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Improving success with information technology using an organizational epistemology

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Abstract

There may be a disconnect between technology as-created and as-used that could lie at the foundation of frequent failure in cost, schedule, and/or performance of Information Technology/Information Systems (IT/IS). This can perhaps be reconciled through a focus on the socially constructed and emergent nature of IT as it enters and is used by an organization. A structured and facilitated dialog technique, by focusing on properly perceiving human felt needs in addition to technological aims, may improve the process of technology realization. This paper starts with an analysis of IT/IS failure factors using case studies. Then, a theoretical framework is derived to attempt to address the systemic failure factors. This is then made practical by creating a conceptual decision framework for management to use in framing complex investment decisions including IT/IS. The framework elements achieve an organizational epistemology, or knowledge framework, that can potentially facilitate more accurate acquisition and development of the system-as-created, and perhaps lay the foundation for subsequent transition into a system-as-used that an organization can use in the manner needed and intended. In addition, this epistemology may underlie the process and products of successful IT/IS architecture.

Keywords: Information systems, knowledge representation, management decision-making, organizational epistemology.

Introduction

Evaluation and justification of Information Technology (IT) are both complex and difficult (Mondragon, Sarbadi, & Millar, 2001; Serafeimidis, 2001; Wang, 2007), particularly given the high rate of implementation failure in IT projects (upwards of 40-95%, depending on methodology and definition of failure (Amid, Moalagh, & Zare Ravasan, 2012; Charette, 2005; Dalcher & Drevin; Ewusi-Mensah, 2003; DeSarbo, Di Benedetto, Song, & Sinha, 2005; Flowers, 1996; Jones, 1996; Kanfar, 2018; Miles & Snow, 1978; Reel, 1999; Rodriguez, Ortega, & Concepcion, 2016; Schwarz & Trigeorgis, 2004; Verner, Evanco, & Cerpa, 2007; Whiting, 1998; Yaghoobi, 2018). The financial measures typically used by firms to evaluate any project (such as Return on Investment (ROI), Net Present Value (NPV), Internal Rate of Return (IRR), etc.), when applied to technology projects, attempt to be quantitative, precise, and certain. However, as an innovation project applied to a social group (i.e. an organization), an IT project might have benefits that are frequently intangible and uncertain (Lefley, 1996). This clash between the need for discrete performance measurement and the intangibility or the outcomes of innovation in social groups caused a long period of research (from about 1976 through 2001) that attempted to bring these financial and intangible poles together. Many techniques were brought to the table,

but few could be empirically tested because of many factors including political, cultural, and accounting tradition. The need for insightful evaluation has, if anything, become greater as IT becomes more complex and touches more parts of an organization's value proposition, foundation, and partners. This particularly was leading to the "death of geography", as the enterprise model becomes extended, strategic alliances become more important, and the organization begins its shift to more of a "virtual" model (Irani, Ezingeard, & Grieve, 1997). So, there is a need for a new look and new tools to be applied to this area, to arrive at something practical for management to apply and for technologists to support. A key part of this problem is defined as a lack of balance between *episteme* (knowledge or science, of the organization and of IT) and *techne* (craft or art, of implementing IT & other business/mission systems) in the organization—based on a lack of shared meaning and a lack of a basis for that shared meaning—which reinforces the existence of only tangential touch points between these frequently opposing forces as well as which concomitantly and continually reduces IT project success. An enterprise-wide approach that enables IT to take a strategic view of the organization is required (Amid et al., 2012; Irani et al., 1997; Kanfar, 2018; Rodriguez et al., 2016; Yaghoobi, 2018;).

It is known from management literature, particularly Simon (1997), and related work, such as Dörner (1996), Farbey, Land, and Targett (1992), as well as Horkheimer (1954), that humans, making microeconomic and many other decisions, are subject to own bounded rationality. As a result, people satisfice decisions; using information they believe is salient to the decision, almost regardless of whether that information is microeconomically optimal. This is particularly applicable in executive decision-making and in decision-making related to IT, which Farbey et al. (1992) found is subject to four main heuristics: act of faith, obeying orders, step-by-step, and got-to-do. Many IT evaluation and justification methods attempt to get around human satisficing through many objective and subjective decision methods, including financial (objective) and heuristic (subjective) methods, among others. In executive teams, financial metrics have particular weight, and so people may expect to find that the heuristic methods at that level may favor financial metrics. In fact, Farbey et al. (1992) and then later Maqsood, Finegan, and Walker (2004), Callahan (2010), Schumacher (2013), as well as Mollanen (2015), found that while executives seem to favor such metrics, it does not mean that they are truly making their decisions based on the objective financial analysis at hand.

