International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at www.sciencesphere.org/ijispm

Getting the balance right between functional and non-functional requirements: the case of requirement specification in IT procurement

Björn Johansson
Department of Informatics, Lund University
Ole Römers väg 6, Lund SE-223 63
Sweden
www.shortbio.net/bjorn.johansson@ics.lu.se

Markus Lahtinen
Department of Informatics, Lund University
Ole Römers väg 6, Lund SE-223 63
Sweden
www.shortbio.net/markus.lahtinen@ics.lu.se

Abstract:
IT procurement represents a business process of high importance, including the ability to articulate requirements that the procurement deals with. Furthermore, specifying requirements is of importance for both procurer and potential supplier, as it functions as central contractual element between the two. The purpose of this article is two-fold: *(i) to show how established terminology for requirement specification is represented in current call for bids for the procurement of IT; and (ii) to introduce an organizing framework that may assist procurers in actively addressing functional requirements and business requirements.* Ten "call for bids" were examined from a Swedish national procurement database. From the analysis of the bids, it can be concluded that: (i) the call for bids displays a high degree of precision regarding hardware aspects, but less precision regarding software; (ii) supplier experience and competence is stressed, but rarely elaborated on in detail; and (iii) call for bids vagueness may be used as a lock-in opportunity for suppliers. From the discussion on this, a tentative procurement framework is suggested, aiming on increasing the logical transparency for the procurement of IT.

Keywords:
procurement of IT; software specification; government procurement; software requirement; procurement checklist.

DOI: 10.12821/ijispm010101

Manuscript received: 18 December 2012
Manuscript accepted: 4 February 2013

1. Introduction

For firms and public administration, procurement represents a business process of high importance. Regarding the role of Information Technology (IT), it may be used as a tool to increase an organizations' procurement capability [1, 2] and IT may also be the subject of the procurement. In this paper we are interested in the latter and in particular the case of the European Union-wide legislation of "Government procurement in the European Union". Put shortly, the legislation stipulates - and in line with the ambitions of the common market - that an individual Government procurement exceeding a certain monetary threshold value needs to be published in open competition. The act applies to all services and goods that government bodies procure, including the procurement of IT.

From an academic point of view, procurement in a broad sense has previously been covered extensively [3]. Less interest has been given to procurement of IT. In the majority of call for bids, financial value of the bid is not specified by the procurer, because the supplier is required to submit a proposal of the financial value. However, in Sweden 2009 the part of call for bids that pre-specified value of procurement of IT amounted to 63 million Euro. Further illustrating this trend towards increased importance of procurement is the increased amount of job postings explicitly demanding purchasing competence surrounding procurement of IT. Also, Swedish trade press has on numerous occasions reported on challenges associated with procurement legislation. Rådmark [4] reports on the CIO of Växjö Municipality having to resign as a result of not complying with Government procurement in the European Union. Eriksson [5] and Eriksson [6] comments upon on procurement challenges when procuring vaccine for the Health sector and procuring services with Swedish Civil aviation is literally described as being a "nightmare". Similar challenges have been reported by Du Preez [7] from the UK. In its capacity of overseeing the efficiency and effectiveness of the civil services in the UK, the Cabinet Office has ordered a review of current Information and Communication Technologies (ICT) procurement procedures as direct response to the reported lack of supplier scope in Government IT procurement. Put shortly, Small and Medium Enterprises (SME) are suggested to be cut out in the bidding process by larger enterprises. Conspicuously and somewhat ironically, the same Cabinet Office [8] offered an ICT Strategy Implementation manual under the parole "Moving from the 'what' to the 'how'" the past year. We believe it is important to address procurement of IT, not only because of the significant financial value that it represents, but also to address the reported challenges regarding compliance.

The ability to specify requirements is another important area for firms and public administration when they aim at equipping themselves with IT-based resources. This implies the need to specify requirements for future software to a satisfactory degree. Furthermore, being able to specify requirements becomes important since organizations increasingly buy the software as either standardized software package or buy the software development as a consultancy service rather than develop them in-house.

Pivotal to any activity of system development analysis and design is the process of specifying requirements [9]. Also, as stated above, requirement specification process applies to instances of both in-house development, as well as instances of procuring IT from external suppliers.

