TOP IS RESEARCH ON QUALITY OF TRANSACTION STANDARDS:

A STRUCTURED LITERATURE REVIEW TO IDENTIFY A RESEARCH GAP

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This paper contains the results of a systematic literature review executed to determine the coverage of transaction standards in top information systems (IS) and management journals. Specifically, it aims to identify a research gap with respect to this topic. The top 25 journals are thoroughly searched and the selected publications are classified in order to make grounded statements. A moderate amount of literature found specifically aims at transaction standards. Hardly any research is found on quality aspects of transaction standards, which therefore counts as the research gap.

Information systems without standards are hard to imagine. Also in the e-business domain, standards are gaining importance and attention. Much focus is nowadays on the concept of inter-organizational interoperability: the ability of two or more socio-technical systems to exchange information, to interpret the information that has been exchanged and to act upon it in an appropriate and agreed-upon matter (Rukanova, 2005). Inter-organizational interoperability is of special interest in the e-business domain. Standardization is one of the means to achieve such interoperability. In literature, different terms are used for this kind of standards, such as e-business standards, vertical and (business) transaction standards. A standard, in the simplest sense, is an agreed-upon way of doing something (Spivak & Brenner, 2001). Transaction standards are often developed inside a specific industry domain, often outside the traditional standard setting organizations (also called standard development organization).

As standards are a means to an end — interoperability — a general assumption is that a good standard will improve interoperability. Surprisingly, the question as to what makes a good standard is relatively rarely given explicit treatment in the literature on standardization (De Vries, 2007), although Markus, Steinfield, Wigand & Minton (2006) note that the technical contents of the standards will have impact on the standards diffusion. This suggests a relevant quality aspect attached to the technical content.

Goal

This research is a first step in developing knowledge on quality of transaction standards. The ultimate goal is to enable the measurement of quality of transaction standards. The goal of this paper is limited to assessing the topic of quality of transaction standards as a possible research gap. A derived goal, and contribution to the knowledge area, is the analysis of coverage of this research subject within the most important Information Systems and Management literature.

Research Questions

In order to get an overview of existing state-of-the-art in top journals regarding the topic of quality of transaction standards, the following research questions have been constructed:

1. What trend can be noted by looking at the amount of publications per year?
2. Are there any studies related to quality of transaction standards published?
3. Are there many papers related to transaction standards, and in specific for certain domains (verticals)?
4. What can we say about the maturity of the standardization discipline?

Research Method

A systematic literature review (Petticrew & Roberts, 2006) has been set-up and performed to enable grounded statements to the research questions and to assure that no major publication will be missed. The search was constructed based on Rumsey's (2008) description of planning the campaign. The goal of identifying a research gap implies that the top 25 information systems journals and top 25 management journals should be included (and restricted to) in the search phase. Search engines were selected based on our analysis of coverage of the journals in the search engines. The selection of journals and search engines was based on previous work (DuBois & Reeb, 2000; Mylonopoulos & Theoharakis, 2001; Schwartz & Russo, 2004). More information on the journals and search engines is available in appendix 1.

From the domain of quality measurement of business transaction standards, keywords have been selected. To assure the quality of the keywords, the selection was done iteratively by testing the keywords in the search engine and by adding multiple synonyms. The selected keywords are visualized in Figure 1, while the synonyms and search strings are mentioned in appendix 1.
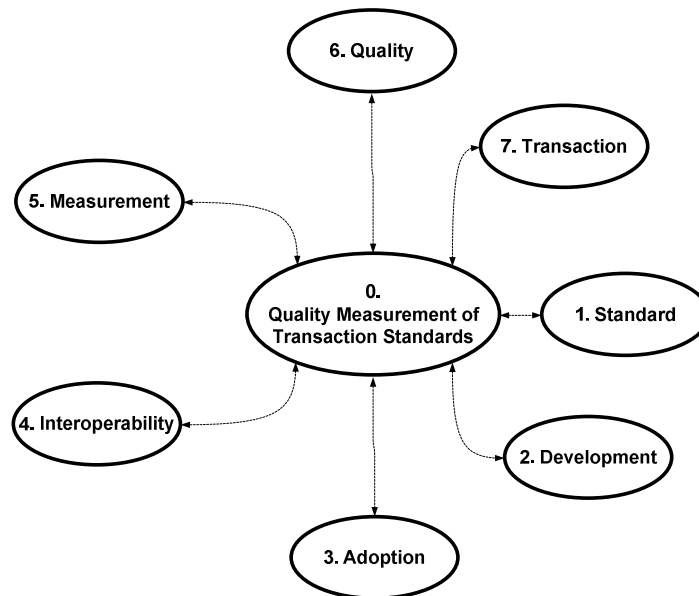