This brings a question about whether management information used in satisficing decisions can be "set" to some degree, submerging less relevant information and maximizing the prominence of information with the most utility to the decision at hand. It could be said that many aids to management decision-making attempt to do just that, as they ply management with report after report that contain much interesting and relevant information. Yet, it is known that many decisions fail to attain their objectives, particularly in IT, where project failure can occur as high as 40-95%, depending on the definition of failure (Dalcher & Drevin, 2003). The types of dysfunctional executive behavior that drive this failure include acting without prior analysis of the situation as well as failing to anticipate side effects and long-term repercussions, among others (Dörner, 1996). So, the present supply of reports to management does not appear to be working very well. It is also known from knowledge research (e.g. Nonaka, 2005) that it is important for successful decision-making that the involved people focus on information and knowledge most relevant to the decision. The difficulty is that much of this information,

contained in documents, reports, presentations, charts, and spreadsheets, is explicit in nature, yet upwards of 90% of knowledge used in decision-making is actually tacit (Nonaka, 2005). This makes the "deck-loading" quite difficult, because it is difficult to perceive and set (or reset) tacit knowledge. Now there is the subtle, but difficult, factor in the overall problem—decision-making requires focus on the right information, but this right information is difficult to set and access.

This difficulty can be overcome, however. It turns out that Nonaka (2005) and others have found that the difficulty of working with tacit knowledge is because humans typically go about it wrong—they attempt to work with tacit knowledge the way they work with explicit knowledge. Training is an example of setting and working with explicit knowledge—a syllabus is put down in front of a student, reading and exercises take place, and, at the end, a test is given. There are mnemonics and heuristics for remembering information, so the moderately educable can succeed. Decision-making does not seem to work this way—it seems to be only moderately teachable and much more subject to an apprentice-style effect, requiring time and experience to get right. This time and experience is the process of encoding explicit information over time and making it part of the individual's tacit knowledge (Nonaka, 2005). This tacit knowledge and experience then becomes part of the executive's satisficing "gut," and that 90% of decision-making that is not subject to seemingly objective information (Farbey et al., 1992). In a similar vein, Kahneman (2011), shows that humans have a number of cognitive and heuristic biases associated with both "System 1" (fast, instinctive, emotional) thinking, and "System 2" (slower, deliberative, logical) thinking. These biases include anchoring, availability (of examples), substitution (of simpler for more difficult questions), optimism/loss aversion (have an illusion of control), and sunk cost (throwing good money after bad). Use of these biases can lead to overconfidence (in the executive, in ourselves).

Now there is a key part of the prospect of "setting" satisficed knowledge and the gap in current IT evaluation and justification methods—the knowledge involved must be tacit. As already known, dealing with tacit knowledge is not easy, but there are tools from the social sciences and philosophy that help explore human behavior and knowledge in seemingly tacit ways, including hermeneutic study, epistemology, and phenomenology. These methods can work because they explore the entire context of the situation and thereby access the tacit knowledge used in the given situation. Many research methods involve positivist approaches that many (e.g. Patton, 2002) have demonstrated do not fit well with humans. Yet, Orlikowski and Baroudi (1991) have shown that almost all IT research has been done using positivist methods. What might happen if IT decision-making is explored using non-positivist methods? Perhaps a more human-friendly evaluation, one that builds a knowledge framework relevant to the human decision-makers involved, will work better. Such knowledge frameworks are philosophically called an *epistemology*—the structure of how knowledge is acquired and used by one or more humans. It turns out that human (individual) epistemologies are analogous to organizational (social) epistemologies and can improve or degrade as a function of the quality of knowledge and the quality of the methods at hand to use the knowledge. This social sense of knowledge comes from the tension between the Greek *techne* and *episteme*, or analytic (breaking down) and synthetic (building up, synthesizing) – a combination of cognitivist, connectionist, and autopoetic perspectives or dimensions (Russ, Fineman, & Jones, 2010), which transform from data to information (data in context, with meaning) and to knowledge (actionable information) in

individual as well as social senses. Linguistically, language and the knowledge expressed with it seem to range beyond one person's 'knowing' to a concept, which only possesses meaning (& therefore, usefulness) as a function of the social setting – of that person, thought, and knowledge. This is critical, because scholars typically study knowledge in an individual setting (because it is admittedly hard enough at that level), but knowledge itself may possibly be social in nature.

There are several parts to an epistemology, including a *taxonomy* (terms & their meaning), an *ontology* (the nature of "being" in that organization & around it), and an *axiology* (the values, cultures, beliefs used in, & by, that organization) (e.g., Aaby, 2004). "Filling" an organizational epistemology with useful knowledge perhaps helps that organization work well; ensuring there is alignment between one organization's epistemology and those of its partners might ensure better collaboration among them, perhaps by preventing problems in knowledge transfer and use, such as miscommunication, differences in interpretation of meaning, as well as the recrimination behind bad decision-making and its consequences.