Consequently, we argue that requirements may be used as an anchor to analyze a procurement situation. Using call for bids, the purpose of this article is two-fold: *(i) to show how established terminology for requirement specification is represented in current call for bids for the procurement of IT; and (ii) to introduce an organizing framework that may assist procurers in actively addressing functional requirements and business requirements.* In order to reach the purpose, the following question was initially asked: How are functional and non-functional requirements represented in current call for bids for the procurement of IT?

The rest of the paper is organized as follows: we first present some descriptions and problematic issues with systems development and requirements focusing specifically on software requirements specifications. The section thereafter presents our research method, how empirical data were collected and analyzed. In the penultimate section we then present our findings which we discuss and draw some conclusions in the final section.

2. Systems development and requirements

A major problem in Information Systems (IS) development is misalignment between needed functionality and the functionality offered in the developed IS. This could be stated as being a continuous challenge - independent on if it is internal development or if it is procurement of standard software package. This problem could be described as the distance between what end-users want to have support for in the business processes, and what the IS de facto gives support for. There are definitely a lot of different reasons for why this is the case. But, it can be stated that one important consideration are difficulties of translating and transferring business requirements from identification to specification, and further into implementation.

To have some input on this it is first important to stipulate what requirements and especially what (process) business requirements are. Jackson [9] propose that requirements are descriptions of the application domain and the problems to be solved, and sees the challenge in the requirement collection process between the method for problem structure on one hand and the description per se on the other. The same is described by Power [10] who speaks about "requirements as needs" and "requirements as text". Both authors emphasize the distinction between these two different types of requirements specifications. They describe the challenge of transforming requirements from needs to text and into formal descriptions, which can be easily transformed into program code and software system features.

Jackson [9] makes a distinction between requirements and specifications and states that specifications are descriptions of the interface between the developed system and the application domain. This is in line with the statement that a requirement specification should form a bridge between requirements engineering and software engineering [11]. A brief investigation of what requirements are could suggest that requirements are clear and well-defined. But, that is not the case, and there are several reasons for that. There have been attempts both from research and practice to classify and categorize requirements, resulting in classification schemes that distinguish between functional and non-functional requirements [10]. For example, the IEEE standard for the software requirements specification [12] distinguishes fourteen types of requirements, divided into functional requirements and thirteen types of non-functional requirements. Robertson and Robertson [13] make a similar distinction when they describe seventeen different types of requirements divided into product constraints, functional requirements and non-functional requirements. From this it can be suggested that requirements could be seen as either: a function, capability, or property of a proposed system; and/or, the statement of such a function, capability, or property [10] and/or as described by Jackson [9] as descriptions of the application domain and the problems to be solved there. This last description emphasizes on what and not how. This is to some extent in conflict with the description from Zave and Jackson [14] that state: there was a time when the epigram "requirements say what the system will do and not how it will do it" summarized all of requirements engineering. That time is long past.

The statement by Zave and Jackson [14] could be interpreted as being a change in what requirements should describe has occurred and that requirement specification now also focus on how the developed system will execute the wanted requirement. This statement suggests that the scope of what requirements are have broadened over time.

Literature on software development often makes a high-level distinction between functional and non-functional requirements (cf. RUP, software engineering). The software engineering-approach to software specification has not gone without criticism; Odeh and Kamm [15] state that the formalism associated with Unified Modeling Language (UML) techniques are not suitable for translation of business models into software models. Technical methodology, by its very nature, does not take organizational aspects into account, for example dynamic internal political agendas and conflicting interests and interpretations among the involved stakeholders. Nevertheless, and returning to the high-level separation, functional requirements represent the type of operations that connects the user and problem domain with the representation of the problem domain [16]. More specifically, functional requirements may be divided into four major categories of operations: calculation, signaling, update and write. According to Stellman and Greene [17] non-functional requirements represent requirements beyond the above mentioned; for example usability, computing efficiency, reliability, scalability, reusability, portability, etc. In tandem with specified requirements, use cases define

interaction with a suggested system from an actor's point of view. In all of the above mentioned categories, the requirements need to be specified, clarified and documented in some way. The result of this exercise often ends in a software requirements specification (SRS).

