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ERP Customization vs. Business Process Reengineering: Technical and Functional Perceptions

Meg Fryling
mfryling@siena.edu
Computer Science
Siena College
Loudonville, NY 12211, USA

Abstract

Information system failures and cost overruns have plagued organizations for decades. In order to take full advantage of Enterprise Resource Planning (ERP) systems, implementations require drastic structural and cultural changes within the organization including business process reevaluation and reengineering. These changes are difficult to accomplish and organizations continue to struggle with change management of ERP systems. Stakeholder involvement and perceptions regarding the ERP system change over time. Understanding evolving perceptions may lead to improved long-term ERP system management and reduced costs. The purpose of this research is to gain dynamic insight into the software project management of pre-packaged enterprise-wide information systems (i.e. ERP). This study uses system dynamics modeling together with interviews of ERP project members to better understand the technical and functional perceptions regarding customization versus business process reengineering to satisfy functionality gaps.

Keywords: ERP, System Dynamics, Business Process Reengineering, Enterprise Resource Planning, Customization, Total Cost of Ownership

1. INTRODUCTION

Enterprise Resource Planning (ERP) information systems emerged during the 1990s as a cross-functional enterprise-wide information system solution. ERP systems integrate data and processes from disparate organizational departments into a single information system (Dodds & Spencer, 2007; Rashid, 2005; Sammon & Adam, 2005). This vast integration is intended to improve data access, data accuracy and workflow as well as to enhance efficiency, agility and responsiveness (Sammon & Adam, 2005). ERP systems were initially intended for large industrial companies but are now implemented by a wide variety of organizations, including higher education institutions. A key piece of ERP integration is the use of a single database and multiple software modules covering various departmental business functions. ERP implementations force the merger of disparate organizational data and functions (Dodds & Spencer, 2007; Rashid, 2005; Sammon & Adam, 2005). This enterprise-wide integration of diverse departments is what makes ERPs more complex and larger in scope than traditional software packages (Brehm, Heinzl, & Markus, 2001; O'Brien & Marakas, 2006). This complexity is due to the underlying business processes embedded in ERP systems (Bansal & Negi, 2008). Therefore, ERP systems require vigilant change management to implement successfully (Dong, 2000; Somers & Nelson, 2001).

Issues related specifically to the implementation of traditional pre-packaged ("off-the-shelf") information systems have overwhelmed

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organizations since the 70s, decades before the emergence of ERP systems. As McNeil discussed in 1979, the fact that both user requirements and vendor offerings are constantly fluctuating and evolving; making the proper management of pre-packaged information systems nearly impossible. There are unique challenges associated with implementing these types of information systems. Organizations have little control over the quality of "off-the-shelf" information system functionality and are at the mercy of vendors who make software improvements based on their strategic internal policies and not necessarily customer needs (McNeil, 1979). While customers can certainly make desired software modifications themselves, vendors typically deny software enhancement request due to the high development and maintenance costs (Brehm et al., 2001). Often the software as delivered does not fully meet the needs of the organization so frequent changes (customizations) and extensive maintenance are required (McNeil, 1979). Organizations can choose to have custom software built to meet their unique requirements but this imposes additional costs, risks, and implementation delays (Brehm et al., 2001; Fryling, 2010).

ERP systems differ from traditional software packages because they are neither "custom-built" nor "off-the-shelf" (Brehm et al., 2001, p. 2). ERP systems are, in theory, designed based on industry best practices and are intended to meet the needs of all similar organizations (Kumar & Van Hillegersberg, 2000). Since ERPs are developed to meet the needs of a variety of institutions, they are inherently generic and often reflect the vendor's perception of best practices; these will likely contradict many of the implementing organization's notions of best practices (Crumbly & Fryling, 2012; Dong, 2000; Orlikowski, 2002). This is further complicated by the integrated nature of ERP. In the pre-ERP environment functional offices could work fairly autonomously and developed specialized unit business practices (Frantz, Southerland, & Johnson, 2002); hence, technology-wise they were decentralized. Pre-ERP information system implementations did not require cross-functional collaboration and in fact necessitated little functional user involvement at all; they were principally IT initiatives (Frantz et al., 2002).

While ERP systems are generic in nature, they do have some flexibility built in and are configurable to meet some of the specific requirements of each institution. This configuration is not technical in nature but requires functional business process expertise. Therefore, implementation requires technical and functional communication, collaboration, and active project participation. "Because ERP software has to be implemented rather than simply installed, it requires a paradigm shift for most functional users" (Frantz et al., 2002, p. 40). "ERP implementations usually require people to create new work relationships, share information…, and make business decisions they were never required to make" (Appleton, 1997, p. 52). Often it is the case that in the pre-ERP environment there were more efficient ways to do business that were simply impossible with disparate information systems. For example, in a higher education environment without ERP the financial aid office must wait for nightly interfaces to run in order to make decisions regarding a student's financial aid eligibility. With an ERP the financial aid staff can access student account and student records information in real time; thus, improving customer service. These improved business practices can be exploited with ERP only if functional and technical project stakeholders communicate and collaborate effectively.