Figure 1: *Keywords*

The searches conducted with the search engines yielded several articles per query. Search queries where designed so that manageable amounts of publications were found. Then, an exclusion process has been initiated as described by (Van der Linde et al., 2004). First, abstracts and keywords were assessed manually on relevance; in order to ensure that nothing was overlooked this process was done twice and by two individuals. This resulted in a list of 100 papers. A second screening on relevance took place by scanning the whole publication, again double-blinded. This resulted in a list of 48 publications, these publications were classified according to the framework. During this classification we found out that an additional 5 papers were out of scope, which resulted in a final list of 43 publications (the complete list can be found in appendix 2). This selection process is visualized within Figure 2. Even though this selection process has been carried out, it is a weak spot in this methodology, because the selection criteria are subjective and difficult to trace. In the first step many papers related to software engineering, healthcare, multimedia and accountancy were removed. The second step removed publications with only marginal attention for standards.
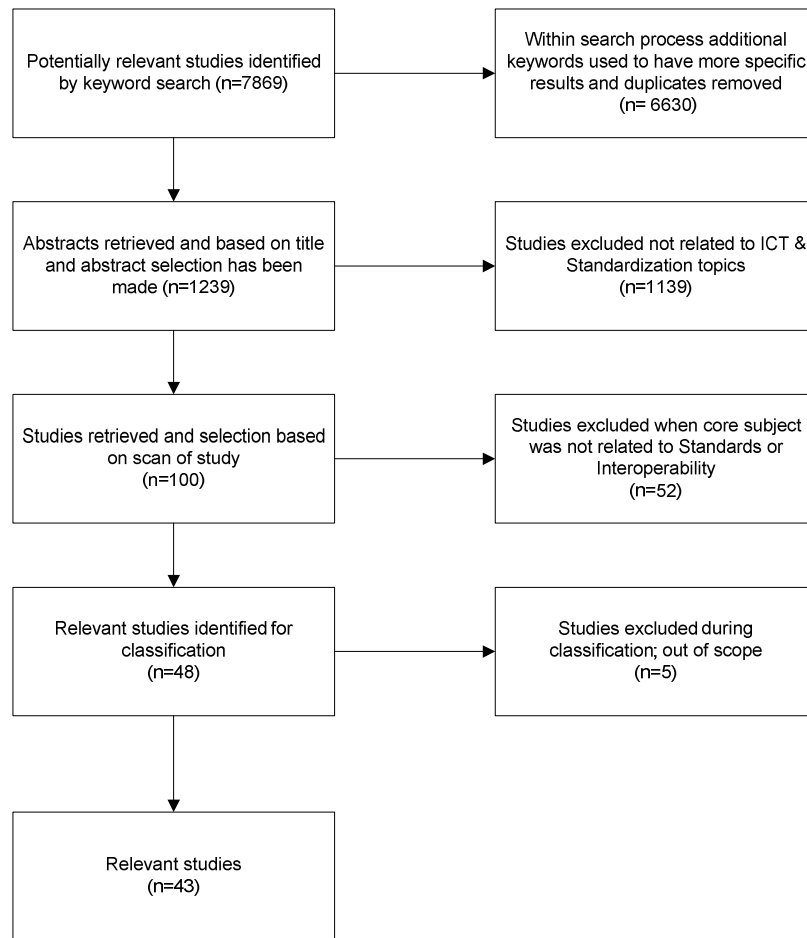
Figure 2: *Quorum flowchart*

Then, a classification framework is needed to arrange the studies found, in order to be able to answer the research questions. This framework has been set up before the classification process itself.

Classification framework

Based on the research questions and other systematic literature review research (Wareham, 2005) several classifiers regarding the standardization subject were selected, as well as classifiers regarding the research rigor. They are:

- Topic: The topic (domain) of the research
- Standard Lifecycle: The phase within the lifecycle of a standard
- Standards View: The actor's viewpoint on the subject
- Type of Standard: What kind of standards is the paper about?
- Research Approach: The research approach (fundament) for the paper
- Research Method: The applied research method of the paper

Several other classifiers have been considered, such as the IS core theories used in many publications. The model of Benbasat and Zmud (2003) consisting of IT-artifact, Usage, Impact, IT managerial, methodological, and technological capabilities, and IT managerial, methodological, and technological practices would have been applicable. And also, on a subset of the papers, the diffusion of innovation theory of Rogers (2003) is applicable. But the main reason for selecting the mentioned classifiers is the relevance to the research questions.

Next, the six chosen classifiers will be further decomposed.

Topic
Based on the keywords and brainstorming, five different topics have been identified.

Topic	Description
Standards Lifecycle	The publication discusses one or more steps from the standards life cycle, such as standards development or standards diffusion.
Standards and Interoperability	The publication concerns interoperability issues, or other higher-level aspects of standardization.
Standards Quality	The publication addresses the quality aspects of standards.
Standards Policy/Strategy/Impact (PSI)	The publication concerns economics of standardization, business cases, general advantages, the impact of usage of the standard, or the effectiveness of standards.
Standards Organization	The publication concerns standards setting organizations (SSO) and standards development organizations (SDO), National Standards Organizations, etc.

Table 1: *Standardisation topics*

Standards Lifecycle
Considerable literature on standards lifecycles exists. Amongst others are Cargill (1995), De Vries (2007) and Egyedi and Blind (2008). Söderström (2004) compared seven different standards life cycle models, and build a new model based on that. Each of these seven may be useful for classification, but we chose Söderström's extended general lifecycle as a start, because it takes most other lifecycle models into account.
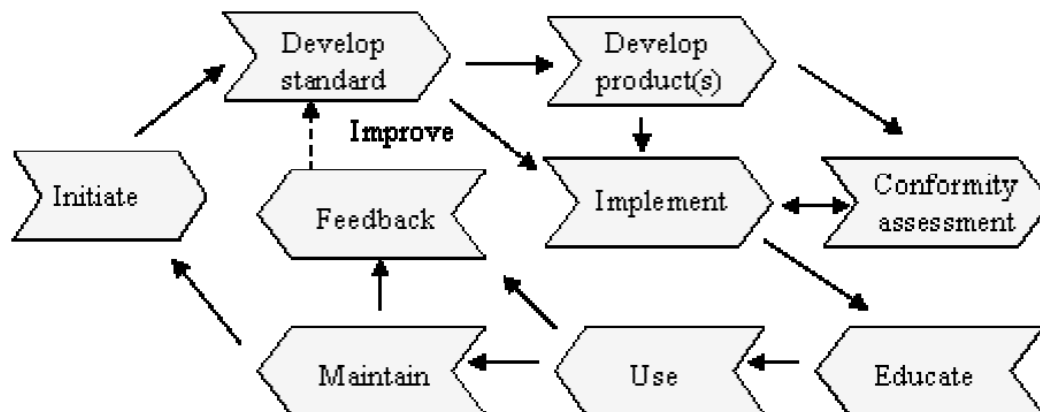

Figure 3: *Extended general lifecycle (Söderström, 2004)*

Although this model fits our purposes we need to condense it for pragmatic reasons; it contains too many steps, which may result in fragmented results. We combined the Initiate and Standards Development phase (and kept the latter name), and did the same for Develop Product, Conformity Assessment, Educate and Implement. Also, Feedback is combined with Maintain.