Software requirements specifications are important documents, used by different groups of people for communicative purposes; by customers, to know what to expect; by the software developers, to know what to build and how; by test groups, to test and evaluate the system [18-20]. The SRS act as a channel of communication between developers and customers and help to ensure that the system satisfies customer needs [21]. Moreover, it creates a baseline upon which sub-sequent systems development activities are based [22].

It is clear that an SRS is one part of the overall systems requirements determination process which in its turn is part of the entire systems development process. An SRS is described by Eriksson [23] as a document produced when a system is built from scratch, or if there are major changes being made to an existing system. Wiktorin [24] on the other hand states that "a requirements specification consists of several parts". Another description, also rather short, is given by Duggan and Thachenkary [25]: "Requirements specification: representing the results [of the previous steps in the SRD process] in a document".

One explanation of the contents of an SRS is given by Wieringa [26], who states the following: "A requirements specification consists of a specification of product objectives and a specification of required product behavior".

In other words, an SRS shows the purpose of the system, and how it is supposed to behave - its functionality, which is described by Carvalho et al. [27] in the following way: an SRS should describe the "what" of a system, not the "how". Wiegers [18] states that since the SRS is important for the following activities in systems development, it needs to have a detailed description of system behavior. Smith et al. [28] state that the SRS should describe essential system requirements of the software and its external interfaces, such as functions, performance, constraints and quality attributes. Another similar description of the SRS is given by IEEE in standard 12207: "the systems requirements specification shall describe: functions and capabilities of the system; business, organizational and user requirements; safety, security, human-factors engineering (ergonomics), interface, operations, and maintenance requirements; design constraints and qualification requirements" [29]. Due to its proximity to spoken language, the natural language approach to SRS is arguably the most common one [22]. While natural language may suffice in very informal and small software requirement specification situations, they represent an exception since precision and formality is not a priority. However, since more stakeholders get involved and contractual relationship becomes a reality, the natural language approach does not suffice for several reasons. For example, natural language does not lend itself to be efficiently coordinated and communicated in a team of stakeholders - this could be further problematic due to geographical and cultural asymmetries. Finally, according to Daniels and Bahill [30] highly complex systems require a higher level of formality.

To sum up, a SRS is a document created when a system is built or rebuilt, containing purpose and behavior of the system as well as descriptions of the system and its desired functions. As have been discussed above and depending on the analytical approach to software requirement specification, the degree of precision and formality in requirements vary. More technical approaches generally excludes important organizational aspects that impacts requirement specification. The softer approach - mostly accentuated by the natural language approach loses out on communicative precision and formality. Finally, not enough theoretical attention has been directed towards the increasing use of handling requirement specification contractually. Thomsen [31] has contributed with an elaboration on the meaning of purchasing competence in relation to IS, which is of particular importance in procurement situations. But, requirement specification lies outside the analysis scope. Consequently, there is a need to explore the use of requirement specification in the case of contractual relationship. Given our review above, in the context of this paper we view the 'call for bids' as a sort of initial formalization of a SRS nonetheless. This further allows us for being open from an interpretative point of view towards our empirical material.

3. Data collection and collected data

Ten current calls for bids concerning the procurement of IT were reviewed (see Table 1). We attempted to generate observations, primarily based on a data-driven approach, to problematize our theoretical understanding. The ten cases were hard-copy printed in completeness in two sets. Supplied with post-it notes, it was decided that we (the two authors of the paper), independently from each other, read through the call for bids looking for theoretical gaps in terms of functional and non-functional requirements. The two sets of post-it notes were then compared and discussed. This exercise ended in some findings and the analytically most promising were selected for future analysis. The selection was made from the question asked: How are functional and non-functional requirements represented in current call for bids for the procurement of IT?

More specifically, we were interested in assessing both use as well as the usefulness in relation to how the 'call for bids' were formulated. The selected calls for bids were collected from e-Avrop, which is Sweden's biggest free database for procurement.