The major challenge for the organization implementing an ERP is instituting a major paradigm shift for executive leadership. "CFOs approach business processes from a practical orientation, whereas CIOs tend to be more technically oriented" (Frantz et al., 2002, p. 40). "ERP systems are really about closely integrating different business functions; this is what sets them apart from many other IT efforts" (Akkermans & van Helden, 2002, p. 36). This tight integration provides an information system with increased access to real-time data and a significant reduction of data redundancy, yet those same benefits impose significant complexity. The complex design of ERP systems makes them difficult to understand, implement and modify (Dodds & Spencer, 2007).

Information system failures and cost overruns have plagued organizations for decades (Peterson, 2003; Tapp, Hesseldenz, & Kelley, 2003). In order to take full advantage of ERP systems, ERP implementations require drastic structural and cultural changes within the organization including business process reevaluation and reengineering. These changes are difficult to accomplish and organizations

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continue to struggle with change management of ERP systems.

ERP implementations have distinct phases. Each of these phases involve a variety of stakeholders, with different levels of perceived understanding (Besson & Rowe, 2001). Stakeholder involvement and perceptions regarding the ERP system change over time (Besson & Rowe, 2001). Understanding evolving perceptions may lead to improved long-term ERP system management and reduced costs. This study focuses on the perceptions of ERP project stakeholders in the post-implementation phase, shortly after a major system upgrade.

2. METHODOLOGY

Research Questions and Objectives
The purpose of this research is to gain dynamic insight into the software project management of pre-packaged enterprise-wide information systems. This study seeks to better understand the technical and functional perceptions regarding customization versus business process reengineering to satisfy pre-packaged information system (i.e. ERP) functionality gaps.

Primary questions to be addressed are:
- Are customizations perceived a "slippery slope" such that the more they are implemented, the more they are desired?
- How likely are customizations to be reevaluated once created?
- What impact does top management support have on business process reengineering versus customization?
- Is there a perception that business process reengineering is more time consuming than customization?
- Is there a perception that customizations are an easier fix for functionality gaps than business process reengineering?
- Are customizations perceived as more costly than business process reengineering?

Case Study
This research employed a case study methodology with interviews of key functional and technical ERP project participants. The case study institution is a state research university consisting of approximately 13,000 undergraduate students, 5,000 graduate students and 4,300 employees. The institution implemented its first ERP system in 2004 and conducted its first major upgrade of that system in 2008.

System Dynamics and Casual-Loop Diagrams
Because ERP management consists of dynamic problems arising from complex social, managerial and economic systems, the system dynamics methodology is ideally suited to study ERP project management (Richardson, 1996). In order to address the challenges of ERP management, practitioners need a tool that will help them understand the complexities of the system they are attempting to control. System dynamics is a useful methodology for this type of research because it helps individuals understand the dynamics occurring in the real world (Meadows, 1989) and explore the impact of alternative decision options.

Causal Loop Diagrams (CLDs) are visual representations used to explain the interactions/influences within a system and help provide insight into a system's structure. CLDs explicitly show the complex interdependence and circular causality between components in the system (Sterman, 2000). The use of causal loop diagrams in the interview setting allowed for a focused discussion regarding model elements. Based on the research questions, a CLD was created for use during the interviews (see Appendix A, Figure 1).

Interview Administration
The interview protocol was developed and piloted with two case study employees; one from a functional department and one from the centralized technical department. The interview structure was modified based on the feedback from these pilot tests. To further improve the interview structure and consistency between interviews, a comprehensive administrative script was created. A solicitation to participate was sent to 9 case study project participants. A purposive sampling frame was used because it was important that the researcher interview key project participants who are able to provide information relevant to the research focus (Bryman, 2004). In addition a solicitation was sent to a technology in higher education listserv. Individuals were selected based on their role and level of experience on the ERP implementation/maintenance project. Of particular importance was the recruitment of a sampling frame with a balanced mix of functional and technical stakeholders as well as executive leadership. The results of the

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recruitment were positive with 8 of the 9 case study individuals solicited actually participating. In addition, three listserv respondents from three institutions were interviewed.

Based on the timing of the pilot tests, all interviews were scheduled for 90 minutes. The Introduction and Model Overview sections of the booklet were sent to the interviewee ahead of time and interviewees were asked to review these documents prior to the interview. At the start of the interview the participant was given a complete Interview Booklet and the Model Overview section was reviewed together.