A consequence of this human orientation to the research is that there can be a difference in the perception of benefits received by a given investment in different communities of interest and practice. Typically, individuals might believe that something like IT bought from a vendor will deliver something at least near to what is specified by the vendor; if a new system can process 1000 transactions in an hour, they probably believe it should do better than 500 such transactions in an hour, but maybe not as high as 2000 per hour. In fact, the metric of transactions per hour is a very analytic and objective factor for success of that system, and those types of objective factors are only one element of how the system is received. Orlikowski (2000) found that IT systems are socially-constructed and emergent, meaning that what the IT system is used for by those in the organization using it may (or may not) be seen as what the vendor (& those in the organization purchasing the system) intended. There can in fact be a significant gap between the system as created (defined in this research as IT) and the system as used (defined in this research as information system (IS)). It should be the case that the larger that gap is, the more such systems may fail, and, similarly, the smaller the gap, the higher the likelihood of success. If the system as-used resembles what people think it should do, it probably will be a better overall fit. However, if the system as-used ends up diverging substantially from what the vendor thinks it sold and the organization thinks it bought, this is not likely to make the organization function better. This research attempts to show that reconciling this gap may help.

This research explores the domain of large investment decision-making (particularly IT evaluation & justification) using relevant social science methods. This research attempts to create an IT evaluation and justification method, which attempts to 'set' satisficed and tacit knowledge in an organizational epistemology that can potentially succeed more reliably, efficiently, and effectively than previous IT decision-making methods, thus, reconciling the gap between IT (system as-created) and IS (system as-used). The IT decision-making domain explored is in large systems contracts with significant IT components. However, the applicability of this research is possibly well outside this domain, because the difference between IT procurements and different investments is perhaps only a difference in epistemologies—different assumptions and constraints contained within the knowledge framework. The humans in those organizations still work in analogous ways, and so the principles explored in the research may

still be theoretically applicable to other types of complex investment. The implication is that early investment lifecycle activities performed in a way that reflects a proper organizational epistemology may build success somewhat regardless of the organization type. Such early investment lifecycle activities include concept definition, planning, budgeting, architecture, early design, and early prototyping, which are applicable to any investment. For example, it can be applied to a business architecture – a set of aspects of the business and their relationships – constitutes a business plan.

The next section presents the Research Framework including purpose, research questions, and focus. After that is the Research Methodology, including discussion of the meta evaluation and meta interpretation. The Theoretical Framework is then discussed. The Summary of the research activity is then given, followed by presentation of the Conceptual Decision Framework and a discussion of potential future work.

Research Framework

Purpose

The purpose of this research was to determine and study a knowledge framework for potentially improving IT/IS investment efficiency as well as effectiveness to enable greater congruity between business mission and the IT/IS investment, while allowing for more consistent business results. Beyond consistency in results, this purpose also includes setting the stage for an increase in maturity of this investment, to achieve better, more consistent business results with the given IT/IS investment, and to use more sophisticated IT/IS to achieve more sophisticated business/ mission processes. From a review of the literature, it is apparent that a focus on an organizational knowledge framework or epistemology, including taxonomy, ontology, and axiology, can address the key issues discussed earlier.

Based on the organizational epistemology, a more rigorous balance between episteme and techne can perhaps enable IT project success, as contrasted with the typical organizational focus on techne alone. It is also important that any recommended methods or tools be able to "hide" the details of the above concepts, to avoid confusing the organizational elements (on both the business/mission process side & on the technology side). Anecdotally, it would be difficult to consult directly for an organization using the concepts of organizational epistemology. These concepts describe aspects of knowledge creation and use, which are basically submerged in the human psyche and consciousness—people are (usually) not directly aware of how they systematically analyze and synthesize knowledge – they just do it. Thus, it will perhaps be important to explore these concepts more indirectly or implicitly, rather than directly. The argument is that such shared meaning can be achieved using an evaluation approach based on factors such as tacit knowledge, to balance the complexity of the financial and technological environment of the project with the need to achieve IT success in a user base that may not appreciate this complexity. The fundamental hypothesis is that an approach based on a structured, facilitated dialog technique can potentially improve the process of IT project evaluation and justification.

A case study approach applied to organizations identified the key aspects of the value chain relevant to IT decision-making. The theoretical framework results from this identification of systemic failure factors. A conceptual decision framework was then created to enable management to potentially make complex investment decisions, such as in the acquisition and use of IT, with more success. This methodology will be further introduced and explained in the Methodology section.