Table 1. Description of the 10 call for bids cases

Case	Subject of procurement	Categorization of the subject in the database e-Avrop
Örnsköldsvik Municipality	New external webpage	Production of a new external webpage for the municipality in accordance with pre-specified graphical profile program
Östra Göinge Municipality	Procurement of surf pads	120-130 units of tablet computers
Eskilstuna Municipality	Web-based support system for relatives of patients	Web-based turn-key support system for relatives of patients
Umeå University	Video conferencing system	Video conferencing hardware
Sundsvall Municipality	Unspecified IT	Experience output-specified
Courts of Sweden	Service and support for a video conferencing system	Service and support for video conferencing system
Flen Municipality	Creative Media	IT-based education on creative media main focus.
Sundsvall Municipality	Apple-products	Pre-procurement of tablet computers
Örnsköldsvik Municipality	Surf pads	24 units of tablet computers
Skellefteå Municipality	SMS platform	Meta-integration of disparate SMS-systems delivered as Software as a Service

4. Data collection and collected data

In this section we present findings from the analysis of the call for bids. The first finding discussed is the different precision between hardware and software requirements. Next finding discussed is the demand for a track record of the bidders from the procurer and how that is related to low specificity of requirements. This finding is closely related to the third finding discussed which discusses how low specificity restricts or gives opportunities for suppliers. The last

finding discussed is the inherent tension existing between functional/non-functional requirements on the one hand and hardware/software on the other hand. From the discussion on these four findings we present a procurement framework which we suggest could act as a starting point for developing a strategy for the procurement of IT.

4.1 Hardware precision and software vagueness

Three of the cases concerned procurement of tablet computers. Sundsvall and Örnsköldsvik Municipality are pure hardware purchases, while the procurement of Östra Göinge Municipality stipulates tablet computers to be used in pre-school and compulsory school. Consequently, the suggested user group can be assumed being pupils in the age span 6-16 years. Usability requirements are also included in the call for bids.

The requirement specification of Östra Göinge Municipality shows a high level of precision regarding hardware and product specification and less in terms of detailed software performance. The high level of hardware and product specification is illustrated by the following three examples:

*"The pad must have a built-in battery providing at least 8 hours of battery time. […] The pad must be delivered with a minimum of 16 Gb primary memory. […] The pad must have a minimum screen of 9,5" allowing for 1024*768 resolution" (Östra Göinge Municipality, 2011a)*

As is common in call for bids, the overarching evaluation criterion are given weights, and in this case price quality is given 5/10 of evaluation importance, "usability" is given 4/10 of importance and insurance solution is given 1/10 of importance. As the call for bids is formulated, hardware aspects are included in the usability definition (see point 8 below) and the generic minimum performance level of software is not covered in any detail. According to Östra Göinge Municipality (2011b, p. 4), usability will be assessed based on the quality of the following aspects: 1) Protective cover; 2) File management; 3) Application management (purchasing, installation and remove); 4) Administrative tools; 5) Security back-up; 6) Boot-up time; 7) Experience of performance (lagging, efficiency in switching between windows); and 8) Hardware.

Besides the hardware requirements previously mentioned before, the criterion ranging from 1-7 are not expressed in any measurable minimum metrics. Due to context-dependent quality of usability, it has been suggested [32-34] that usability should be expressed in measurable context-specific metrics. For example, boot-up time may be specified in seconds. In the Östra Göinge case the criteria is supposed to be evaluated subjectively by the procurement staff. Further improvement would have allowed for evaluation to be made by stakeholders that are supposed to use the pads, if not, any objective measurement such as seconds could be used.

This is a call for a more coherent use of non-functional requirements. It can also be stated from the findings of the Östra Göinge case that there exists possibilities for procurers to be more precise when describing how the evaluation is planned to be done as well as what evaluation criteria that is supposed to be used. The benefits for being more precise would be two folded. First the bidders would be able to more clearly evaluate their products and thereby prevent errors, as well as being able to give a more accurate price. Second, the procurers' evaluation of specific proposals would be much more easy to conduct.

4.2 The objects looking for a subject or the requirements looking for a supplier

In procurement processes we have identified numerous instances of explicit demand by the procurer for the supplier to prove a track-record of previous deliveries. This illustrates the importance of the subject, meaning the supplier. In the process of requirement specification, which could be seen as the object of the activity, the screened "call for bids" clearly states the qualities the suppliers need to have. We can only speculate on implications of this, it could be used as a screening-mechanism of supplier, guaranteeing that the supplier has been able to deliver in the past. However, the obvious risk is that more competitive suppliers are excluded from the bidding process.

