A case study of software procurement strategies in Sudanese organizations
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Abstract
Generic software components that can be procured off-the-shelf (COTS) are now available to perform most of the functions that in the past required bespoke development. The use of commercial software products in organizations is being driven by its potential for reducing the cost and time to develop software systems. A number of COTS-based development methods and standards have been proposed in the literature, however, many organizations struggle in their attempts to select appropriate software products for use in systems. This paper examines procurement activities carried out in three organizations with the aim of identifying their risks and potentials. The outcome of the work highlighted areas of improvement, e.g. business requirements analysis, risk assessment, and documentation of procurement projects. The authors argue that availability of products because of language, cost, embargo add a further set of complexities to procurement in developing countries. The paper concludes by making recommendations to foster the informal networks of information exchange on products that exist among IT staff in similar (also across) organizations, as a possible medium for wider participation in the development of national standards, as well as outlining final thoughts on some of the imperative tasks and challenges that remain to be addressed in country efforts on software procurement and development.

INTRODUCTION
Generic software components that can be procured off-the-shelf (COTS) are now available to perform most of the functions that in the past required bespoke development. The use of commercial software products (or COTS) in organizations is being driven by its potential for reducing the cost and time to develop software systems. A number of COTS-based development methods and standards have been proposed in the literature, however, many organizations struggle in their attempts to select appropriate software products for use in systems. Given the complexities of today’s software systems, the cost and risk of procuring/purchasing wrong package due to inadequate requirements acquisition and product selection is large.

Central to COTS evaluation for suitability is the process of establishing the context of procurement such as functional, technical, business, etc. that determine the criteria for evaluation criteria to assess the product. [1] While some of the challenges come from limited access to internal design of products and scope for evaluation of fitness [10], other challenges come from the dynamic nature of COTS market and rapid change in technology. Software products procurement in developing countries have additional sets of challenges that come from being at our infancy as software consumers, and hence have little effect on its market and the development of standards. As part of local efforts by government to regulate and develop standards for software procurement, this paper compares and evaluates processes employed at three local organizations with the aim of identifying their risks and potentials, and propose a set of guidelines that can support organizations in making carefully reasoned and sound product decisions, as well as improve their process models.

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The paper is structured to give in section 2 an overview of the concepts that are knitted in the procurement process and common procurement activities and steps proposed in the literature. Section 3 presents procurement processes from the case study which is followed by comparative and critical analyses in section 4. Section 5 concludes with highlighting some of the questions and thoughts on product evaluation, process improvement, and challenges in procurement processes that arose from the study.

**Software Procurement Concepts and Processes**

The development of systems using COTS products bring fundamental changes to the way organizations do their work [4]. The central cause of change is that the organization becomes a consumer with less or no control over the product implementation and adopts standard interfaces based on COTS market. Some familiar software engineering activities are altered. Requirements analysis may have to consider standard implementations, architecture design must be performed together with package evaluation; and new activities will become significant parts of development process, for example product adaptation and integration. These changes require organizations to have an understanding of the capabilities and limitations of COTS products and standards in their domain, conduct market research and product evaluation to select products, and involve different kinds of expertise such as business analysts and legal consultants in the procurement process.

There are two types of standards that an organization must deal with. The first are the standards used in implementations to be able to balance requirements with available product features. The second are standards and recommended practice for conducting procurement processes. For example, IEEE 1062 suggests a number of major phases, steps and milestones for acquiring COTS products, and its variant MOTS (Modified-off-the-shelf), as well as provides checklists to assist organizations in developing their own processes [6]. Another standard that is not specifically geared for COTS but offer related guidelines is the ISO 9126 for software quality. A number of COTS-based development methods have also been proposed, for example OTSO (Off-the-Shelf Option) and PORE (Procurement-Oriented Requirements Engineering). The OTSO method starts with a specified set of requirements and provides techniques to define evaluation criteria and to compare the costs and benefits of alternative products [7], while PORE [13] integrates the process of requirement specification and product evaluation using techniques from requirements acquisition and engineering such as card sorting and laddering, and provides guidelines to design evaluation test cases.

**Investigating current procurement practice in Sudanese Organizations**

This section will consider how three very different organizations deal with the problem of procuring an appropriate COTS product. One organization, (“A”) is a major telecommunication company that is privately owned. The second organization, (“B”) is a government owned bank and the last organization (“C”), is a large industrial corporation that is a public/private partnership. While the three use very different approaches to COTS evaluation, still it was observed that the abstract process ideas underlying are similar. The procurement project consists of three major steps to initiate, select, install and integrate of the COTS product in the system. And the authors also learn that differences in approaches support the notion that whatever the actual process used, it is driven by context. The subsections below highlight the main features of the organizations and their COTS software procurement processes (depicted in Figures 1, 2 and 3 – in the Appendix).