The benefits to the organization should include:

- A new technique for evaluating and justifying IT projects. These projects comprise an increasing percentage of organizational resources (ranging from 3-4% of total firm capital expense in 1990, to upwards of 50% (Lefley, 1996)) and, thus, require closer and more substantive looks.
- Setting the stage for more even performance of IT projects, as the potentially stronger decisions reached with the technique may enable better project governance and an increasing likelihood of success.
- The pursuit of more sophisticated IT projects in faster implementation cycles, potentially increasing the maturity of the organization and its ability to accelerate its business/ mission process using IT.

Research Questions

RQ1. What are the foundations of IT/IS failure, and how do they relate to the absence or presence of structured dialog?

RQ2. Based on those foundations, what are the dimensions of structured dialog that help fill the gap between users' felt needs and IT specifications, to produce an environment for better collaboration?

RQ3. What are the aspects of tools and methods applied at early lifecycle activities that can, or seem to, fulfill these dimensions?

The thesis behind these questions is as follows: organizations find IT justification and evaluation difficult. New techniques will have to leverage shared meaning to implicitly handle the complexity of relevant decision factors (including tangible/quantifiable & intangible/qualitative) without bogging down the decision process.

Research Focus

The focus of this research is based on Habermas's Theory of Cognitive Interest and Theory of Communicative Action (Habermas, 1967; 1973; 1975; 1979), which essentially drive a Critical Social Theory (CST) (Huynh & Klein, 2004). According to Habermas, there are two fundamental tasks in such a CST:

1. Narrative reconstruction – a systematically generalized history to record the conditions and causes of the "as-is" situation (a situation which requires emancipation to some degree) (Huynh & Klein, 2004, p. 170)
2. Influencing the formative process of society (Habermas, 1967, pp.viii-ix) – in this case, the society is the organization. This is to achieve a "to-be" situation different

> from the "as-is." An emancipation is sought from the conditions in the "as-is." This requires a synthesis of natural (IT) and social science (IS) aspects normally missing in research of IT in organizations.

This theory posits a tension between the as-is and to-be concepts. The reason an organization is pursuing change is due to the recognition of a need to change, perhaps due to some problem or perception of an issue. Such an issue may or may not be "real" (perhaps as adjudicated by an independent [or quasi-independent] third party, such as a corporate board or advisor), but it only need be real enough to satisfy the epistemological processes in the organization-society. The thought-equation is basically:

> *As-is situation* AND *some problem*
>
> INSPIRES *a perceived need for change*
>
> TO *a to-be state*

Thus, the to-be state is set up to emancipate the organization-society from the conditions in the perceived problem (incident to, or part of, the as-is state). The inspiration process and the perceived need define the essence of a *felt need*—something that the individual (e.g., an executive) is tacitly aware of. At this stage, there may be an inability to clearly articulate that felt need (which may also cause its own frustration) and convert it to a *stated need* (expressed as explicit knowledge that others in the organization can use). At the point of a stated need, the requirement for the to-be state is still missing. Such a requirement must be manifested by interpreting the stated need (a step typically performed by business or systems analysts). The manifested requirement is then operated on by the people creating the to-be state, hopefully satisfying the chain of needs and requirements back to the original as-is state and the perceived problems with it. One particular confounding issue with this process occurs if the problem in this thought equation is not independently real, or if its causal factors are incorrectly identified. An example of the latter would be an executive who identifies a problem in the organization as being due to incorrect technology in the organization when the problem might really be with the configuration and management of the team. Application of technology to solve this problem might only exacerbate the team management problem; if it does help the team, it maybe only due to a Hawthorne effect rather than the application of technology itself (that is, the organization improves as a function of executive attention to it, rather than new machinery *per se*).

In the context of this study, IT was applied to the situation to create this movement to a to-be. It is, therefore, imperative that good understanding be achieved of every part of the thought-equation before such movement. Errant movement, incorrect articulation of the to-be state, unsatisfactory awareness of the as-is conditions and problems, incomplete conversion of felt needs to stated needs and on to requirements, and inadequate leadership across this process can all produce conditions which take the organization-society away from the expressed benefits of the to-be state, perhaps exacerbating the original conditions. Such negative results usually produce cognitive dissonance, which has its own exacerbating effect, as leadership attempts to explain and rationalize the lack of success. Thus, the real need for emancipation to prevent cyclically reinforcing conditions in a downward spiral.