In comparison with lifecycle models from other domains (e.g. software domain (Ambler, 2009)), the standardization lifecycle models found are open-ended: they lack an "end" phase. Based on the Enterprise Unified Process, we therefore decided to add a Retirement phase to the lifecycle model.

Standards Lifecycle	Description
Develop	The creation and development phase of a standard.
Implement	Implementation of the standard in products or systems, including implementation services.
Use	The usage of the standard, the adoption in the market (diffusion).
Maintain	The maintenance phase where standards (periodically) are improved to current needs.
Retirement	The phase when a standard is withdrawn from maintenance.

Table 2: *Standards Lifecycle*

Standards View
Different roles take part in the stages identified in the lifecycle model. We however see no one-to-one correspondence between lifecycle stages and roles. For instance, it is possible to have a user view on the implementation of standards, but also the view of the creator of the standard on implementation phase. Krechmer (2006) identifies three main recognizable views on standards: User, Implementer and Creator. We added the Policy Maker role. One might argue that this constitutes a specific type of user, but for our goals we decided to add this additional view.

Standards View	Description
Creator	The developer of the standard. (creates the standard)
Implementer	The implementer of the standard. (implements the created standard)
User	The (end) user of the standard. (uses the implementation of the standard)
Policy Maker	The policy maker about standards. (develops policy about the standard)

Table 3: *Standards Viewpoints*

Type of Standards:
"Researchers working on standards still struggle to order and understand existing standards" (Rukanova, 2005). Probably Cargill (1989) was among the first with a classification of voluntary and regulatory standards. A classical definition by David and Greenstein described by Van Wessel (2008) distinguishes:
- Reference Standards
- (Minimum) quality Standards
- Interface or compatibility Standards

De Vries (2006) makes a distinction between three types of standards; Basic, requiring and measurement standards. Basic standards provide a structured description of (aspects of) interrelated entities. Requiring standards set requirements for entities or relations between entities. Measurement standards provide methods to be used to check whether requiring standards' criteria have been met.

Another possible design-based classification (De Vries, 2006) is similar to David and Greenstein's: Interference standards, compatibility standards and quality standards. Interference standards set requirements concerning the influence of an entity on other entities. Compatibility standards concern the fitting of interrelated entities to one other, in order to enable them to function together. Quality standards set requirements for entity characteristics to assure a certain level of quality (De Vries, 2007). Van Wessel (2008) uses the classification of formal and informal standards.

Another classification is based on the organization that drives the process (De Vries, 2006; Van Wessel, 2008):
- Governmental
- Formal
- Consortium
- Company

Yet another classification is based on characteristics of the process (De Vries, 2006; Van Wessel, 2008):
- Anticipatory, participatory, responsive
- Open or closed

- Consensus or non-consensus

The list is endless (for instance classification on national, regional, international, etc) and many have been described by de Vries (2006). More specific for the e-business domain is the hierarchical classification (Zhao, Xia, & Shaw, 2005):
- e-business standards (e.g. RosettaNet, MISMO, Papinet, STAR, etc)
- Interaction standards (e.g. BTP, SAML, BPEL4WS, WSDM, etc)
- Communication protocols (e.g. UDDI, WSDL, SOAP, etc)
- Internet standards (e.g. HTTP, TCP/IP, XML, etc)

This shows some resemblance to the Open System Interconnection model (from physical connectivity, data link, network, transport, session, presentation, to the application level), while condensing the lower levels. Standards for the presentation and application level are often called semantic standards (Steinfield, Wigand, Markus, & Minton, 2007), while the standards on the levels below are called syntactical standards. The classification used by Steinfield et al. (2007) decomposes the semantic standards into horizontal (cross-industry) and vertical (industry-specific) standards.

As this paper focuses on transaction standards we chose to use the classification also used by Steinfield et al. (2007), as this is the closest fit to our third research question.

Type of Standard	Definition
Syntactical	The scope is related to technical standards like TCP, IP, SOAP
Semantic – Horizontal	The scope is related to cross industry standards like ebXML, UBL
Semantic – Vertical	The scope is related to industry standards like MISMO, hr-XML
All	Multiple types are covered

Table 4: *Types of Standards*

Research Approach
An often-used classification of the research approach is from Orlikowski and Baroudi (1991):
- Positivist
- Descriptive
- Theoretically grounded
- Critical
- Interpretive

Klein and Myers (1999) uses the same categories to classify IS research but without the shown subdivision of positivist research. For an analysis of e-commerce research, Wareham (2005) distinguishes between positivist, interpretivist, descriptive and design science. The critical approach has been left out, perhaps because of low expectations on finding articles that fit this category. Design science has been added as a more recent research approach (Wareham, 2005). Other options would be to distinguish between:
- qualitative and quantitative approaches, and
- positivism, post-positivism, critical theory, and constructivism for qualitative research as described by Guba & Lincoln (1994).

For our purposes, we used the original list of Orlikowski and Baroudi (1991) .

Research Approach	Description
Positivist (Theoretically grounded)	Propositions or hypothesis are formulated and tested, or analytical propositions are derived. Typically quantifiable measures on stated populations (Klein & Myers, 1999).
Positivist (Descriptive)	Describes current practices, without theoretical grounding or rigorous data collection and analysis. They describe issues to be shared with the community. Typically case studies (Orlikowski & Baroudi, 1991).
Critical	Critical perspective if the main task is being seen as being one of social critique, whereby the restrictive and alienating conditions of the status quo are brought to light (Klein & Myers, 1999).
Interpretive	A basis premise is that the perspective is fundamentally subjective, and thus, attempts to understand the phenomena through the meaning that participants assign to them (Orlikowski & Baroudi, 1991; Wareham, 2005). Typically orientated at social constructs, or the context of information systems.

