A Proposal of an Upfront Requirements Modeling & Design Practice for e-Commerce Projects

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Abstract

This paper examines the nature of e-commerce systems development and finds that e-commerce is different requiring a high degree of business innovation and responsiveness. A study undertaken on a B-B e-marketplace in Egypt illustrates the problems with the use of traditional analysis and design techniques. They reduce imagination and the ability to respond to change, as they are systematic, comprehensive and plan-driven. The study focuses attention on the importance of modeling value-added services beside business processes for e-commerce applications, as well as the need for self-organizing, non-prescriptive activities, which we call the ‘Practice’, that enhances creative thinking and self-reflection on the problem situation. As a response to these findings an ‘upfront requirements modeling and design practice’ is identified, outlined, and experimented with. It is based on brainstorming sessions guided by the use of a ‘non-prescriptive’ requirements modeling tool that provides a classification of the possible different e-commerce issues. The introduced tool (the e-Business Issues Roadmap) helps to trigger issues and design ideas. The results found a number of business innovative ideas that were unlikely to have been generated by traditional analysis models.

1. Introduction

According to Baskerville et al. [10] traditional ISD (information systems development) methods are unsuitable and inhibit rather than enhance software development in what they call the ‘post-modern’ era or Internet-time development. Carstensen & Vogelsang [15] stress that the design and development of web-based information systems is different from the development of traditional IT-based systems and they identify severe problems in simply attempting to adapt traditional approaches for the development of e-commerce applications.

The turbulent nature of the e-business environment [25] requires organizations to react quickly and creatively to make the most of the new opportunities and business models. The globalization effect of the Internet creates pressure on organizations to raise the quality of their products and services as well as react more creatively to be able to compete internationally. The development environment of e-commerce is thus characterized by high competitive pressures, large amounts of change, uncertainty and increased time pressures.

In addition Adam et al. [1] and Turban et al. [25] characterize e-commerce as multi-disciplinary in nature where business, technological, social, economic, legal and political factors interplay. Therefore the development of e-commerce applications needs to be multi-disciplinary. Recently new technologies (end user computing, fourth generation languages and local area networks) [10] have resulted in incremental, fragmented, and non-linear development of software. Carstensen & Vogelsang [15] agree describing the new programming environments such as Java, XML, HTML, Multimedia VRML and others as invisible because the software is spread in numerous small components and scripts.

Thus, it is argued that e-commerce systems development is different and requires new ISD practices and competencies, as will be examined in section 2. In order to form a practical view we have studied the development process in a real case of a B-B (business to business) e-marketplace for the pharmaceutical sector (section 3). The field study
highlights the need to model value-added services and business processes in a creative way (section 4 & 5). The study also draws attention to the importance of the development of self-organizing activities, referred to as the ‘Practice’ where the developer reacts independently, driven by opportunity and events, but guided by some general rules that set the boundaries. (section 6) The outcome is an ‘upfront requirements modeling and design practice’ that addresses the modeling of business-value ideas for e-commerce applications in a self-organizing way (section 7). The benefit of the proposed practice is a very flexible and appropriate approach to e-commerce development activities. The case also demonstrates that the ‘Practice’ helps generate a number of business innovative ideas that are unlikely to have been identified by conventional analysis models such as use cases, functional decompositions and process flowcharts (section 8).

2. ISD Practices & Competencies for E-commerce Development

The new highly turbulent and often chaotic environment poses new imperatives on organizations to become more ‘absorptive’, i.e. more able to exploit and redefine themselves [20]. He explores an ‘E-commerce Organizational Model’ adopted from Gascoyne that suggests a shift from hierarchical to team-based structures, with more emphasis on creativity and learning environments, new forms of virtual corporation, based on linking global business and core competencies, high responsiveness, more external orientation and an improved focus on customers. He concludes that e-commerce will prosper by offering innovative products and services valued by customers. This indicates the importance of business value creation, beside process improvement and optimization.