The qualification of a supplier is given in a rather superficial way. One example of this could be found in the bid from Örnsköldsvik Municipality in which it is stated "The provider shall have required experience and competence to deliver and be a provider that has delivered similar services before". The implications from this requirement could mean difficulties both from suppliers' perspective as well as from buyers' perspective. For the suppliers it means that they have to make a statement on its experience and competence, which could be hard if recently established. It also means that the providers need track-records that are positive and to have those they probably need to have been in the business for some time. For the buyer it could be seen as strictly positive to get references from earlier customers to the provider and it is probably easier to evaluate a provider if the provider could present a track record of successful deliveries. However, for both the supplier and the buyer, this requires a satisfactory level of articulation of both experience and competence.

The theoretical implication following from this is that the model of functional and non-functional requirements does not adequately address the issue of "who", suggesting that further research activities need to be focused on including qualities of the supplier into the existing models. Considering the importance given in investigated call for bids, it is clear that more consideration needs to be taken to include qualities of the suppliers to have a useful framework for procurement of IT.

4.3 Vagueness as a supplier opportunity

From theoretical point of view the call for bids are fuzzy in terms of precision on the absolute-haves. In the case of Eskilstuna Municipality under "Requirements for the service", of the presented six bullets regarding requirements relating to the service in itself were five fuzzy in terms of how to evaluate them. The sixth requirement, "being able to link externally" to the service we find redundant since external linking to web service in most cases always are possible. Under the same headline there are numerous of shall requirements, however, the evaluation of all these requests are handed over to the supplier. The suppliers are asked to state if each and every of the requirements are fulfilled by giving a yes or no answer on the direct question "is the requirement fulfilled?" Potential suppliers are also asked to make comments on each answer. This may be a satisfactory way of having a supplier to make the first evaluation of the bid. However, it demands clear and precise requirements, as well as a clear description of what the procurers wants to have. In the Eskilstuna case the call for bids is fuzzy in the description of what is asked for, which makes that potential suppliers have an opportunity to also be fuzzy in their bids. Thereby rendering the supplier an opportunity to clearly state that they fulfill the requirements.

Another case that epitomizes vagueness as a supplier opportunity is the Sundsvall Municipality case on "unspecified IT". The case presents Sundsvalls Municipality's vision about their new building at the big square and asks the supplier to deliver something that makes visitors to be so extremely surprised that it creates an "Oh, shit"-feeling (literal translation) among the procuring party. This call for bids is a clear example on how an organization uses suppliers to help them create innovative solutions. However, it also is a clear example on how suppliers could use the vagueness to try out some innovations and at the same time give them a possibility to get a "big project" if they want that. The call for bids is relatively thin and it does not say anything about the level or scope - in the form of needed or available resources - of the project, which also indicates suppliers' opportunity.

4.4 Procurement framework – strategy for the procurement of IT

In the studied cases we have observed a lack of explanation of what "product" that was asked for, how the "product" should be used, as well as who should use the "product". This could be improved by using use cases when specifying requirements in the procurement of IT. Furthermore, non-functional requirements include a multitude of possible use qualities that may be connected to software, hardware and also requirements beyond the scope of hardware and software. In the circumstance of IT procurement, we argue for more purposeful representations of IT to assist procurement staff in organizing requirements. In line with this, it is necessary to address the inherent tension existing between functional/non-functional requirements on the one hand and hardware/software on the other hand. Several of

the studied cases conflate hardware/software requirements with functional and non-functional requirements, creating logical inconsistencies since the realization or delivery of non-functional requirements needs to consider the interactive nature between hardware and software. In concrete, a call for bid which specifies hardware to restrictive might negatively impact the realization of functional and non-functional requirements.

From the findings above, we argue that there exist limitations when only considering requirements in terms of functional and non-functional requirements due to wide scope of what may be included under the umbrella term of non-functional requirements. In addition, from the call for bids we have shown that from a user point of view - the separation between functional and non-functional requirements is problematic.