Table 5: *Research Approaches*

Research Method

Research methodology is a vast and diverse field. For our research, the amount of methods should be limited in order to avoid fragmented results. Also, it should match our research questions. In our case, this means that a general, high-level classification of research methods will suffice.

Wareham (2005) uses for his e-commerce literature review: Conceptual, Survey, Experiment, Development, Data Analysis, Case Study, Review, Others. Orlikowski and Baroudi (1991) uses a somewhat different list: Survey, Laboratory Experiment, Case Study, Mixed Method, Field Experiment, Instrument Development, Protocol Analysis, Action Research.

Our literature review parallels Wareham's, although the subject is different. Therefore we chose Wareham's list as a start. The following table is based on Wareham's (2005), but slightly adapted by combining Survey, Experiments and Data Analysis into one category.

Research Method	Description
Conceptual	Conceptual analysis, theoretical analysis, mathematical models, analysis or narration based upon author's experience, observation or thoughts. No strong empirical evidence to support author's conclusion. Descriptions of current practices, situations and imagined scenarios.
Data Analysis/ Survey/ Experiments	Mail survey, online survey, use of questionnaires to obtain quantitative or qualitative data. Lab experiment, field experiment, free simulation. Document analysis, content analysis, secondary data analysis, field data analysis, and other analysis based on data not from questionnaire instruments and/or experimentation.
Review	Literature review, historical rendition, commentaries, current status review, practice review.
Development	Techniques, methods, frameworks, instruments to develop some technical application, system, protocol, etc.
Case Study	Intensive analysis of cases based upon interviews, observations and analysis in some specific context.
Other	Ethnography, action research, other.

Table 6: *Types of Research Methods*

Operational classification process and results

Like the selection process, the classification process has been carried out double blinded to improve the quality of the results. Differences in the classification have been solved by analyzing the differences and achieving consensus from both individuals and to make use of a third individual. The complete list of papers and their classification can be found in appendix 2.

The first table contains an overview of the distribution of papers across the journals, and over time.

Journal	<	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	total
Academy of Management Journal													1				**1**
ACM Computing Surveys													1				**1**
ACM SIGMIS Database													1				**1**
Communications of the ACM (CACM)	1			1			1				2	1	2	1	1	2	**12**
Decision Support Systems								1					1				**2**
European Journal of Information Systems								1									**1**
IEEE Transactions on Industrial Informatics (TII)														1			**1**
IEEE Trans. on Information Technology in Biomedicine (TITB)						1	1									1	**3**
Information and Management	1		1										1	1			**4**
Information Systems Journal												1					**1**
International Journal of Electronic Commerce (IJEC)				1								1					**2**
Journal of Management Information Systems (JMIS)					1							1	1	1	1		**5**
Journal of Strategic Information Systems (JSIS)		1															**1**
Management Science			1														**1**
MIS Quarterly: Management Information Systems (MISQ)														6			**6**
Organization Science					1												**1**
Totals	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**0**	**0**	**2**	**4**	**8**	**10**	**2**	**3**	**43**

Table 7: *Distribution of relevant papers*

The peak in 2005 and 2006 is remarkable, and is partly explained by the special issue on standardization in MISQ in 2006 (nr. 30). Communications of the ACM hosts by far the most relevant publications on this subject.

The next table contains the classification based on topic.

Topic	Count
Standards Lifecycle	16
Standards and Interoperability	13
Standards Quality	1
Standards Policy/Strategy/Impact (PSI)	11
Standards Organization	2

Table 8: *Results on topic*

Remarkable is the low number of studies in the third and fifth categories. The second category contains papers that are more high level and standards are often not the main subject. This is also the reason why especially these papers could not be scored on the Standards Lifecycle (see next table).

Standards Lifecycle	Count
Development	4
Implement	1
Use	23
Maintain	-
Retirement	-
Not applicable	15

Table 9: *Results on Standards Lifecycle*

Remarkable are the low scores for the maintain and retirement phases, and the high score for the use/adoption phase. The table below contains the results on the Standards View.

Standards View	Count
Creator	7
Implementer	15
User	20
Policy Maker	1

Table 10: *Results on Standards View*

This shows, in combination with the results on standards lifecycle, that most of the papers are dealing with a user view on standards. Hardly any have a creator's view, or deal with the development life cycle phase of the standard.

The table below contains the results on the Type of Standards.

Type of Standards	Count
Syntactical	10
Semantic – Horizontal	11
Semantic – Vertical	14
All	8

Table 11: *Results on Type of Standards*

The classification process for this category was somewhat difficult, because many papers did not completely focus on one type. Also, the emphasis was not always clear. It is remarkable that only 14 papers have been found that mainly deal with vertical standards, as the keywords were specifically aimed to find as many as possible.

Next are the results on the Research Approach and Research Method.

Research Approach	Count
Positivist (Theoretically grounded)	5
Positivist (Descriptive)	26
Critical	6
Interpretive	6

Table 12: *Results on Research Approach*

Research Method	Count
Conceptual	11
Data Analysis / Survey / Experiments	5
Review	9
Development	7
Case Study	11
Other	-

Table 13: *Results on Research Method*

Remarkable is the low amount of papers with a positivist approach, fundamentally grounded with thorough data analysis, and the high amount of descriptive research.

Findings

This section revisits our research questions.

1. What trend can be noted by looking at the amount of publications per year?
Based on this study, no upwards/downwards trend can be derived from the statistics. The publication peak in 2005 and 2006 can be seen as an incident with 42% of the selected publications is published in 2005 and 2006. We conclude that the area identified is currently not a continuous research area.