Carstensen & Vogelsang [15] identify new competencies and development cultures for web development, such as visual design, communication and collaboration, information gathering and innovation. They also identify new roles and a need for multi-disciplinary backgrounds, e.g. web-information architect, web interface designer & web graphic art designer. Braa et al. [14] argue that the key elements of web-based development are prototyping, object orientation, reuse & bricolage, quick and dirty ethnography, networking, redundancy, plug-ins, and innovation. Avison and Fitzgerald [8] identify various alternatives to traditional systems development, such as development with tools, component-based development, incremental or evolutionary methods such as RAD and DSDM (Dynamic Systems Development Method) and agile, external development, tailorable packaged systems, and outsourcing.

Baskerville & Pries-Heje [9] identify a package of 5 systems development practices for short cycle time systems development, those include focus on completion speed, release-oriented parallel prototyping, component-based development, criticality of common architecture and tool suites, negotiable quality and a rush to coding, as well as a new development culture based on less structure, smaller team sizes and diverse expertise.

It is apparent that in spite of the diversity of the suggested practices they all aim to business innovation and high responsiveness. In fact the theory behind e-commerce development is organization emergence, as explained by Truex et al. [23] where new economic realities pressure organizations to change from stable to emergent as the rapid development of commercial technology and increased global competitiveness require organizations to continuously adapt to their shifting environment. They describe organizations as seeking stability but never achieving it and thus being ‘emergent’. Truex et al. [24] refer to this as amethodical development; by amethodical they do not mean a state of chaos and anarchy, but rather orchestration of the development activities without a predefined sequence, rationality or universality. Amethodical development also supports innovation and ‘organizational shake-ups’ that will lead to adaptation, experimentation, accidents and opportunism.

It is important to note that practices aiming at just rapid and flexible development, such as prototyping, end-user development, open systems connectivity and contingent approaches, are not enough according to Truex et al. [23], as they still ultimately have the aim of achieving a stable product. For example RAD practices are characterized, according to Beynon-Davies et al. [13], by iterative incremental development, active user involvement, empowered development teams and frequent delivery of products. However, these still aim at low-maintenance and stable IT systems that continually battle against an ever-changing environment, instead of adapting to it, thus inhibiting rather than facilitating organizational emergence. So emergent systems development aims to replace even rapid and flexible IS development. We conclude that e-commerce systems development is an emergent process that is characterized according to
amethodical development principles [24] as random, non-linear, unique and capricious.

3. Research Methodology

This research is an interpretivist study [16] aiming to understand the phenomenon of e-commerce systems development from the position of the researchers and the participants directly involved. With the context of e-commerce developments explicitly included in the study so that relevance may be brought to the research, it is thus a form of action research. According Baskerville & Wood-Harper [11] the purpose of ‘action research’ is to observe and create effective organizational change and they consider it ideal for studying new or changed systems development methodologies. The complex, multivariate settings of systems development methodologies as well as the need to intervene in some way to inject new techniques into the practitioner environment make pure ‘case study’ research (which is ‘non-interventionist’) inappropriate for studying systems development methodologies [11] [16].

Susman and Evered [22] state that in terms of generating action and knowledge, action research employs a ‘process view’ of research and they modeled action research process as a five phase cyclical process; including diagnosing, action planning, action taking, evaluating and specifying learning. In case of this research an investigation into a real case B-B (business-business) digital marketplace relevant to the pharmaceutical sector was undertaken. The major objective was to investigate practical issues related to the development of e-commerce applications. For example, what sort of development methods and techniques, if any, were adopted, what sort of problems were faced, were current traditional methods suitable and sufficient or were new approaches needed? (Diagnosing Phase) During the fieldwork, over a period of four months, the researcher identified problems with simply adopting the traditional, comprehensive analysis and design models, such as use cases, functional decomposition diagrams and process flowcharts. As a result this led to the evolutionary design and introduction of an ‘upfront requirements modeling and design practice’. It is based on the use of a requirements modeling tool designed specifically for e-commerce applications. (Action Planning Phase)

The source of data collected was primarily via interviews (unstructured at the beginning then semi-structured) conducted mainly with the business consultant and the IT manager, but also with the general manager, the business analyst, members of the IT & technical staff, the legal representative and the users (pharmacists, pharmaceutical companies and distributors). A total of fifteen interviews were conducted. The other sources of data include meetings (a total of seven), observational notes, documents and protocols of the application.