Tightly intertwined with this is the need to ensure that usable truth-seeking and claims-justification behaviors are applied in order to minimize the potential for cognitive dissonance and confounding factors. The techniques used posit a structured dialog technique to ensure precise and accurate recording of the knowledge used to inspire and to create movement towards the to-be. It is not within the scope of this study to ensure the reality or truth of those claims beyond the focus of the organization (that is, as independently true by some external agent). The scope of this study is oriented to the epistemology of the organization-society as defined by its own taxonomy, ontology, and axiology. It is assumed that there is sufficient alignment between those factors and external ground truth so that the movement to the to-be will be beneficial. Where such alignment is not in place, the conditions would be treated as pathological and not within the scope of the study.

This study proposed to form the organizational epistemology to ensure more rational movement from the as-is to the to-be. The precision and accuracy of the recording is important, not the verifiable truth of it. The principle proposed is that the lack of alignment (inaccuracy & imprecision of recording) produces problems, subsequently producing efforts inconsistent with where the organization desires to go. Precision and accuracy of recording, combined with sufficient (but not complete) alignment to some externally verifiable concept of "real" truth, would be potentially beneficial. Philosophically, the "sufficient alignment" truth condition is already foundational for business success, as empirically verifiable alignment in inter-organizational truth is not mandate in order for business to be transacted. Contractual law only stipulates such conditions to the extent that a reasonable person would agree, subject only to adversarial argument rather than empirical truth. This is exactly the level of constraint that is at the foundation of this principle within this study.

This research sought to understand the instrumental nature of IT, balanced with building communicative interest and rationalizing practical knowledge. In an organization, this will function to achieve mutual understanding and ultimately emancipatory interest with a dialog or discourse for the purpose of truth-seeking and claims-justifying across the requirements team. In Husserl's terms, the ongoing "always already" directed experience (*noesis*) of the world as meaningful has as a necessary condition an ongoing structural correlation or unity (*noema*) (Introna & Ilharco, 2004). When the intentionality of consciousness is map (in the form of requirements to help convert the as-is to the to-be), it is important to judge whether it is rational and meaningful or random and confused. This research will help organizations reconcile this by achieving a necessary noematic structural unity of intentional consciousness concerning IT and its development as IS. That structural unity can then drive emancipation from the "as-is" conditions. This requires, for the sense of Heidegger's *Dasein* (Heidegger, 1982), a "being in their world" ("their" meaning the organization) to drive out shared meaning, and leverage of that shared meaning, towards a rational end (i.e., a useful IS). Separately, this tension between "as-is" and "to-be" also underlies the field of Enterprise (IT) Architecture, which has pursued the theoretical goals outlined here in a somewhat different fashion (e.g., through qualities, aspects, & attributes, which could be considered meta-information to the organization and project at hand: useful, but insufficient). Some of the difficulties that occur in the Enterprise Architecture domain (such as getting organizations to use it) might, therefore, be a function of a lack of suitable structured dialog, as well.

Methodology

This research proposed, in the interpretivist tradition, to explore the interchange between the more positivist IT knowledge domain and the more phenomenological organizational domain by attempting to bridge them in a way that increases potential success with IT in organizations, probably extending, in the spirit of CST, to direct participation in improving success. The operative area for exploration was in IT evaluation and justification, particularly in the development of IT requirements, and the technique explored the use of structured dialog to achieve a better, common, more human understanding of IT as an enabler of stronger success. The purpose of this research was to determine and empirically study a knowledge framework for potentially improving IT/IS investment efficiency and effectiveness to enable greater congruity between business mission and the IT/IS investment, allowing for more consistent business results. Evidence suggests that the use of this framework should create a stronger, shared understanding of the purpose and context of IT in the organization, therefore enabling more consistent success. IT failures are significantly a function of the organization, not necessarily the technology. Reconciling this issue would resolve a huge sink of financial and human capital. The structured dialog technique presented should help lead to more consistent success with IT.

This research included a case study metaevaluation/metainterpretation with failure factor analysis, leading to a theoretical framework for addressing these systemic failure factors. The outcome of this work then resulted in the creation of a conceptual decision framework for strategic decision making in complex areas like technology investment. The meta evaluation of IT failure factors is based on case studies, particularly focused on cases documented in (Ewusi-Mensah, 2003; Flowers, 1996; Jones, 1996). The trends and patterns in these factors were studied to determine potential causal links and correlations and their relationship to the presence or absence of structured dialog. The next task was to analyze the problem statements and relationships as systemic failure factors—what were the root causes of these systemic failures, and what could potentially prevent them? This was done by extending the meta evaluation by documenting and analyzing the failure factors in relation to one another. A key factor of the case study approach used in this study is that it is essentially a metaevaluation of multiple cases. This is a holistic, multiple-case approach (Yin, 2003), performing a research synthesis based on interpretation. Metaevaluation is typically focused on reductive averaging of statistical means—a so-called "mean of means of means" (Wood, 2000, p. 414). If any qualitative data are involved (such as interpretation of case studies), however, then statistical reduction can eliminate the insight from that interpretation (Weed, 2005). The key is to create a *triple hermeneutic* that results in an *interpretation of interpretations of interpretations*, thus maintaining the richness of the qualitative data (Weed, 2005). The key is maintaining the meaning of context across the analyzed studies, leaving an audit trail that enables rigor on the one hand and downstream analysis by other researchers on the other. Thus, the criteria for metainterpretation need to be clearly stated and applied to the iterative analysis of case studies.