The use of both open ended questions and Likert-scale questions followed by open discussion was well received by the participants and provided rich data. Although the notation used in the causal loop diagrams was new to the interviewees, a fairly short explanation at the beginning of the interview seemed to clear up any questions. In addition, interviewees were given an introduction packet before the interview so questions were minimal.

Since this was a case study, the population was small enough that all of the functional and technical project leads could be including in the interviews. A larger sample of external experts could have been reached had surveys been used instead of interviews but the resulting data would lack homogeneity, making it difficult to compare the case study interview findings with the external data. In addition, the answers given in the Likert-type questions were sometimes different than the statements made during the structure review discussion. The ability of the researcher and the interviewee to ask questions regarding Likert-type questions reduced the possibility of misinterpretation by both the parties.

Data Capture and Coding

Interview lengths varied between 45 minutes and 2.5 hours. Data collected included open-ended discussion regarding the model concepts and causal structure. Additionally, participants were asked to answer Likert questions related to the model structure, indicating one of the following choices: strongly disagree, disagree, neither, agree, or strongly agree. Interviewees were encouraged to ask questions and offer comments/suggestions while answering the questions. Again following the Likert items, participants were asked if they would like to elaborate and/or offer additional explanation for

their answers. Much discussion was generated during this time and dynamic insights were identified. After each interview all data was transcribed, coded and summarized.

3. FINDINGS

Expert Reaction to Model Structure

Semi-structured interviews for this study were conducted with eight case study institution project stakeholders, including executive project leadership and functional/technical leads. Additionally, three external interviews with experts from other higher education institutions were conducted. This section provides an overview and preliminary analysis of these data.

Case Institution Interviews

All interviewees, technical and functional, agreed that there is a customization "slippery slope" phenomenon where when an office sees that other units are getting a customization approved they want the same. Additionally, as customizations are approved for a specific office that office is more likely to request more customizations. As one functional participant explained, "[t]he more you customize, the more they want!" Also adding "once you customize something [the users] will always want it." Despite this agreement during the open ended discussions, there was remarkable divergence on the related Likert items.

While in general there was agreement that as gaps between existing business practices and delivered software functionality are discovered there is an increased pressure from the user community to customize the ERP, technical respondents agreed overall more than functional respondents (see Appendix B, Table I, Question 1). Technical respondents also agreed that users tend to prefer a customization solution over a business process reengineering solution, while functional respondents were more neutral (see Appendix B, Table I, Question 2).

One functional participant explained that the "[i]nitial reaction is to customize but if there is someone with good knowledge of the system [the office] can be persuaded to use existing functionality." Another functional participant added that the pressure to customize comes from the office level staff and that the executive level did encourage business process reengineering. A technical interviewee further elucidated, "…the reflexive response of the community is to customize but you can change with framing, communication, and leadership."

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A functional respondent added that even when the existing functionality satisfies the business requirement, but in a different way than current business practices, there is often an initial pressure to customize. He/she felt that despite the origin of the push (IT or not), there is simply a resistance to change. Even when a new process is more efficient, the functional community is uncomfortable with doing things differently. They also added that the more users are educated about the long-term implications of customizing the less likely they are to request customizations.

While interviewees agreed that clerical level users might not consider the time/resources required to maintain customizations/add-ons, one functional interviewee felt this was a consideration to functional offices. This interviewee reported that there "…is more awareness these days thanks to the IT priority list but there still isn't a handle on the time it will take for each task to implement and/or maintain; thus, making it difficult to prioritize." The interviewee felt their office is more concerned with improvement for the students' benefit versus improvement simply to benefit the administrative end-users.

The largest divergence between the functional and technical groups of participants was in response to the theory that once a customization has been developed to satisfy functionality gaps it is unlikely that gap will be reviewed in the future as a business reengineering candidate (see Appendix B, Table I, Question 3). One functional participant explained that they felt there is more of a willingness to explore delivered functionality and conduct business process reengineering than the model suggests. They also added that as familiarity with the software grows, willingness to conduct business process reengineering improves. Technical participants were overall in agreement that the need for customizations decreases as understanding of the ERP functionality increases, while functional participants were generally between neutral and agree (see Appendix B, Table I, Question 6).

Technical respondents agreed that it is difficult to retire a customization once it has been implemented, while functional participants were more neutral (see Appendix B, Table I, Question 4). Again, technical interviewees generally agreed that the more customizations that exist, the more difficult it is to encourage business process reengineering options for new fit gaps, while functional participants were in the neutral to disagree range (see Appendix B, Table I, Question 5). Two technical interviewees indicated that while customizations should be reviewed regularly they often are not unless IT pushes for it. Participants all agreed that willingness to explore business process reengineering and delivered functionality changes over time. The primary drivers reported by participants were real experience using the system, changes in leadership and changes in institution missions/goals. With each bundle/upgrade "…part of the challenge is to remember to re-explore functionality that didn't work before."