After the proposed new approach was evolved, and its elements outlined, three user-based analysis sessions (brainstorming modeling sessions using the introduced modeling tool) were undertaken to try it out. As the proposed approach aims to model upfront strategic requirements just a few of such sessions is believed to be sufficient. (Action Taking Phase) In order to evaluate the design ideas generated from those sessions two additional meetings were held with the general manager and the IT manager to discuss ways to operationalize some of the design ideas produced from the proposed practice. Their response was very positive about the business value ideas triggered beside the business process models. (Evaluation Phase) This research work is ongoing and further work is required to improve the concept of the proposed approach in other real-world e-commerce applications as well as analysis of benefits, insights and drawbacks associated with its use. (Specifying Learning Phase) The outline of the case and approach together with its benefits are discussed in the following sections.

4. The Case Situation & Problems Faced

The case situation was a B-B digital marketplace that offers electronic trading tools for the pharmaceutical industry in Egypt, covering drugs, cosmetics, medical supplies, personnel & childcare products. The main objectives of the application are to offer better and more efficient electronic trading tools, compared to traditional ones, for its users locally and regionally in other Arab countries, as well as linking to other global digital marketplaces.

A portal application had already been developed before the fieldwork was carried out. The fieldwork of this study was initially part of an evaluation of the portal project, as it was decided that the application needed to be changed/adjusted, soon after its launch to improve its competitive value and effectiveness. The original analysis and design approach used traditional methods and focused on business process analysis and business process modelling of the case and the pharmaceutical trading supply chain was extensively analysed using functional decomposition techniques and process flowcharting. For example, the order lifecycle was
decomposed into order preparation, order placement and order fulfilment, also the ‘return of expired products’ lifecycle was identified and was extensively analysed.

The outcome of the evaluation was the identification of problems and drawbacks resulting from the developers becoming overwhelmed with too much detail resulting from the comprehensive analysis of the e-business case. The team apparently ignored the global and business-value requirements and the need to rethink and innovate as they became lost within all the very detailed issues and the desire to identify all the requirements in detail. The e-commerce application is complex and the traditional extensive analysis techniques increased the complexity caused many problems.

The researcher also identified problems with the heavyweight, long-term planning approach used, as it limited the ability to respond to change and hence did not suit the highly turbulent fast changing e-business environment. Lightweight and agile methods [2] were found to be more appropriate for the development of the e-business application. Problems were additionally identified with the traditional software development culture that is based on individuals rather than team-working, for example the business consultant was dominant in defining the requirements and producing the designs, often ignoring the other team members’ ideas and contributions that might have made the project more successful.

In response to those problems the researcher started to point to the importance of modeling business-value ideas beside business processes for e-commerce applications, as well as the need to re-think requirements modeling practices.

5. Requirements Modeling for E-commerce Projects

Vidgen et al. [26] characterize requirements for web information systems as vague and imprecise, indeed often completely unknown, and frequently changing. They suggest that they need to be evolved, through understanding of the application, the circumstances and the customer perspectives, as well as through the experience gained as the e-business application is realized. Truex et al. [23] concur and suggest that the traditional lengthy analysis to obtain complete and unambiguous specifications of requirements is no longer relevant. Instead they suggest a shift to new ISD values, such as dynamic requirements negotiations, continuous redevelopment and adaptability.