2. Are there any papers related to quality of transaction standards?
Within these top journals hardly any (only 1 paper) research has been published about the quality of transaction standards. This clearly suggests that quality of transaction standards constitutes a research gap. With only two results, the subject of standardization organizations can be called a research gap as well.

3. Are there many papers related to transaction standards, specifically for certain domains (verticals)?
Although the keywords were specifically aimed at transaction standards, including search terms such as *e-business* and *vertical*, only fourteen papers have been found that deal with vertical industry standards. Much attention is paid to technical standards, but research regarding vertical standards seems not to reach major journals. The fourteen papers found moreover revisit the same vertical standards, which makes the unique number even lower.

4. What can we say about the maturity of the standardization discipline?
Given that only the Communications of the ACM regularly pays attention to this subject, this is no good sign for the maturity of the standardization discipline. Another negative sign is the lack of fundamentally grounded positivist research, and the high amount of descriptive research approach without fundamental background. The case studies are almost all related to the fourteen papers identified as related to vertical standards. Empirical research is in the minority. Based on these observations, we may conclude that the standardization discipline is not mature. Yet, a more thorough benchmark with other disciplines is needed to make this conclusion more definite.

Conclusions

At least two research gaps have been identified, which was the primary focus of this research. Also the second goal was achieved; the overview gives some remarkable insights of the coverage of standardization research within the top IS journals.

It is important to notice though that the validity of these conclusions is limited to the set of journals we have investigated. There seems to be a major difference between the standardization research covered in the top journals and the research covered in the less known specific standardization literature (for instance the International Journal of Standardization Research). Some topics (like Standardization organization) that was not covered in top journals is often covered in those journals and other edited books by members of the EURAS community.

The goal of this research, as has been set earlier, has been achieved by declaring the quality of transaction standards as research gap. However, this is only a first step in achieving the ultimate goal of measuring the quality of transaction standards. The second step is to deeply analyze the 43 selected studies on its value for this ultimate goal, and to broaden the horizon with searching and analyzing of studies beyond the top journals.

References

Ambler, S., W. (2009). Enterprise Unified Process (EUP). from http://www.enterpriseunifiedprocess.com/

Benbasat, I., & Zmud, R. W. (2003). The identity crisis within the IS discipline: Defining and communicating the discipline's core properties. *MIS Quarterly: Management Information Systems, 27*(2), 183-194.

Cargill, C. F. (1989). *Information Technology Standardization: theory, process, and organizations*. Bedford: Digital Press.

Cargill, C. F. (1995). A Five-Segment Model for Standardization. In B. Kahin & J. Abbate (Eds.), *Standards Policy for Information Infrastructure* (pp. 79-99). Cambridge: The MIT Press.

De Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), *Advanced Topics in Information Technology Standards and Standardization Research* (Vol. 1, pp. 1-26). Hershey: Idea Group Publishing.

De Vries, H. J. (2007). Fundamentals of Standards and Standardization. In W. Hesser, A. Feilzer & H. J. De Vries (Eds.), *Standardisation in Companies and Markets* (2 ed., pp. 1-43). Hamburg: Helmut Schmidt University.

DuBois, F. L., & Reeb, D. (2000). Ranking the international business journals. *Journal of International Business Studies, 31*(4), 689-704.

Egyedi, T. M., & Blind, K. (2008). General Introduction. In T. M. Egyedi & K. Blind (Eds.), *The Dynamics of Standards* (pp. 1-12). Cheltenham: Edward Elgar.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). London: Sage.

Klein, H. K., & Myers, M. D. (1999). A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly: Management Information Systems 23*(1), 67.

Krechmer, K. (2006). Open Standards Requirements. In K. Jakobs (Ed.), *Advanced Topics in Information Technology Standards and Standardization Research* (Vol. 1, pp. 27-48). Hershey: Idea Group Publishing.

Markus, M. L., Steinfield, C. W., Wigand, R. T., & Minton, G. (2006). Industry-wide Information Systems standardization as collective action: The case of U.S. residential mortgage industry. *MIS Quarterly, 30*, 439-465.

Mylonopoulos, N. A., & Theoharakis, V. (2001). Global perceptions of IS journals - Where is the best IS research published? *Communications of the Acm, 44*(9), 29-33.

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research, 2*(1), 1-28.

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciencesa practical guide*. Malden, Mass., [etc.]: Blackwell.

Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Rukanova, B. (2005). *Business transactions and standards : towards a system of concepts and a method for early problem identification in standa[r]d implementation projects*. Enschede.

Rumsey, S. (2008). *How to find informationa guide for researchers*. Maidenhead: Open University Press.

Schwartz, R. B., & Russo, M. C. (2004). How to quickly find articles in the top IS journals. *Communications of the Acm, 47*(2), 98-101.

Söderström, E. (2004). Formulating a general standards life cycle. *Lecture Notes in Computer Science, 3084*, 263-275.

Spivak, S. M., & Brenner, F. C. (2001). *Standardization essentialsprinciples and practice*. New York [etc.]: Dekker.

Steinfield, C. W., Wigand, R. T., Markus, M. L., & Minton, G. (2007). Promoting e-business through vertical IS standards: lessons from the US home mortgage industry. In S. Greenstein & V. Stango (Eds.), *Standards and Public Policy* (pp. 160-207). Cambridge: Cambridge University Press.

Van der Linde, H., Hofstad, C. J., Geurts, A. C. H., Postema, K., Geertzen, J. H. B., & van Limbeek, J. (2004). A systematic literature review of the effect of different prosthetic components on human functioning with a lower-limb prosthesis. *Journal of Rehabilitation Research and Development, 41*(4), 555-570.

Van Wessel, R. M. (2008). *Realizing business benefits from company IT standardization; case study research into the organizational value of IT standards, towards a company IT standardization management framework*. CentER, Tilburg University, Tilburg.