Meta Evaluation/Meta Interpretation Criteria

The criteria included the following:

1. Why was this finding noted? What were the related circumstances? What is the context of the situation? This was determined from the case study finding in the literature itself.
2. What were the noted root causes at the time of the finding? Why? Again, this was determined from the case study finding in the literature.
3. What root causes were dismissed? Why? In some cases, this was directly stated in the case study finding. In others, this could only be determined indirectly.
4. What relationships among problem statements were considered at the time of the finding? What hierarchy or causal network was considered and recorded, if any? Why or why not? This was normally included indirectly as a discussion of the given case study. Synthesis into causal networks or other analytic framework could usually only be done as a function of how the discussion was provided or laid out in the case study finding.
5. What were experiences of similar programs in comparable circumstances? Were they successful or problematic? The failure factors were organized into tables and compared in order to determine this.
6. What better, and best, practices could have been leveraged to help this program prevent some of the problems that occurred? In some case study findings, root cause analysis progressed to recommendations and other resolutions, and this was stated in the finding. In other cases, this could only be explored through analysis.
7. And, most importantly, does the failure factor involved have a direct relationship to communication and dialog, an indirect relationship, or none at all? An indirect relationship would be one where communication and dialog relate somewhat to the factor, but that factor has other more primary causes.

In each presentation of the failure factors, communication/dialog is directly related (meaning the failure factor involved is primarily related to communication & dialog), indirectly related (meaning secondarily, but significantly, related to communication & dialog), or not at all (for example, an external environmental factor not under the control of the team). The determination of that relationship was a function of the discussion in the literature as well as a synthesis by the researcher. If the discussion related primarily to discussion of proxies for dialog and communication, then the failure factor was marked as directly related to dialog/communication. If the discussion related more primarily to another factor (such as unavailability of budget) but also had aspects of dialog/communication (such as the budget expectations or assumptions not being set correctly in early team meetings), then the given failure factor was marked as indirectly related to dialog/communication. If the discussion related to a distinctly non-communication-related factor (such as a business emergency, like fire or other disaster), then the given failure factor was marked as not at all related to dialog.

This research step resulted in the answer to RQ1. We then had a good epistemological foundation to build and apply the theoretical framework in Phase II. In Phase II, a theoretical framework was created to probe the relationship between early lifecycle activities and structured dialog elements found to be important in Phase I. This was based on a survey developed to take the context from Phase I and attempt to explore it in detail with respect to IT implementations. The survey was created, pre-piloted, and piloted to probe the relationship between early lifecycle activities and structured dialog elements found to be important in Phase I. Early lifecycle activities were explored with respect to tools that are brought to bear in these activities,

specifically including Business Process Analysis (BPA) tools. The survey was pre-piloted among a group of experienced BPA academics and professionals in order to ensure that it was a valid and usable instrument. The survey was then distributed electronically to systems professionals in a large world-wide professional society who have applied BPA methods and tools in early lifecycle activities, both formally and informally. The survey instrument, data, and cross-tabs run in analysis are available from the author, as they would not fit within the limitations of this paper.

Research Summary

The structured dialog tools and techniques surveyed in this research demonstrated that targeted work at ensuring common understanding in some basic attributes of the project has direct payoff—requirements are more clearly specified, more clearly understood, and, therefore, have a improved likelihood of leading to project success. Since few requirements development techniques have these payoffs, and many IT projects ultimately fail, these benefits, if systemically realized, would have a very significant impact. For IT decision-making and management, there are many factors that account for success or can be attributed to be in some relationship to success. Picturing these factors and relationships can be done in many ways, but one example is shown in **Figure 1.** Concept Map of IT Success Factors. This concept map attempts to organize the associations and/or causal relationships among various factors of IT success or failure. It is based on the work done in this research. The foundation of this research in organizational epistemology is shown near the top of the chart, which shows the relationship among knowledge-based factors such as taxonomy, ontology, and axiology and their relationship to the foundation of architecture, all based on structured communication. Extending this work into impacts on other significant factors related to IT success, such as risk management, program governance, and even technology selections, would be interesting and significant, and also relates to the objective factors such as financial success, shown below in red.