Schwaber [21] also addresses the problems of requirements engineering in Internet-time, arguing that it is hard to formulate a clear vision of a system in a world of constantly changing requirements and proposing the adoption of agile principles such as increments of work, iterative development and adaptation as an alternative. Ambler [7][6] proposes an Agile Modeling Methodology (AM) consisting of 12 core practices and 9 supplementary practices. The core practices include; (1) active stakeholder participation i.e. that stakeholders are closely involved in identifying requirements, (2) applying the right artifacts by e.g. the use of UML activity diagrams to model business processes, and entity relationship diagrams to model data architectures, (3) creating several models in parallel as a single representation is insufficient as there are several perspectives of an object to be considered, (4) displaying models publicly to enhance communication and collaboration, (5) modeling in small increments in order to help requirements evolve, (6) using simple tools, such as paper and pen, whiteboards, etc. There are a number of recommended supplementary practices intended to help achieve the main goals of speedy development and simplicity. For example, discarding temporary models and only updating documentation when it really begins to cause problems not to do so. Ambler [7] studied the project development process at two Internet start-up companies and suggests that the findings support AM practices. For example, development teams preferred simple sketches on whiteboards, they produced several models at once, they used use-cases along with some screen sketches, some sequence diagrams and class diagrams, etc. In fact AM can be seen as a practice-based methodology [7], as it does not define detailed procedures but instead focuses on effective modeling efforts and habits.

In this study, and as a response to the problems identified during the field study research (section 4), we identify the importance of modeling global and business-value requirements as well as generic design features before going into the comprehensive detailed analysis and design of the e-commerce application.

Joint Requirements Planning (JRP) as well as Joint Application Development (JAD) sessions [19] have been suggested as a means to set up the initial requirements for a project through brainstorming activities, but we feel they are too narrowly focused. They concentrate on producing requirements artifacts such as functional decomposition diagrams, dependency or data flow diagrams, etc. They are also
highly structured and involve formal meetings that have defined rules of behavior e.g. the use of well-defined agendas, keeping official meeting minutes, the involvement of a qualified facilitator, etc. These we feel reduce creativity and therefore found agile modeling sessions to be more appropriate.

Ambler [5] suggests that agile modeling sessions be highly iterative, with the agile modeler iterating back and forth; as it is more common to identify a requirement, analyze it, and propose a potential design strategy within minutes if not seconds, hence the need to iterate quickly between phases. Also the formulation of requirements is likely to happen by asking questions, therefore Ambler [4] suggests the use of user stories [12] that are essentially very high-level wish list of stakeholders. Ambler [4] characterizes user stories as a reminder to conduct a conversation with project stakeholders and capture high-level requirements, including business rules, constraints, and technical requirements. However, for e-commerce projects we believe that the complexity of such applications, together with the variety of multi-disciplinary issues that interplay, make the use of user stories too vague and loose. Therefore the ‘e-Business Issues Roadmap’ (Figure 1) was derived [3]. This provides a template that categorizes the different underlying issues and concerns that typical e-commerce projects face. The classification proposes issues by sector, e.g. business, technological, legal, political, economic and social, and the level they work at, for example, intra-organizational, customers and partners and environmental. Due to the complexity of the e-commerce environment and the large variety of potential issues, the proposed roadmap acts as a ‘balance’ between structure and freedom by providing an initial set of topics/issues that need to be thought about. It is used to drive and guide the triggering of issues under the various identified categories but still leaves space to the modeler to be creative. The roadmap provides a starting point without which some of the many relevant issues might be missed and too much time wasted but it is not restrictive as other issues are readily triggered by discussion and added.

6. ‘The Practice’; The Development of Self-organizing Activities

The problems encountered in the use of rigorous analysis techniques focused attention on the limitations of the traditional techniques for e-commerce systems development, as they are systematic, prescriptive and plan-driven [24] [18] and hence reduce creative thinking and the ability to respond to change. This led us not to regard or call the proposed approach a ‘technique’ as it relies on people to drive it according to the opportunities and events that arise rather than being driven by it. We thus call it a ‘Practice’. The dictionary definition of the word ‘practice’ relates to activities such as exercise, training, run through, habit, ritual, etc. Applying these meanings to software development we identify the proposed ‘Practice’ as a ‘discourse’ during which software development activities and responses evolve. Hence we characterize the ‘Practice’ as a self-organizing activity driven by opportunity and experiences gained.