Wareham, J. (2005). Critical themes in electronic commerce researcha meta-analysis. *JIT : journal of information technology, 20*(1), 1.

Zhao, K., Xia, M., & Shaw, M. J. (2005). Vertical e-business standards and standards developing organizations: A conceptual framework. *Electronic Markets, 15*(4), 289-300.

Appendix 1 - Search strategy

The top journals and search engines
The nature of this research (identification of research gap) dictates that all top 25 information systems journals and management journals must be included; therefore it is important to determine which search engines cover these top 25 journals. Schwartz (Schwartz & Russo, 2004) produces such an overview, although the search engines significant changed since then. So, we re-examined the coverage of these search engines across the top fifty CS/IS journals (Mylonopoulos & Theoharakis, 2001) and the top thirty of International Business Journals (DuBois & Reeb, 2000). The search engines INSPEC, ACM DB and Ei Compendex as mentioned by Schwartz have been excluded because no published list of accessible journals was available. The results of this comparison, limited to the first 25 journals of both categories, are shown in Table 14.

Based on the coverage and availability, the decision was made to use Scopus and EBSCO as search engine. Three of the journals are not covered by either of these two search engines. These journals have been manually searched from the year 2000 until April 2009. These journals are:
- Database
- International journal of management
- Advances in international banking

Scopus and EBSCO contain partly the same journals. In practice only the journals not covered by Scopus were searched using EBSCO. These are:
- Communications of the AIS
- International studies of management and organization
- Multinational Business review
- The international journal of accounting

Using keywords
The keywords for performing the research are of crucial value. We selected seven keywords, determined by means of consults between peers, brain storming and by examining known literature regarding the subject. Then, we searched for synonyms, in its broadest sense, including different words in the same vein. ***Table 14*** summarizes these results.

Keywords	Standardization	Development	Adoption	Interoperability	Measurement	Quality	Transaction
Synonyms	*Standardization*	*Process*	*Compatibility*	*Interoperable*	*Measuring*		*Vertical*
	Standard	*Developing*	*Comply*	*Interorganiz(s)ational*	*Measur(e)ment*		*Semantic*
		Organization	*Compliance*	*Compatibility*	*Measure*		*Exchange*
		Consortium		*Compatible*	*Metric*		*Domain*
		Consortia		*Integration*	*Criteria*		*e-Business*
							Industry

Table 14: *Overview keywords and other words in the same vein*

The next step was to create regular expressions for capturing different forms and spelling of words, by using wildcards. For instance, *interoperab** will yield results for *interoperability* but also for *interoperable*. The following table shows the expression used as query for each base term within Scopus and EBSCO.

	Used query expression
Standardization	*Standard**
Development	*Develop* OR Process OR Organi?ation OR Consorti**
Adoption	*Adoption OR Compatibility OR Comply OR Compliance*
Interoperability	*Interoperab* OR Interorgani?ational OR Compatib* OR Integration*
Measurement	*Measur* OR Metric OR Criteri**
Quality	*Quality*
Transaction	*Transaction OR Vertical OR Semantic OR Exchange OR Domain OR e-Business OR Industry*

Table 15: *The query expression for each keyword*

	Top 25 CS/IS journals	ISSN	Scopus	Web of Science	Ingenta	ABI/ Inform	EBSCO Business
1	MIS Quarterly: Management Information Systems	0276-7783	x	x		x	x
2	Communications of the ACM	0001-0782	x	x		x	x
3	Information Systems Research	1047-7047	x	x		x	x
4	Journal of Management Information Systems	0742-1222	x	x		x	x
5	Management Science	0025-1909	x	x		x	x
6	IEEE Transactions on Computer sciences *(various)*	e.g. 0018-9340	x	x			x
7	Harvard Business Review	0017-8012	x	x		x	x
8	Decision Sciences	0011-7315	x	x	x	x	x
9	Decision Support Systems	0167-9236	x	x	x	x	x
10	Information and Management	0378-7206	x	x	x	x	x
11	European Journal of Information Systems	0960-085X	x	x	x	x	x
12	MIT Sloan Management Review	1532-9194	x	x		x	x
13	ACM Transactions on Database Systems *(various)*	e.g. 0362-5915	x	x		x	x
14	Data Base	0095-0033					
15	Organization Science	1047-7039	x	x		x	x
16	Information Systems Journal	1350-1917	x	x	x	x	x
17	Academy of Management Journal	0001-4273	x	x		x	x
18	Communications of the AIS	1529-3181				x	x
19	IEEE Computer (Graphics and Applications) *(various)*	e.g. 0272-1716	x	x			x
20	Journal of Strategic Information Systems	0963-8687	x	x	x		x
21	Administrative Science Quarterly	0001-8392	x	x		x	x
22	Academy of Management Review	0363-7425	x	x		x	x
23	International Journal of E-Commerce	1086-4415	x	x		x	x
24	ACM Computing Surveys	0360-0300	x	x		x	x
25	Accounting, Management and Information Technologies	0959-8022	x		x		
25	Information and Organization	1471-7727	x		x		x
	Total		23	22	7	20	23

