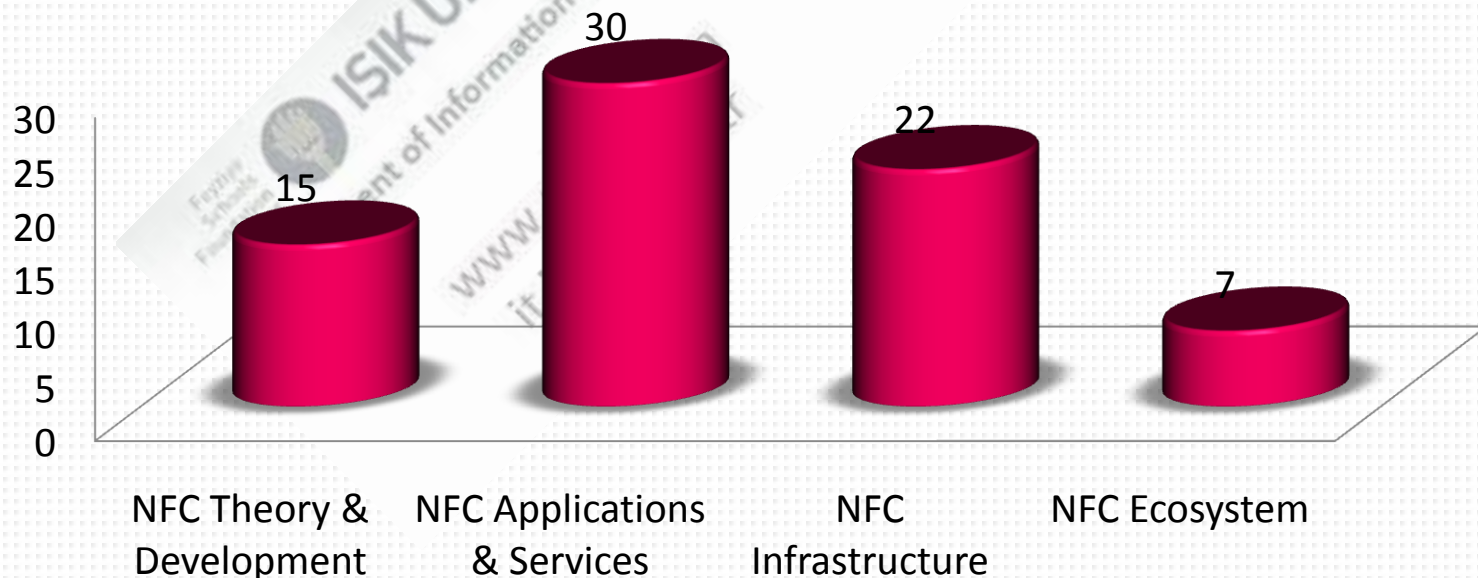
Results (2/4)

- The second largest proportion of the papers is related with the NFC Infrastructure; importance of focusing on technical issues of a new technology

- But, more specific research need to be conducted on
  - economics, business values or strategies for NFC development, dissemination and marketing ...

  - ecosystem of NFC technology, new business models, roles of stakeholder ...

  - policy, ethical and legal problems which can be referred as behavioral issues were demanding research areas for development of a new, emerging technology ...

Results (3/4)

- Currently it seems that the most popular NFC related research subjects are on developing new NFC enabled applications and developing NFC infrastructure
  - Thus, NFC research can be mostly referred as *design science research*

- Design an Artifact and Problem Revelance
  - Most of the NFC design science papers proposes an innovative artifact which provides an utility for a specific, relevant business problem

- Design Evaluation
  - Using more descriptive (e.g. scenarios, use cases) or analytical (e.g. architecture analysis) methods

Results (4/4)

- Research Contributions
  - Must be in clear, explicit and verifiable way for future studies

- Research Rigorous
  - More high level representation of applicability and generalizability of the artifact

- Search Process
  - Most of them facilitate a search process

- Communication of Research
  - Most of them are presented to technology oriented audiences

Conclusion

- We believe that this study provides a holistic review and a comprehensive base for understanding of NFC research

- More rigorous and highest level of research is required

- More attention has to be paid to less developed research areas
  - In particular economics, strategy, business values, culture, policy and legal issues ...
  - Useful guidelines for the development of NFC enabled applications or infrastructure

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