Unlike traditional software development techniques, the ‘Practice’ will neither be prescriptive, nor anchored in rationality, reductionism, empirical or scientific underpinning. An initial rule or template is needed to define the general rules and act as a guide to set a boundary leaving space to the development team to react independently to the problem situation. Hence the ‘Practice’ depends on the individuals and their creativity to find ways to solve problems as they arise, rather than providing them with inclusive rules, i.e. all things they could possibly do under all situations.

However, the concept of the ‘Practice’ is not introduced to replace the ‘Technique’ nor to find a kind of a compromise, as we believe that they are complementary. The ‘Practice’ addresses the planning and the global analysis and design activities that sets the strategic general features of the required system creatively in a rapid, emergent way. Whereas ‘Techniques’ will be needed later to carry out a comprehensive, rigorous, detailed analysis and design to get to the level of detail needed to build the application.

The concept of the ‘Practice’ builds also on the new requirements of approaches suggested in the literature (section 2). It supports the amethodical view of Internet software development suggested by Truex et al. [24]. This requires new approaches to be unstructured, opportunistic and driven by accident, and supports the short-cycle continuous development suggested by Baskerville & Pries-Heje [9]. It also builds on the AM (Agile Modeling) methodology suggested by Ambler [7][6], in fact it fills in some of the gaps of AM that provides only a set of guidelines without providing a mechanism to operationalize them. The ‘Practice’ uses brainstorming sessions based on a modeling tool as described in the next section.

7. A Solution: An Upfront Requirements Modeling & Design Practice
To identify and analyze global, business value requirements for e-commerce applications a heuristic approach was used as it seemed more appropriate for the turbulent, uncertain, and fast changing nature of the e-commerce environment, as explained in section 5. As a result a brainstorming sessions was chosen as suitable for this purpose using the ‘e-Business Issues Roadmap’ (Figure 1) as a paper-based tool to explore requirements. The roadmap was used to trigger issues under the different categories and as a result trigger generic design features and business value ideas concerning the e-marketplace application. This resulted in the running of three modeling sessions as will be shown later. Only a few such sessions proved adequate for modeling upfront strategic value ideas. This is because a comprehensive analysis was not required only a limited up-front set was sought. This also helps to reduce complexity and stimulate creative thinking. As the e-commerce issues are multi-disciplinary, the participants of the modeling sessions included representatives of the different kinds of members (stakeholders) involved with operationalizing the e-marketplace portal.

The first brainstorming session was attended by the business consultant, the business analyst and the researcher. Some of the issues that were triggered in this session were that the organizational structure needed to suit the e-marketplace architecture and not vice versa. Also a sales pipeline was identified as necessary to fulfill the sales process, as some of its major activities were still carried out offline. In that way requirements evolved and were written down under the different categories of the ‘e-Business Issues Roadmap’ (Figure 3). Some of the solutions triggered as response to those issues were the ‘awareness campaigns’, the ‘installment program’ and the various value-added services, such as the customization of product dispatch as part of the order placement cycle, the new special offer announcements in the form of SMS messages or e-mails, and others. Those design features and ideas were written on a separate sheet (Figure 2).

It was found that the business consultant and analyst were only knowledgeable about the business, economic, social, legal and political issues. Therefore there was a need to hold other sessions with representatives of the technical staff as well as senior management to ensure that different perspectives and issues were taken into consideration. So another brainstorming session was held attended by the IT manager, two junior software developers and the researcher. Some of the issues that came out in this session were that the e-trading process is somewhat invisible and ambiguous compared to the traditional system. It was felt that this might make the buyers reluctant to use the e-marketplace application. (Figure 3) This resulted in a focus on the importance of the confirmation of the order before it is placed and the introduction of further flexibility by providing the ability to cancel a placed confirmed order within a certain period. Another idea was to provide virus-shield software as part of the e-marketplace solution as a way to further increase customer trust and satisfaction, and other ideas as shown in Figure 2.