	Top 25 International Business Journals		Scopus	Web of Science	Ingenta	ABI/ Inform	EBSCO Business
1	Journal of international business studies	0047-2506	x	x	x	x	x
2	Management international review	0938-8249	x	x		x	x
3	Journal of world business	1090-9516	x	x	x	x	x
4	International marketing review	0265-1335	x	x	x	x	x
5	Journal of international marketing	1069-031X	x	x		x	x
6	International business review	0969-5931	x	x	x		
7	International studies of management and organization	0020-8825				x	x
8	Journal of global marketing	0891-1762	x	x		x	x
9	International journal of research in marketing	0167-8116	x	x	x	x	x
10	Advances in international comparative management	0747-7929	x			x	
11	Advances in international marketing	1474-7979	x			x	x
12	Journal of international financial management and accounting	0954-1314	x		x	x	x
13	Multinational business review	1525-383X				x	x
14	Advances in international accounting	0897-3660	x			x	
15	International trade journal	0885-3908	x			x	x
16	International management	0020-7888	x			x	
17	The international journal of accounting	0020-7063			x	x	x
18	International journal of management	0813-0183				x	
19	Global finance journal	1044-0283	x		x	x	x
20	Journal of international management	1075-4253	x	x	x		
21	Thunderbird international business review	1096-4762	x			x	x
22	Journal of international consumer marketing	0896-1530	x			x	x
23	Advances in international banking and finance						
24	International journal of conflict management	1044-4068	x	x	x	x	x
25	International journal of finance	1076-9307	x	x		x	x
	Total		20	11	10	22	18

Table 16: *Overview Top journals and search engines*

The combination of keywords

The keywords will be combined during the search process. The keyword "Standardization" is so important that it was decided to include it in every query. Table 17 contains the two-, three- and four-word combinations we have used. The table should be read so that every keyword stands for its corresponding query listed in Table 15.

Standardization Development	Standardization Interoperability Adoption Development
Standardization Adoption	Standardization Measurement Adoption Development
Standardization Interoperability	Standardization Quality Adoption Development
Standardization Measurement	Standardization Transaction Adoption Development
Standardization Quality	Standardization Measurement Interoperability Development
Standardization Transaction	Standardization Quality Interoperability Development
Standardization Adoption Development	Standardization Transaction Interoperability Development
Standardization Interoperability Development	Standardization Quality Measurement Development
Standardization Measurement Development	Standardization Transaction Measurement Development
Standardization Quality Development	Standardization Transaction Quality Development
Standardization Transaction Development	Standardization Measurement Interoperability Adoption
Standardization Interoperability Adoption	Standardization Quality Interoperability Adoption
Standardization Measurement Adoption	Standardization Transaction Interoperability Adoption
Standardization Quality Adoption	Standardization Quality Measurement Adoption
Standardization Transaction Adoption	Standardization Transaction Measurement Adoption
Standardization Measurement Interoperability	Standardization Transaction Quality Adoption
Standardization Quality Interoperability	Standardization Quality Measurement Interoperability
Standardization Transaction Interoperability	Standardization Transaction Measurement Interoperability
Standardization Quality Measurement	Standardization Transaction Quality Interoperability
Standardization Transaction Measurement	Standardization Transaction Quality Measurement
Standardization Transaction Quality	

Table 17: *The 41 combinations of keywords*

Search process

The search has been performed on title, abstract and keywords (only SCOPUS). Searches within the top journals are conducted by means of the ISSN numbers of those journals and is performed during March and April of 2009. The combination of three and four keywords created a large, but manageable number of studies. Only three keyword searches that yield more than two hundred results were refined by adding a fourth keyword. To make sure to include the core studies a two keyword search has been performed, with the following additional rules:

- Articles from year 2000 untill April 2009 that have been cited more than five times are included.
- Articles before year 2000 cited more than fifty times are included.