One way forward to resolve some of the above mentioned problems could be to introduce the product model suggested by Kotler and Keller [35]. In our view this model represents an alternative way of separating functional and non-functional requirements, but also to clarify both functional as well as non-functional requirements. In particular, we hypothesize that merging requirement terminology with the product layers suggested by Kotler and Keller [35] is a more useful way to specify requirements under practical procurement activities. Separating the instance of IT being procured into core product (the essential problem-solving side of a product), basic product (the actual product, e.g. SW and HW), expected product (what the customer expect the product to include), augmented product (attributes beyond the scope of the actual product, e.g. insurance, guarantees and deliver times) and potential product (the qualities important for the future use of the product) assists procurers to make increasingly sense of the separation between functional and non-functional requirements. In particular this holds true for non-functional requirements, due to unclear scope of what quality attributes to include as non-functional requirements.

Placing the different product layers alongside the requirement terminology (Table 2) contextualizes the requirements into a wider business-driven framework more useful for procurement activities.

Table 2. Matching product levels with requirement terminology

Kotler and Keller [35])	**Suggested requirement specification equivalent**	**Comments**
Potential product	Scalability, Flexibility, Reusability, "Nice to have in the future"	The requirements dealing with dynamic requirements that changes over time, for example increased users
Augmented product	Guarantees, service and maintenance contracts, "small extras". Non-functional requirements, e.g. availability, portability, integrity, reliability, reusability, robustness	Augmented product overlaps mostly with non-functional requirements, e.g. availability, portability, integrity, reliability, robustness. Performance is considered a non-functional requirements, but is included in the scope of usability efficiency (cf. [34]; [33]; [32])
Expected product	System objectives expressed in terms of assumed improvement organizational benefits, i.e. the business-realizing of requirements	In order to cover the business-side of requirements in the framework, and to fulfill the customer needs (cf.[21]), the expected products should be expressed as technology-neutral desired outputs
Basic product	Use cases, usability	Use cases in combination with usability considerations provide a language to address the theoretically desired quality of what rather than how (cf. [26];[27])
Core benefit	Customer value/citizen utility	Essentially the choice of the procurers; and policy-makers, ultimately, in the case of government procurement
Potential product	Scalability, Flexibility, Reusability, "Nice to have in the future"	The requirements dealing with dynamic requirements that changes over time, for example increased users

5. Overarching conclusions

Due to changes in the legal system, public and governmental procurement is increasingly important within the European Union. In line with the ambitions of creating a common European market where suppliers across the union may bid for any call for bids posted publicly. This is assumed to increase competition. Another reported citizen benefit is the increased transparency following from the need for procurers to articulate and specify their need. Theoretically, citizens are given the possibility to scrutinize how tax-payers money is spent. However, challenges and hurdles have been reported. One example is the difficulties non-established firms have in winning a call for bids. Another example is the increased administrative burden that is put on the procuring organization. In this paper we set out to explore 10 call for bids by Swedish municipalities and government bodies. Call for bids can be seen as a form of requirement specification and of special interest in this paper was to examine how requirement specification terminology was expressed and formulated in these call for bids.

From the analysis of the call for bids it can be concluded that non-functional requirements do not sufficiently separate between the business-side and HW/SW-side of the "product" that the municipalities demand in their bids. This conclusion made us search for other ways of specifying requirements in call for bids. One solution on the problematic issue of specifying and separating functional and non-functional requirements could be to use the Kotler and Keller [35] product model.

Furthermore, the analysis suggests that dividing requirements into functional and non-functional requirements results in low precision of requirements as well as limitations in applicability. It is also found that supplier qualities, or the question of "whom", is empirically important in the bids.

Procurers claim to require "functionality" and "usability", however these requirements are rarely expressed in any meaningful level of detail. While this relationship may enable for mutual discussion on what is the most purposeful solution, there is also a financial risk that the procurer takes by the imprecision that can be used both on the margin-side as well as proprietary opportunities side by the bidders. This supports the conclusion that there needs to be a balance between precision and impreciseness, in the call for bids.