The critical aspect in the center of the chart below is Complexity. It seems a significant number of failures in IT implementations can be traced back to a lack of reconciliation of complexity. In this case, that complexity does not mean technological complexity (although that can be a downstream consideration). This chiefly relates to the complex factors in the mission/business conditions, including recognizing complexity and then being able to 'deal with it'. Considering the difficulty involved in rationalizing complexity, this is probably not too hard to understand. However, what is needed are tools which do in fact help identify and rationalize complexity, whether directly or indirectly. A significant component in complexity is related to the interactions among the members of the social group in that organization—people have different ways of structuring and using knowledge, which influences how the organization itself structures and uses knowledge. Other factors in this chart seem to help mitigate complexity, including improved recognition and management of risk, enhanced enterprise governance (which then influences governance down to lower levels), and how an organization manages strategic change. Strategic change is particularly important to rationalize because such change may not always be due to organizational choice, but may be imposed from competition, technology use, and market systemic factors. Miles and Snow (1978), as well as DeSarbo et al. (2005) also found that

organizations are enabled for certain strategic choices as a function of the factors related to their previous choices and the conditions that they face. In reality, these strategic choice frameworks are certainly built upon how the organization structures and uses knowledge, meaning that an organizational epistemology would not only help with current conditions but would help perhaps change the strategic choice framework itself if needed, or at least help the organizations plan for the future.