Appendix 2 – Overview of selected studies

Authors	Title	Journal	Year	Topic	Lifecycle	View	Type	Approach	Method
Albrecht, C. C., D. L. Dean, et al.	Marketplace and technology standards for B2B e-commerce: Progress, challenges, and the state of the art.	Information and Management	2005	Interoperability	-	User	Syntactical	Critical	Review
Backhouse, J., C. Hsu, et al.	A question of trust.	CACM	2005	PSI	Use	User	Syntactical	Critical	Case Study
Bernstein, P. A. and L. M. Haas	Information integration in the enterprise.	CACM	2008	Interoperability	-	Implementer	Syntactical	Descriptive	Review
Boh, W. F. and D. Yellin	Using enterprise architecture standards in managing information technology.	JMIS	2006	PSI	Use	User	All	Positivist	Data Analysis
Boh, W. F., C. Soh, et al.	Standards development and diffusion: A case study of RosettaNet.	CACM	2007	Lifecycle	Use	Creator	Vertical	Descriptive	Case Study
Cathomen, I. and S. Klein	The development of FEDI in Switzerland: A life-cycle approach.	IJEC	1996	Lifecycle	Use	User	Vertical	Descriptive	Case Study
Chari, K. and S. Seshadri	Demystifying integration.	CACM	2004	Interoperability	-	Implementer	All	Descriptive	Development
Chen, H. M. and P. J. Sheldon	Destination Information Systems: Design Issues and Directions.	JMIS	1997	Interoperability	-	Implementer	All	Descriptive	Development
Chen, P. Y. and C. Forman	Can vendors influence switching costs and compatibility in an environment with open standards?	MISQ	2006	PSI	Use	Implementer	Syntactical	Descriptive	Data Analysis
Damsgaard, J. and D. Truex	Binary trading relations and the limits of EDI standards: The Procrustean bed of standards.	EJIS	2000	PSI	Use	Implementer	Horizontal	Critical	Conceptual
De Bruijn, J., D. Fensel, et al.	Using the web service modeling ontology to enable semantic e-business.	CACM	2005	Interoperability	Use	Implementer	Syntactical	Descriptive	Conceptual
Dogac, A., Y. Kabak, et al.	Collaborative business process support in eHealth: Integrating IHE profiles through ebXML business process specification language.	IEEE TITB	2008	PSI	-	Implementer	Syntactical	Descriptive	Conceptual
Eichelberg, M., T. Aden, et al.	A survey and analysis of electronic healthcare record standards.	ACM Computing Surveys	2005	Quality	-	Implementer	Vertical	Descriptive	Review
Elgarah, W., N. Falaleeva, et al.	Data exchange in interorganizational relationships: review through multiple conceptual lenses.	ACM SIGMIS	2005	PSI	Use	User	Horizontal	Descriptive	Review
Fodor, O. and H. Werthner	Harmonise: A step toward an interoperable e-tourism marketplace.	IJEC	2004	Interoperability	-	User	All	Interpretive	Development
Frenkel, K. A.	Politics of standards and the EC.	CACM	1990	PSI	-	Policy Maker	Syntactical	Interpretive	Review
García, R. G. and E. Gelle	Applying and adapting the IEC 61346 standard to industrial automation applications.	IEEE TII	2006	Lifecycle	Implement	Implementer	Vertical	Descriptive	Development
Glushko, R. J., J. M. Tenenbaum, et al.	An XML framework for agent-based e-commerce.	CACM	1999	Interoperability	Use	Implementer	Vertical	Descriptive	Review
Hanseth, O., E. Jacucci, et al.	Reflexive standardization: Side effects and complexity in standard making.	MISQ	2006	Lifecycle	Develop	Creator	Vertical	Descriptive	Case Study
Hardwick, M., D. L. Spooner, et al.	Sharing Manufacturing Information in Virtual Enterprises.	CACM	1996	Interoperability	Use	Implementer	All	Descriptive	Development
Hart, P. and C. Saunders	Power and Trust: Critical Factors in the Adoption and Use of Electronic Data Interchange.	Organization Science	1997	Lifecycle	Use	User	Horizontal	Critical	Conceptual
Hovav, A., R. Patnayakuni, et al.	A model of Internet standards adoption: The case of IPv6.	Information Systems Journal	2004	Lifecycle	Use	Implementer	Syntactical	Interpretive	Case Study
Ingenerf, J.	Telemedicine and terminology: Different needs of context information.	IEEE TITB	1999	Interoperability	-	Implementer	Vertical	Descriptive	Conceptual
Jacobides, M. G.	Industry change through vertical disintegration: How and why markets emerged in mortgage banking.	Academy of Management Journal	2005	PSI	-	User	Vertical	Descriptive	Conceptual
Kaefer, F. and E. Bendoly	Adoption of Electronic Data Interchange: A model and practical tool for managers.	Decision Support Systems	2000	Lifecycle	Use	User	Horizontal	Descriptive	Development
Kauffman, R. J. and H. Mohtadi	Proprietary and open systems adoption in E-procurement: A risk-augmented transaction cost perspective	JMIS	2004	Lifecycle	Use	User	Horizontal	Positivist	Case Study
Kreger, H.	Fulfilling the Web services promise.	CACM	2003	Interoperability	-	Implementer	Syntactical	Descriptive	Conceptual
Lu, X. H., L. H. Huang, et al.	Critical success factors of inter-organizational information systems - A case study of Cisco and Xiao Tong in China.	Information and Management	2006	Interoperability	-	User	Horizontal	Descriptive	Case Study
Markus, M. L., C. W. Steinfield, et al.	Industry-wide information systems standardization AS collective action: The case of the U.S. residential mortgage industry.	MISQ	2006	Lifecycle	Use	Creator	Vertical	Descriptive	Case Study
Mercuri, R. T.	Standards insecurity.	CACM	2003	Lifecycle	Use	User	All	Critical	Review
Mori, A. R. and F. Consorti	Integration of clinical information across patient records: a comparison of mechanisms used to enforce semantic coherence	IEEE TITB	1998	Interoperability	-	Implementer	Vertical	Descriptive	Development
Nickerson, J. V. and M. Zur Muehlen	The ecology of standards processes: Insights from internet standard making.	MISQ	2006	Organization	Develop	Creator	Horizontal	Interpretive	Case Study
Samuelson, P.	Copyrighting standards.	CACM	2006	Organization	-	Creator	All	Critical	Review
Swatman, P. M., P. A. Swatman, et al.	A model of EDI integration and strategic business reengineering.	JSIS	1994	PSI	Use	User	Horizontal	Descriptive	Conceptual
Thissen, W. A. H. and W. J. Stam	Electronic data interchange in an industrial sector: The case of The Netherlands' building industry.	Information and Management	1992	Lifecycle	Develop	Creator	Vertical	Descriptive	Conceptual
Venkatraman, S., H. Bala, et al.	Six strategies for electronic medical records systems.	CACM	2008	Interoperability	-	User	All	Interpretive	Review
Wang, E. T. G. and A. Seidmann	Electronic data interchange: competitive externalities and strategic implementation policies.	Management Science	1995	Lifecycle	Use	User	Horizontal	Interpretive	Conceptual
Weitzel, T., D. Beimborn, et al.	A unified economic model of standard diffusion: The impact of standardization cost, network effects, and network topology.	MISQ	2006	Lifecycle	Use	User	Horizontal	Positivist	Data Analysis
Wigand, R. T., C. W. Steinfield, et al.	Information technology standards choices and industry structure outcomes: The case of the U.S. home mortgage industry.	JMIS	2005	PSI	Use	User	Vertical	Descriptive	Case Study
Wybo, M. D. and D. L. Goodhue	Using interdependence as a predictor of data standards. Theoretical and measurement issues.	Information and Management	1995	PSI	Use	User	Vertical	Positivist	Data Analysis
Zhao, K., M. Xia, et al.	An integrated model of consortium-based e-business standardization: Collaborative development and adoption with network externalities.	JMIS	2007	Lifecycle	Use	User	Vertical	Descriptive	Conceptual
Zhu, K., K. L. Kraemer, et al.	Migration to open-standard interorganizational systems: Network effects, switching costs, and path dependency.	MISQ	2006	Lifecycle	Use	User	Horizontal	Positivist	Data Analysis
zur Muehlen, M., J. V. Nickerson, et al.	Developing web services choreography standards - The case of REST vs. SOAP	Decision Support Systems	2005	Lifecycle	Develop	Creator	Syntactical	Descriptive	Case Study

Table 18: *Overview of selected studies*