Another session was arranged later with the general manager, the business consultant and the researcher where the attendees started to reflect on and evaluate (in an informal way) these solutions (Figure 2). The ideas they really liked were the focus on value-added services to further publicize the site. Using agent-based software was postponed for the next release, as the company wanted to make some revenue before undertaking further investment. Other ideas were hard to implement, as the current system architecture would not allow this easily, such as the customisation of the order preparation function, which would necessitate the redesign of the order module.

This is an example of how the proposed ‘upfront requirements modeling & design practice’ has been applied. Of course there will also be a need to carry out a comprehensive analysis and to get to the level of detail needed to build the application, but this comes after the proposed ‘upfront’ analysis and design. For us the term ‘upfront’ does not necessarily mean ‘initial’ as we believe that the e-commerce application will undergo continuous, constant re-development as indicated earlier in section 2 & section 5, and therefore there is a need to go back again and again to review the global strategic view of the e-commerce application even after the application is launched.

8. Benefits & Values

The creative strategic upfront requirements modeling is critical to the success of e-commerce applications as e-business is about bringing business value rather than just solving a specific problem. Thus a focus on the modeling of value-added services, as well as business processes, is necessary for e-commerce applications. The design ideas triggered by using the proposed approach (Figure 2) show a number of business-value design ideas e.g. SMS messaging of special offers, the use of virus shields etc. that had not emerged when
using the conventional functional decomposition techniques and use cases.

In addition the roadmap provides a global, summarized overview of the design issues that characterize the whole application situation, which helps in abstraction and relating the major issues together, as well as reducing complexity in contrast to use cases and process modeling techniques that although comprehensive are too complex. In fact the introduced roadmap acts as a balance between structure and freedom and therefore will guide the designers within the large variety of issues, but still leave them enough space to be creative.

The proposed approach also engages and stimulates the development team members to collaborate and interact, which helps boost the team-based development culture that is essential for achieving creativity and business innovation that is unlikely to happen when working on an individual basis. The approach is in addition simple as it does not require special skills or intense training courses; the requirements modeling tool (the e-Business Issues Roadmap) is easily understandable and it is simple to complete.

9. Conclusions

E-commerce development is argued to be different from traditional software development in that it requires a high degree of business innovation and high responsiveness. The proposed approach addresses this and introduces a ‘Practice’ for the modeling of upfront business value ideas in a rapid, self-organizing way, based on brainstorming sessions and the use of a requirements modeling tool that categorizes the various issues of e-commerce. Findings and experience from a case study suggests that the ‘Practice’ is both practical and effective in addressing the needs of e-commerce up-front requirements and design. It also illustrates that the necessary creative elements are emerged and shows some examples of important issues that did not result from the original traditional approach to eliciting requirements. Unlike a technique, the ‘Practice’ is a creative and communicative process, it doesn’t follow a set of all-inclusive rules; it rather acts as a ‘parable’ that guides the participants based on a set of concepts, guidelines, previous experiences and best practices, and then the ‘development game’ evolves in use.

10. References


11. Appendix

![Diagram of e-Business Issues Roadmap](image)

**Figure 1. e-Business Issues Roadmap**

- Provide virus shields to increase customer trust
- Confirmation messages before order is fulfilled
- Facility to cancel an order after confirmation within a certain period
- Match excess and deficiencies of products among pharmacists
- No high specs to make it affordable
- Instalment program to make it affordable
- Arabic version to overcome language barriers
- Special offers can be pushed to the buyers through emails or SMS
- Awareness campaigns
- Online demo about how to use the application (animated)
- Agents to customize the dispatch of orders according to customer preferences
- Firewall and SSL for security
- Advertisement, Announcement banners
- Speed up the Search through splitting

**Figure 2. Design Ideas for the e-Marketplace produced from the proposed ‘Practice’**
Figure 3. Issues for the e-Marketplace produced from the proposed ‘Practice’