Two interviewees pointed out during the model segment review that they did not agree that business process reengineering always takes longer upfront than a customization and that it really depends on the task. 62.5% of the respondents agreed with the Likert question that business process reengineering typically takes longer to implement than customizations, while 35.5% were neutral (see Appendix B, Table I, Question 7).

There was a divergence between technical and functional participants in response to the theory that it is easier to customize to fix functionality gaps than conduct business process reengineering (see Appendix B, Table I, Question 8). What was surprising about this divergence was that the technical interviewees generally agreed, while functional participants were largely neutral. One technical interviewee expressed that they agreed but only that this was true initially and not over time. Another technical interviewee explained that business process reengineering necessitates consultation with a large group of constituents in the university community and often requires policy changes; thus, it may seem easier upfront to customize. Nonetheless, there was overall agreement that customizations have a greater long-term cost than business process reengineering (see Appendix B, Table I, Question 9). There was also agreement among all participants that strong top management support increases business process reengineering (see Appendix B, Table I, Question 10).

Overall interviewees were neutral regarding the theory that business process reengineering leads

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to improved functional productivity (see Appendix B, Table I, Question 11). As one technical participant stated, "[b]usiness process reengineering should lead to improved productivity but it doesn't always." Another functional interviewee agreed and stated that it "…depends on user attitude." Adding that adjustment time is needed because "…users are going from a totally customized legacy system to a mostly vanilla delivered with some customizations."

A participant pointed out that the functional perspective changes over time with policy changes, market changes, and technology changes; causing users to look back at the system and say what can the system do to help me.

Non-Case Study Institution Interviews
The non-case study institution interviewees came from three different higher education institutions. Both of the technical interviewees were the project manager for their institution's ERP implementation and are now CIOs at their respective institutions. The functional participant is an administrative office department director. These participants, similarly to the case study institution interviewees, were in high agreement with the model structure/description section of the interview, while there was some disagreement with the related Likert Items. This section will explore the similarities and differences.

One technical participant explained that it was important to gain the trust of functional leads (module managers group). Their organization agreed institutionally that they did not want to customize; they incurred the upfront costs to hire consultants. The interviewee also stated that communication and collaboration are important because the implementation group needs to roadmap the project collectively. The team needs to work together to discover what the options are and then make a decision. Another interviewee explained that "[t]here is a normal predictable resistance to change." Trust and willingness to conduct business process reengineering can be built over time based on early successes. The interviewee stated that these early successes are accomplished via strong leadership and communication.

One participant explained that the pressure to customize depends somewhat on how much the community as bought into the change. If they are not well informed about the big picture and do not have an understanding of what is going to happen, the pressure to customize is high. They added that "most people are not big picture people" and that the community ultimately wants to know, "How is this going to impact me?" The initial reaction for users is to say, "we must have what we had before" because they are afraid. It will take effort to get them to explore, to think about things from a different perspective and to agree on solutions. After the users gain system exposure they loosen up and are more open to change.

Another interviewee added that the pressure to customize depends on maturity level such that it changes over time. They strongly agreed that at the beginning of the implementation as gaps between existing business practices and delivered software functionality are discovered there is an increased pressure from the user community to customize the ERP. After the implementation is mature and the community gains experience with the system, the participant's answer changed from strongly agree to agree (see Appendix B, Table II, Question 1). The interviewee also stated that they strongly agreed that users tend to prefer a customization solution over a business process reengineering solution at the beginning of the implementation but felt that over time with increased exposure to the system this was less the case (see Appendix B, Table II, Question 2).

Two interviewees agreed that once a customization has been developed to satisfy functionality gaps it is unlikely that gap will be reviewed in the future as a business reengineering candidate, while one strongly disagreed (see Appendix B, Table II, Question 3). The individual that strongly disagreed explained that their institution has been able to reduce customizations by 50% in the past 2 upgrades (25% each upgrade) but admitted this took a significant effort initiated by the technical leadership and accomplished via a strong technical/functional partnership.

One of the participants explained that once you give people a customization that makes the system work exactly as it did before they will never explore business process reengineering even if things could work better. "You've put people back in their happy place and when people get comfortable they don't move…" and are less likely to look back to see if they really need the customization. They also added that

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functional users need motivation and free time to re-explore delivered functionality, especially when there is a customization that is already filling the gap. It should be noted that this participant made the preceding statements before they viewed/answered Question 3 (see Appendix B, Table II). When reading Question 3 they stated, "[t]hat's exactly what I was saying."