Finally, the analysis of the findings of hardware precision and software vagueness it can be concluded that there is a need for an increased coherency of non-functional requirements. It can also be concluded that that procurers have a possibility to be even more precise in the evaluation criteria by for instance working with measurable metrics. In turn, this would potentially make evaluation increasingly efficient, and most likely improve the result of the procurement.

Due to the above reported findings, another focus on how to specify requirements is needed for procuring entities. We suggest that a framework building on Kotler and Keller [35] product model may be more useful and comprehensive for procurers than relying on the separation between functional and non-functional requirements or use cases solely. Properly used, the framework forces the procuring entity to think actively on possible future changes to the identified requirements, for example by acknowledging the importance of scalability and the "nice to haves". While precise functionality regarding software is necessary, it is equally important that a call for bids includes comments on the value it is supposed to generate for the procuring organization. This is also included in the framework. It is important to note that we are not suggesting that the framework is to be used as a substitute for established terminology in systems development. It should rather be seen as an organizing and contextualizing framework that puts software and hardware specifications into a value-adding context.

References

[1] Business Link. (2011). Overview on selling to government: e-procurement [Online]. Available: http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1073792572&type=resources

[2] M. J. Garrido, A. Gutiérrez and R. San Jose, "Organizational and economic consequences of business e-procurement intensity," *Technovation*, no. *28*, pp. *615-629*, 2008.

[3] M. Rolfstam, W. Phillips and E. Bakker, "Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination," Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), working paper, WP 2009/07, 2009.

[4] H. Rådmark. (2011). Växjös kritiserade it-chef slutar [Online]. Available: http://www.idg.se/2.1085/1.405870/vaxjos-kritiserade-it-chef-slutar

[5] P. Eriksson. (2011). Det är LOU som är problemet [Online]. Available: http://www.idg.se/2.1085/1.405813/det-ar-lou-som-ar-problemet

[6] P. Eriksson. (2011). En mardrömslik upphandling [Online]. Available: http://www.idg.se/2.1085/1.405813/det-ar-lou-som-ar-problemet

[7] D. Du Preez. (2012). Cabinet Office puts all ICT procurements on hold [Online]. Available: http://www.cio.co.uk/news/3408309/cabinet-office-puts-all-ict-procurements-on-hold/

[8] Cabinet Office. (2012). Government ICT Strategy - Strategic Implementation Plan [Online]. Available: http://www.cabinetoffice.gov.uk/content/government-ict-strategy-strategic-implementation-plan

[9] M. Jackson, *Software requirements & Specifications: a lexicon of practice, principles and prejudices*, London, UK: ACM Press, 1995.

[10] N. M. Power, *A grounded theory of requirements documentation in the practice of software development*, Dublin, School Dublin City University, pp. *223*, 2002.

[11] M. Jackson, "The meaning of requirements," *Annals of Software Engineering*, no. *3*, pp. *5-21*, 1997.

[12] IEEE, *IEEE STD 830-1998: IEEE Recommended Practice for Software Requirements Specifications*, USA: The Institute of Electrical and Electronics Engineers, 1998.

[13] S. Robertson and J. Robertson, *Mastering the requirements process*, Harlow, UK: Addison Wesley, 1999.

[14] P. Zave and M. Jackson, "Four dark corners of requirements engineering," *ACM Transactions on Software Engineering and Methodology*, no. *6*, pp. *1-30*, 1997.

[15] M. Odeh and R. Kamm, "Bridging the gap between business models and system models," *Information and Software Technology*, no. *45*, pp. *1053-1060*, 2003.

[16] L. Mathiassen, A. Munk-Madsen, P. A. Nielsen and J. Stage, *Objektorienterad analys och design*, Lund, Sweden: Studentlitteratur, 2001.

[17] A. Stellman and J. Greene, *Applied Software Project Management*, O'Reilly, 2006.

[18] K. E. Wiegers, *Software Requirements*, Redmond, USA: Microsoft Press, 1999.

[19] R. C. McIlroy and N. A. Stanton, "Specifying the requirements for requirements specification: the case for Work Domain and Worker Competencies Analyses," Theoretical Issues in Ergonomics Science, no. 11, 2011.

[20] E. Hull, K. Jackson and J. Dick, *Requirements Engineering*, London, UK: Springer, 2005.