**Organization “A”**

This is an international telecommunication company that bought a public owned company and has more than 20 branches worldwide. Software is fundamental to the operation of the organization which procures from different ranges of COTS products, e.g. Antivirus,
Billing System. The company is frequently engaged in multiple procurement projects and technology upgrades. Procurement projects are initiated at middle management level and the decision to procure is taken in consultation and approval of higher management. Selection of products considers vendors of existing running components of the system, for example the Reporting system solution used the same vendor of the Billing system. A main feature of the procurement process is the existence of end-of-project evaluation.

**Organization “B”**
This organization is a large government owned bank with 35 national branches, and one branch outside Sudan. Although software is an integral part of the bank system and improves its performance, failure of the computer system is not as catastrophic as for “A”, because the bank can revert to its established manual system. The current core system the bank uses is a Jordanian COTS product that is implemented in COBOL and runs under DOS on Novell system. The rate of change of computer systems is slow in this organization and undergoes various government regularity measures on spending and on procedures followed from the Central Bank. The organization uses a tender system to select products and involves representatives from different stakeholder groups in the organization in the procurement team.

**Organization “C”**
This is an industrial corporation that is owned by government, and private national and international investors. The company’s sites of management and production are located in Sudan, with one office abroad. The main type of COTS the company deals with is CRM (Customer-Relationship Management) systems. A continuous business and needs analysis (using external consultants for large projects) is conducted in the organization that can initiate a procurement project, and yield a list of requirements as well as possible solutions. The procurement process in this organization is characterized by an early identification of a suitable product and that it performs initial testing before signing the contract. This is followed by customization and a second round of testing before the system is launched.

**Analysis and Discussion**
The information obtained from organizations is organized according to the software acquisition life-cycle process model proposed in the IEEE 1062 which includes planning, contracting, implementation, acceptance and follow-on activities. The activities considered during information gathering are based on acquisition management and technical activities associated with the use of COTS products and standards proposed in [11] and on other generic processes of the PORE method that are specifically proposed for requirement engineering and product selection. Table 1 lists the phases and related activities and state how they are considered or occur in each organization.

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**Phases**

**Organization “A”**
- Planning (business strategy, risk analysis, standards use, software requirements)
  - Considers immediate performance needs.
  - No risk analysis
  - Choice of product is
based on quality and short schedules.

- Use own standards.

There are no evaluations of standards used.

- Requirements are determined by beneficiary department. They are expressed in different forms by different departments.

- Considers change in domain requirements.

- Risks are mainly defined in terms of old data.

- Products judged on cost and quality.

- Select products from a set of national standards and participate in their development.

- Requirements are determined from outside organization. They are expressed in standardized language used nationally by similar organizations.

- Considers output of business analysis.

- Evaluates business and technical risks.

- Product quality is prime factor in selection.

- Extensive search and evaluation of international standards.

- Requirement are gathered during business analysis and expressed in standard used by business department.

**Contracting**

(vendor and product selection, suitability assessment, contract development)

- Supplier is selected based on personal
knowledge of staff. The product is selected after supplier selection.
• No suitability tests conducted.
• Legal advisor part of procurement team from the start of project.
• Supplier and product selected using a tender system.
• Tests are performed outside the organization by national regulatory bodies.
• Legal advisor is part of the procurement from the start of project.
• Supplier is selected based on business analysis. Products are selected from proposed solutions by internal staff assisted by external consultants.
• Conducts a set of suitability tests set by organization.
• Legal advisor joins team after product selection.

Implementation
• Configuration starts after contract signing led by vendors and internal technical staff.
• Configuration starts after contract signing led by vendors and internal technical staff.
• Some initial configuration management and testing is done by internal staff prior to contract signing.

Acceptance
• System installed by vendor and technical staff, testing performed by internal staff in real
environment.

- Training of technical staff is carried out, then system set up and testing (also by national bodies) before launch.
- Training of technical staff is carried out before second round of testing. The system is then fully installed and deployed.

*Follow-on* (evaluation)

- Projects and software are evaluated.
- Evaluations are conducted at national level.
- Continuous evaluations.