In response to the statement that it is difficult to retire a customization once it has been implemented, one interviewee indicated that it depends on the vendor (see Appendix B, Table II, Question 4). Adding that their ERP vendor is constantly improving the product and their customer base is willing to look at the new functionality because they have asked for changes. Two interviewees agreed that the more customizations that exist, the more difficult it is to encourage business process reengineering options for new fit-gaps. One participant explained that once you have set an expectation that functionality gaps will go away with customizations, users will assume future gaps will be managed this way (see Appendix B, Table II, Question 5).

One interviewee explained that a major problem with ERP is that people suffer from small-world mentality and with ERP systems it is necessary to have a larger worldview; it is necessary to think about the community as a whole. In their institution they have no overseer of the enterprise (e.g. steering committee), which has been a challenge in developing clear goals. The organization did conduct a strategic assessment and the end result was a report indicating that the project stakeholders were not getting along. They added that as CIO you know that the dynamics will happen whether you like it or not. In order to be successful, an organization needs an open-minded group and this attitude needs to be injected into the blood of the university (culture).   The interviewee stressed the importance of a roadmap so that there are no customizations made to the system that do not fit with the larger strategic mission of the project.

All interviewees agreed that the need for customizations decreases as understanding of the ERP functionality increases (see Appendix B, Table II, Question 6). However, one participant added that "[t]here are some existing business practices that people are going to hold on to even if they understand the delivered functionality."

One interviewee explained that if users find something good in the new system they get excited and are willing to explore further. He/she added that the "good find" (positive early experience) might need to be facilitated (e.g. consulting) as users might get frustrated on their own, depending on each individual's level of experience.

Another participant felt that capability maturity, how far down the ERP path they are, is a factor in determining how receptive an organization will be to business process reengineering. The interviewee explained that it is important to weed out noise in the system (the naysayers).

An organization needs a critical mass of people that can tell a good story (positive experience). They stated that a minimal common vocabulary is required in order to foster technical/functional communication. Finally adding this it is important to remember that "there are no IT projects,   they   are   all   business projects…everything is about the business!" The non-case study interviewees were more in agreement that business process reengineering leads to improved functional productivity than case study participants (see Appendix B, Table II, Question 11).

One interviewee stated that training (functional, technical and end-user) is critical and the key to success. Training is an investment and as such "[i]t is reckless to treat training/development as a cost…[training] is highly associated with a successful outcome." This participant added that the timing of training is important in addition to the   strategic   use   of   consulting.   Another interviewee explained that user training is "not a self-guided   tour."   Generic   vendor   delivered training is good but it is important to get training that is related to what the users do every day. The final interviewee also indicated that training needs to be more than just how the software works; real-life exposure is what makes the difference.

One interviewee explained that business process reengineering does not necessarily take longer than customization solutions (see Appendix B, Table II, Question 7); "the key is whether or not you are good at [reengineering processes]." Another   participant   explained   that   an organization   needs   to   commit   to   business process   reengineering   in   a   disciplined   way; focusing on goals of the university and not just departmental   objectives.   Another   interviewee

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pointed out that customizations do have a recurring cost at the functional office end as each time a customization is reapplied it must be tested, which is very time consuming (see Appendix B, Table II, Question 9).

All interviewees agreed with the statement that "strong top management support increases business process reengineering" (see Appendix B, Table II, Question 10). However, two participants stated they really felt strong management support does not necessarily increase business process reengineering but improves the capacity for it. Unlike the case study institution participants, all non-case study interviewees agreed that business process reengineering leads to improved functional productivity (see Appendix B, Table II, Question 11). One interviewee added a comment that seemed to support the case institution's more neutral stance on this theory, stating "[y]ou would hope the reason you changed was to improve productivity but in some cases this may not be true." The non-case study interviewees were less in agreement than the case study interviewees that it is easier to customize to fix a functionality gap than conduct business process reengineering (see Appendix B, Table II, Question 8).

Indicated Changes to the Model
Based on the interview findings, changes were made to the model structure (see Appendix A, Figure 2). The following table summarizes the relationships eliminated or replaced in the model and the reasons for elimination/replacement:

Additionally, several additions of variables and relationships were added to the model (see Appendix C). Interview findings indicated that willingness to explore business process reengineering changes over time based on system exposure, so the variable needs to reflect this dynamic behavior. System exposure is more than just generic training but a combination of focused training as well as real use of the system. The mean rating for the theories "once a customization has been developed to satisfy functionality gaps it is unlikely that gap will be reviewed in the future as a business reengineering candidate" and "the more customizations that exist, the more difficult it is to encourage business process reengineering options for new fit gaps" was 3.55, indicating neutral to low agreement (see Appendix B, Table II, Questions 3 & 5).