[21] A. Femi, P. Schubert, F. Sudzina and B. Johansson, "Living Requirements Space: An open access tool for enterprise resource planning systems requirements gathering," *Online Information Review*, no. *34*, pp. *25*, 2010.

[22] J. Nicolás and A. Toval, "On the Generation of Requirements Specifications from Software Engineering Models: a Systematic Literature Review," *Information and Software Technology*, no. *51*, pp. *1291-1307*, 2009.

[23] U. Eriksson, *Kravhantering för IT-system*, Malmö, Sweden: Studentlitteratur, 2007.

[24] L. Wiktorin, *Systemutveckling på 2000-talet*, Lund, Sweden: Studentlitteratur, 2003.

[25] E. W. Duggan and C. S. Thachenkary, "Higher Quality Requirements: Supporting Joint Application Development with the Nominal Group Technique," *Information Technology and Management*, no. *4*, pp. *391-408*, 2003.

[26] R. J. Wieringa, *Requirements Engineering: Frameworks for Understanding*, Chichester, John Wiley & Sons Ltd, 1996.

[27] R. A. d. Carvalho, B. Johansson and S. Parthasarathy, "Software tools for requirements management in an ERP system context," *Journal of Software Engineering and Technology*, no. *2*, pp. *101-106*, 2010.

[28] S. Smith and L. Lai, K. Ridha, "Requirements Analysis for Engineering Computation: A Systematic Approach for Improving Reliability," *Reliable Computing*, no. *13*, pp. *83-107*, 2007.

[29] IEEE, *(ISO/IEC 12207) Standard for Information Technology - Software Life Cycle Processes*, USA: The Institute of Electrical and Electronics Engineers, 1998.

[30] J. Daniels and T. Bahill, "Requirements and Use Cases," Systems Engineering, no. *7*, pp. *303-319*, 2004.

[31] M. Thomsen, *Beställarkompetens vid upphandling och utveckling av IT - Om kompetensframväxt i skuggan av kunskapsfragmentering*, in: Department of Informatics, Lund, Sweden: Lund University, 2010.

[32] B. Shackel, "Usability - context, framework, definition, design and evaluation," in *Human Factors for Informatics Usability*, B. Shackel and S. Richardson, Eds., Cambridge, UK: Cambridge University Press, 1991.

[33] G. M. Olson and J. S. Olson, "Human-Computer Interaction: Psychological aspects of the Human use of Computing," *Annual Review of Psychology*, no. *54*, pp. *491-516*, 2003.

[34] A. Joshi, N. L. Sarda and S. Tripathi, "Measuring effectiveness of HCI integration in software development processes," *Journal of Systems and Software*, no. *83*, pp. *2045-2058*, 2010.

[35] P. Kotler and K.L. Keller, *Marketing Management*, Pearson, Prentice-hall, 2009.

Biographical notes

Björn Johansson
Associate professor in information systems at School of Economics and Management, Lund University, Sweden. He received his PhD in Information Systems Development from the Department of Management & Engineering at Linköping University, Sweden in 2007. Previously he worked as a Post Doc at Center for Applied ICT at Copenhagen Business School, involved in the 3rd Generation Enterprise Resource Planning - Strategic Software for Increased Globalization (3gERP.org) research project funded by the Danish National Advanced Technology Foundation. He is a member of the IFIP Working Groups IFIP 8.6 and IFIP 8.9., and the Swedish National Research School Management and IT (MIT).

www.shortbio.net/bjorn.johansson@ics.lu.se

Markus Lahtinen
Lecturer and Doctoral Student in Information Systems at the School of Economics and Management, Lund University, Sweden. Markus holds a M.Sc. in Information Systems since 2001 and a B.Sc. in Business Administration and Economics since 2006. Markus also belongs to the Institute of Economic Research at Lund University, conducting commissioned research for associated industry partners. Since 2006 he has worked with firms like Ericsson, SCA Packaging, Axis Communications, ASSA ABLOY and Niscayah (now part of Stanley Security). His research interest concerns organizational studies and technological change, focusing on the physical security industry.

www.shortbio.net/markus.lahtinen@ics.lu.se