**Table 1: Procurement Activities carried out in Organizations surveyed**

It can be observed that organization “C” has a more robust process compared with organizations “A” and “B”. This may be due to the fact that “C” has a business analysis department as part of the IT Section. This department was important during the initiation and requirements analysis activities and is engaged in a continuous process of assessing the business needs of the organization. When these analyses suggest the need for a software, this department ensures that the software product is in line with the organization’s business objectives and performance goals. This wide view of need/impact assessment of the proposed computer system serve as a quality assurance mechanism for decisions made with regard to investments, as well as ensures coverage of needs and compatibility of requirements from different departments or sections in the organizations.

The tendering procedure used by Organization “B” is considered a strength as it facilitates identification of suitable products based on tender criteria which reduces the search space. The organization benefits from being under the judiciary of National Central Bank that regulates and evaluates processes for government owned banks. However, this can also prolong the procurement process as decision making is required at senior management level and becomes focused on product cost more than quality.

In organization “A”, project and product evaluation – strength, are conducted at the end of procurement. These evaluations are used to update information on vendor, user satisfaction, or to improve procurement processes. More recently (after this study), the organization set up a business/IT section to be responsible for procurement projects. Another characteristic of this model is its emphasis on short schedules of procurement projects which may be necessary in their context because new requirements are introduced at high rates.

**Conclusion**

The outcome of the work highlighted some areas of improvement to the organizations procurement processes. For example, decision to procure must be based on business analysis; use of organizations surveys and market research during product search; and risks to projects must be identified. A number of COTS assessment attributes such as availability, ease of use, maturity, vendor support are proposed Bohem in [2] to use in determining the time that should be spent on product evaluation. Also, teams should include a number of fixed staff
assigned to procurement projects management, and evaluations of product in use and procurement process must be carried out at end of projects. These are considered as some of the enabling factors to improvement continuity and process maturity. The context of the organization was found to significantly influence the procurement activities carried out and their sequence. For example, the lengthy tendering system employed by organization “B” is required for government procurement, while short project schedules was an important criteria for organization “A” where change in requirements and developments in the domain are faster. Alternatively, in organization “C” time was not a factor as software is not a fundamental part of their business process. The paper also identified that language, cost and availability of COTS products for economic or political reasons, add a further set of complexities to known procurement problems and cause some organizations to use unstable or “middle-vendors”. In these cases, serious problems of quality and support types are reported to arise. Very few organizations outside academia are currently using Open Source software (OSS), alone or within their COTS-based systems. Lowering procurement costs, availability of source code and the freedom to modify according to need present some of the benefits of this type of COTS. Quality and support are major concerns in using OSS although this is not the case where OSS has been developing e.g. operating systems and web servers [12]. Collaborative activities and social networks of IT personnel working in related organizations in identifying products, selecting vendors, fixing compatibility problems, is a particularly interesting finding in terms of its potential for an organized local standards development efforts, user community set up, skills transfer, information sharing, and in that it encourages wider participation in the development of national standards.

**Final remarks and thoughts**

More recently in Sudan, specialized government agencies in information and telecommunication technologies moved towards promoting an indigenous software industry by funding the establishment of research centers in a number of universities as well government owned ones. The impact of this initiative is yet to be seen however it is worth noting that the importance of OSS is highlighted. For instance, the newly established Information Technology Research & Development Center (ITRDC) in the Department of Computer Science at the University of Khartoum, in collaboration with the National Telecommunication Corporation, has a dedicated OSS research group and all research staff currently being trained in Linux.

Some of the imperative tasks and challenges that remain to be addressed in the local context of software procurement and development include: First, developing national standards or guidelines that can be tailored for use by different sized organizations, to regulate and support the purchase of products and services. This requires a broader situation analysis similar to the study reported in this paper, as well as examining other country experiences e.g. ChileCompra [5]; Second, resolving the paradox of the need for government support to local (especially growing) industries and how that may infringe global free trade rules. [3] In addition, developing countries gains from OSS is discussed and demonstrated by nongovernmental organizations like UNDP and UNCTAD and by researchers worldwide. The slow uptake of OSS in Africa, behind that of South East Asia and Latin America, can be understood in the context of inadequate telecommunication infrastructure, but it also begs the necessity of political will as well as the examination and perpetuation of national interests, e.g. Peru’s Bill for Free Software in Public Administration [9] and the recommendations of South Africa’s National Advisory Council on Innovation [8]. Finally and crucially, centering the issues of economic and social development into the heart of country software use and
development efforts would foster relevant indigenous industry and boost our critical minds – to address pressing problems and seek appropriate solutions.

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REFERENCES

Appendix: COTS Procurement Activities of Organizations in Sample
Figure 1: Organization “A” Figure 2: Organization “B” Figure 3: Organization “C”