Participants explained during the related model segment discussion that there are a variety of factors that influence the likelihood that customizations will be reevaluated, including system exposure and time available to reevaluate customizations.

Relationship Eliminated	Reason(s) for Elimination
"Willingness to explore business process reengineering" → (-) "Cumulative customizations"	Willingness alone does not reduce customizations; business process reengineering actually needs to take place. The relationship between "Cumulative business process reengineering" and "Gaps in delivered functionality" is more appropriate and already exists in the model structure.
"Cumulative customizations" → (-) "Willingness to explore business process reengineering"	There was not overall agreement with the related Likert items (see Appendix B, Table II, Questions 3 & 5) and statements made during the open-ended discussion supported elimination of relationship.

Model review discussions indicated that as the technical and functional stakeholders learn to work together effectively the pressure to customize reduces, which in turn opens the door for business process reengineering and increased use of delivered functionality. Therefore, the relationship between interdepartmental collaboration and pressure to customize was added to the model.

4. CONCLUSIONS

The pressure to customize an ERP system is driven by real or perceived functionality gaps in a pre-packaged information system. Some gaps are resolved via business process reengineering or software configuration changes, while others are resolved via customizations or add-ons. Additionally, there are a certain percentage of gaps that will never be resolved.

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A fraction of customizations and add-ons will need to be reviewed each time a software bundle is applied (i.e. typically 4 times per year in higher education institutions). For upgrades, all customizations and add-ons need to be reviewed (i.e. typically every 3-4 years). Therefore, the more customizations and add-ons that exist, the more new work will be generated for each bundle/upgrade. While there is certainly real costs associated with business process reengineering and configuration, interviewees were in agreement that customizations have a greater long-term cost than business process reengineering.

As gaps are discovered in system functionality there is an increased pressure to customize. There is often an initial preference to customize the system rather than change business processes to fit the embedded processes in the software. This can be mitigated via top management support, including a formal process to review and approve/deny customization requests based on a real business need.

Interviewees agreed that there is a customization "slippery slope" reinforcing loop where the more customizations that exist, the greater the pressure to customize. Interviewees stressed the importance of system exposure, and not just generic training, to improve functional understanding, increase willingness to explore business process reengineering, and increase the likelihood that customizations will be reevaluated. Top management can also ensure proper communication channels are nurtured and appropriate time is allocated to review customizations and conduct business process reengineering, factors which were all identified by interviewees as important components that can reduce customizations and total cost of ownership.

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Appendix A – Casual Loop Diagrams

Figure 1: Pre-Interview Casual Loop Diagram

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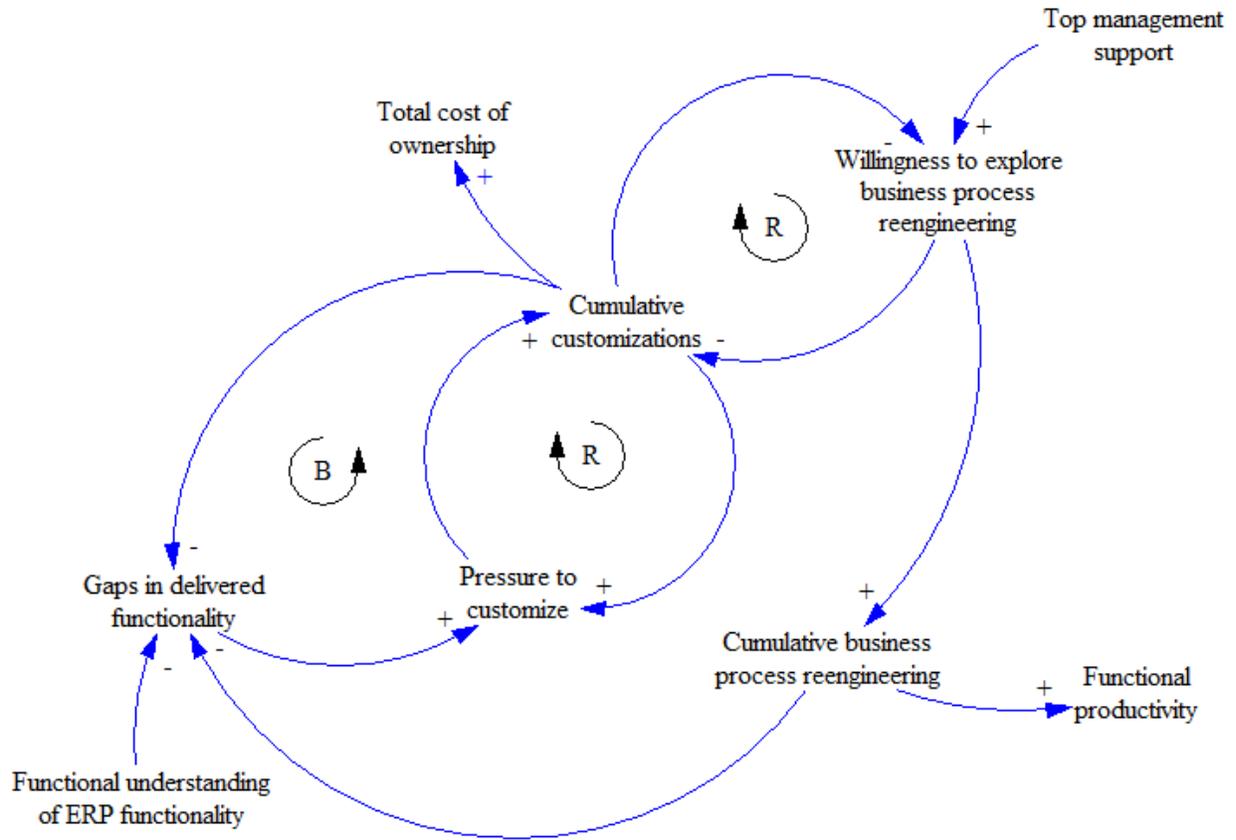
Figure 2: Post-Interview Casual Loop Diagram

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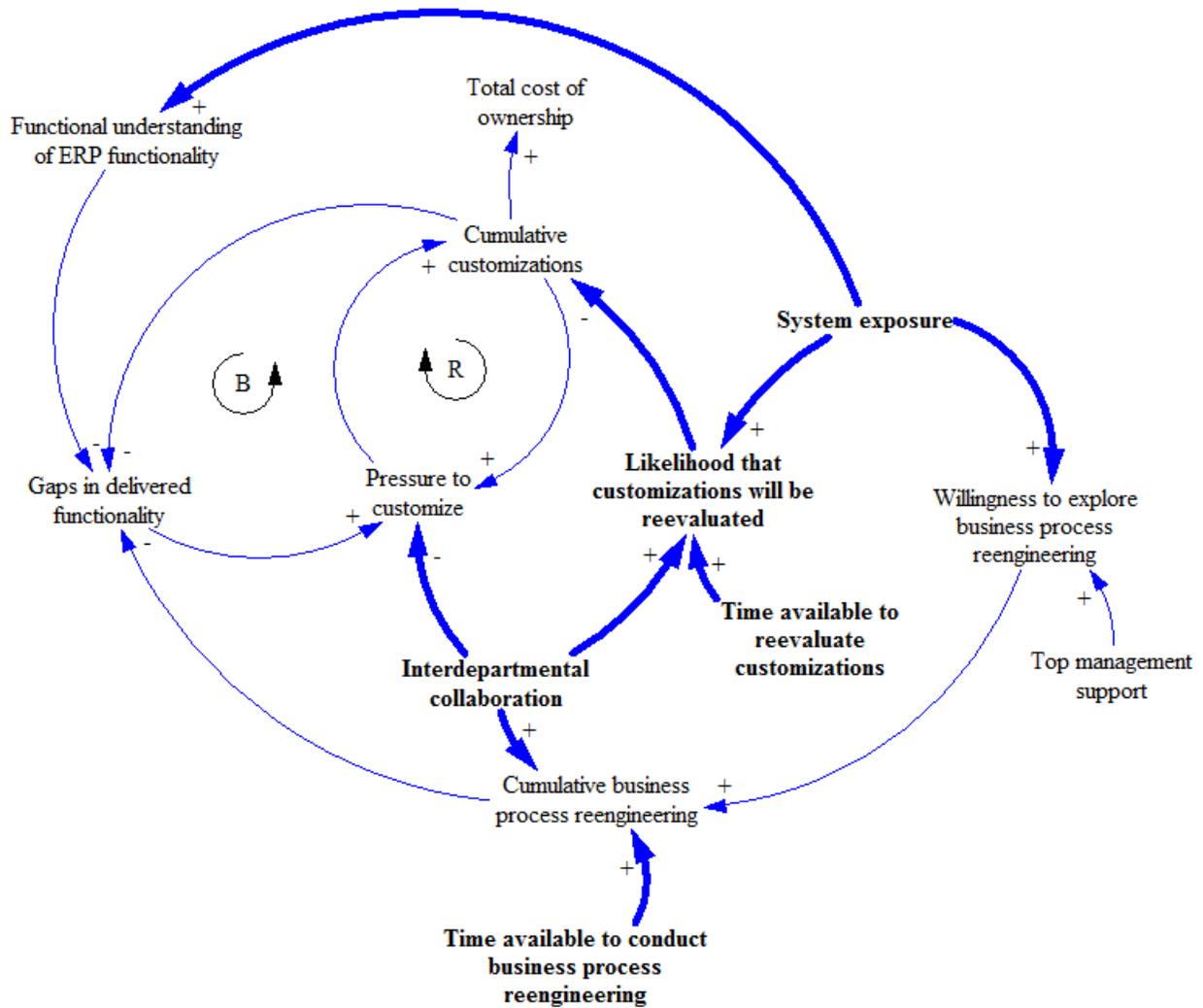
Appendix B. Likert Question Results

Table I: Case Study Interviewees Only

	Rating Mean (All)	SD (All)	Rating Mean (Tech only)	SD (Tech only)	Rating Mean (Func only)	SD (Func Only)
1. As gaps between existing business practices and delivered software functionality are discovered there is an increased pressure from the user community to customize the ERP.	4.13	0.99	4.50	0.58	3.75	1.26
2. Users tend to prefer a customization solution over a business process reengineering solution.	3.88	0.99	4.00	0.00	3.75	1.50
3. Once a customization has been developed to satisfy functionality gaps it is unlikely that gap will be reviewed in the future as a business reengineering candidate.	3.75	1.17	4.50	0.58	3.00	1.16
4. It is difficult to retire a customization once it has been implemented.	3.88	1.25	4.25	0.50	3.50	1.73
5. The more customizations that exist, the more difficult it is to encourage business process reengineering options for new fit gaps.	3.50	1.07	4.00	0.00	3.00	1.41
6. The need for customizations decreases as understanding of the ERP functionality increases.	4.13	0.64	4.50	0.58	3.75	0.50
7. Business process reengineering typically takes longer to implement than customizations in order to satisfy fit-gaps.	4.13	0.99	4.50	1.00	3.75	0.83
8. It is easier to customize to fix a functionality gap than conduct business process reengineering.	3.50	0.76	4.00	0.00	3.00	0.71
9. Customizations have a greater long-term cost than business process reengineering.	4.25	0.46	4.50	0.58	4.00	0.00
10. Strong top management support increases business process reengineering.	4.38	0.74	4.50	0.58	4.25	0.83
11. Business process reengineering leads to improved functional productivity.	3.38	0.52	3.25	0.50	3.50	0.50

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Table II: All Interviewees

	Rating Mean (All)	SD (All)	Rating Mean (UA)	Rating Mean (Non-UA)
1. As gaps between existing business practices and delivered software functionality are discovered there is an increased pressure from the user community to customize the ERP.	4.14	0.84	4.13	4.17
2. Users tend to prefer a customization solution over a business process reengineering solution.	3.91	0.83	3.88	4.00
3. Once a customization has been developed to satisfy functionality gaps it is unlikely that gap will be reviewed in the future as a business reengineering candidate.	3.55	1.29	3.75	3.00
4. It is difficult to retire a customization once it has been implemented.	3.82	1.08	3.88	3.67
5. The more customizations that exist, the more difficult it is to encourage business process reengineering options for new fit gaps.	3.55	0.93	3.50	3.67
6. The need for customizations decreases as understanding of the ERP functionality increases.	4.18	0.60	4.13	4.33
7. Business process reengineering typically takes longer to implement than customizations in order to satisfy fit-gaps.	3.73	1.04	4.13	3.33
8. It is easier to customize to fix a functionality gap than conduct business process reengineering.	3.36	0.81	3.50	3.00
9. Customizations have a greater long-term cost than business process reengineering.	4.27	0.47	4.25	4.33
10. Strong top management support increases business process reengineering.	4.27	0.65	4.38	4.00
11. Business process reengineering leads to improved functional productivity.	3.64	0.67	3.38	4.33

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Appendix C. Variable and Relationship Additions to the Model

Variables Added	Relationships Added
• System exposure • Time available to reevaluate customizations • Time available to conduct business process reengineering • Likelihood that customizations will be reevaluated • Interdepartmental Communication	• "System exposure" → (+) "Willingness to explore business process reengineering" • "System exposure" → (+) "Likelihood that customizations will be reevaluated" • System exposure" → (+) "Functional understanding of ERP functionality" • "Time available to reevaluate customizations" → (+) "Likelihood that customizations will be reevaluated" • "Time available to conduct business process reengineering" → (+) "Cumulative business process reengineering" • "Likelihood that customizations will be reevaluated" → (-) "Cumulative customizations" • "Interdepartmental collaboration" → (-) "Pressure to customize" • "Interdepartmental collaboration" → (+) "Likelihood that customizations will be reevaluated" • "Interdepartmental collaboration" → (+) "Cumulative business process reengineering"

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