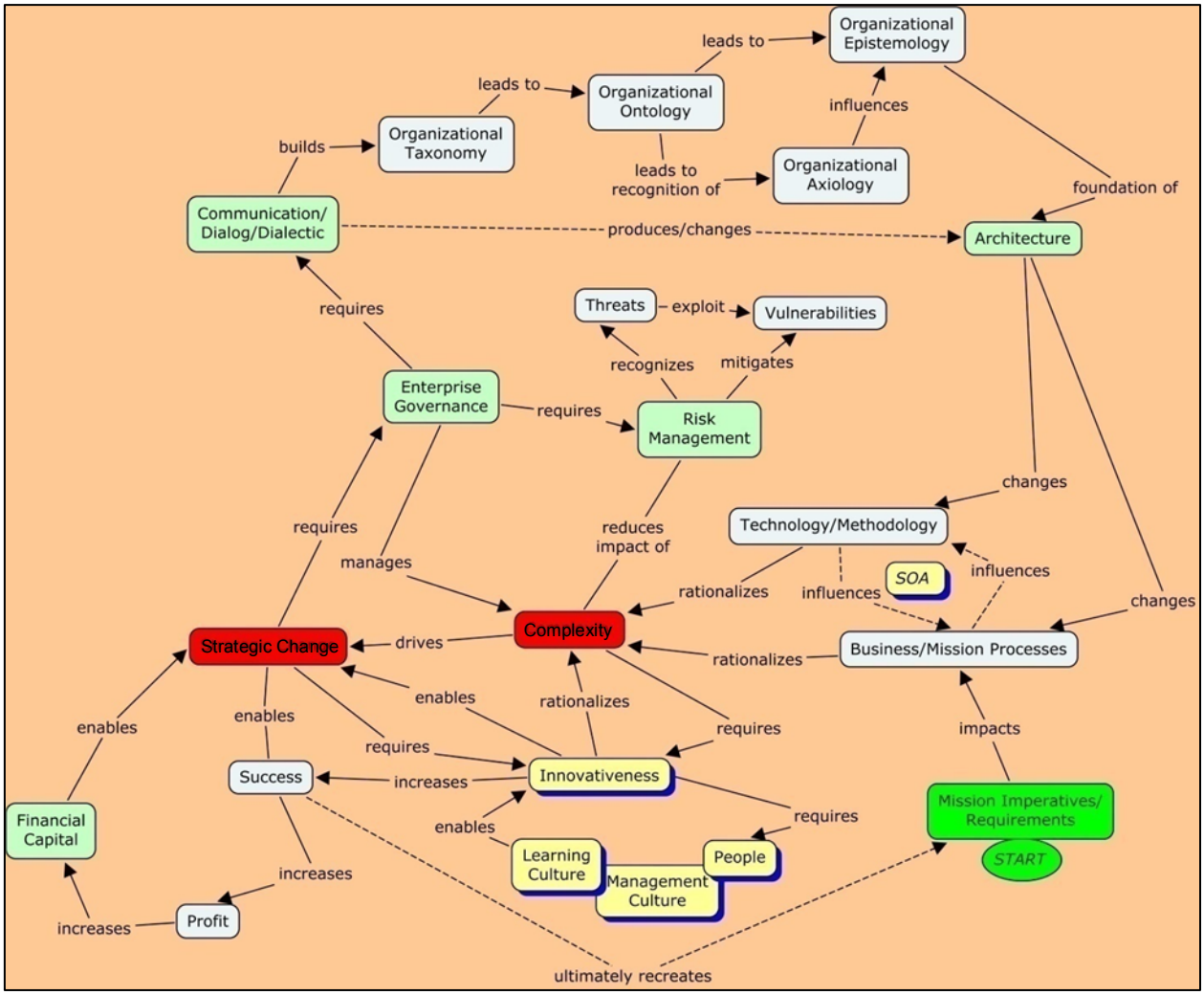


Figure 1. Concept Map of IT Success Factors

Summary of Research Data and Activity

This research activities in Phases I and II, conducted in 2010, demonstrated that there were systemic failure factors which afflict many very large IT investment projects. These data were gathered from a variety of commercial organizations, which participated in complex innovation. This included innovation directly related to their business (such as production of complex technology), and innovation related to the provision and use of IT (such as the implementation of an Enterprise Resource Planning (ERP) system). This research was conducted through case

studies, interviews, and a survey, of individuals that were involved in the production as well as use of technology (such as engineers or software programmers), or were affected by it (e.g., financial & accounting functions affected by the implementation of an ERP system).

Summary of Phase I - Metainterpretation

Data from three literature sources were presented in a metaevaluation and metainterpretation form, related to the effects of communication and dialog on IT failure factors as interpretive aspects of qualitative criteria. It turns out that most IT failure factors are directly or indirectly related to whether, how, and how often communication and dialog occur in the team, including the development of shared understanding. This shared understanding must be developed using insightful and structured dialog and communication that occurs frequently and intuitively. The answer to the first research question is, therefore, quite comprehensive and has started to receive an answer in this data. In every failure factor area where communication and dialog are directly or indirectly related, focus on structure, type, and frequency of communication will result in positive impacts. These include socio-organizational, sociotechnical, and economic impacts, meaning impacts on team behavior and function, the structure of people and technology surrounding the organization working on a given IT program, and more accurate identification of resource requirements manifested as cost and schedule. All of these factors build towards the performance of the system.

Answer to RQ1 – Core Technology Issues and Factors - There are many aspects and attributes of IT failure, which have been analyzed from many dimensions and angles, including sociotechnical, socio-organizational, technical, and economic, among others. There are some core root causes related to the presence or absence of structured dialog, which led directly to the types of questions asked in the survey instrument used in the research:

- What are the parts of the organization involved with the decision, and do they have the necessary competencies in order to make the decision? Basically, most if not all of the parts of the organization are required, acting in concert and facilitated by a champion. Competency can be a function of a representative team (from across the organization).
- Is championship/sponsorship practiced (including executive, management, & technical)? If not, these projects can fail. Championship is significantly correlated with success.
- Team experience plays a significant role—in other words, the process and practice of how the decision is made and implemented, and the social experiences that occur during this timeframe. Are people alienated or incorporated? Do they feel as if they are being listened to, or dictated to? While this was not surveyed directly, it is apparent that a coherent team approach can work, ensuring that all team members feel valued and can contribute to the team's work.
- The time it takes to make a decision is important. There is no set time to make a decision, but the team will know if it is taking too long (showing evidence of an overly deliberative process, or perhaps a decision that was never meant to be made) or has occurred in too short a time (perhaps indicating a "wired" or pre-made decision that they will have no real part in making or changing).

- Team perceptions and perspective are important. If there is a significant gap between what the team believes is happening, and what others (like management) might believe is happening, this can substantially disrupt team performance.
- The processes used in decision-making are important. Are they clearly stated and used, or are there "implicit" or hidden processes, which really determine the final answer? The team needs to know that its work counts. If the team's work will be undone by these hidden methods or agendas, future team participation will suffer, rippling through the organization (for example, increasing resistance to the decisions made).
- Whether the decision ultimately addresses the user community's felt needs—their tacit understanding of what is really needed, regardless of what might have written down and/or discussed about it. This is the gap between "do what I mean" instead of "but I did what you said."

There are certainly many additional issues (such as sufficient budget or technical issues such as the availability of technology to fulfill a given need), but the foundation for success is set based on these dialog-oriented root causes. In other words, a technical or budget issue will not alone determine success (although it can determine failure), whereas a dialog-oriented set of factors can prevent a project, that could otherwise be successful based on its technical or economic factors, from being successful. Dialog is a founding or a confounding factor for project success—if it is present, then success can occur. If it is not present, it is highly unlikely for a project to succeed. Thus, the survey was targeted at determining the aspects of dialog that could enable success, and how BPA tools specifically facilitated this.

Summary of Phase II – Theoretical Framework

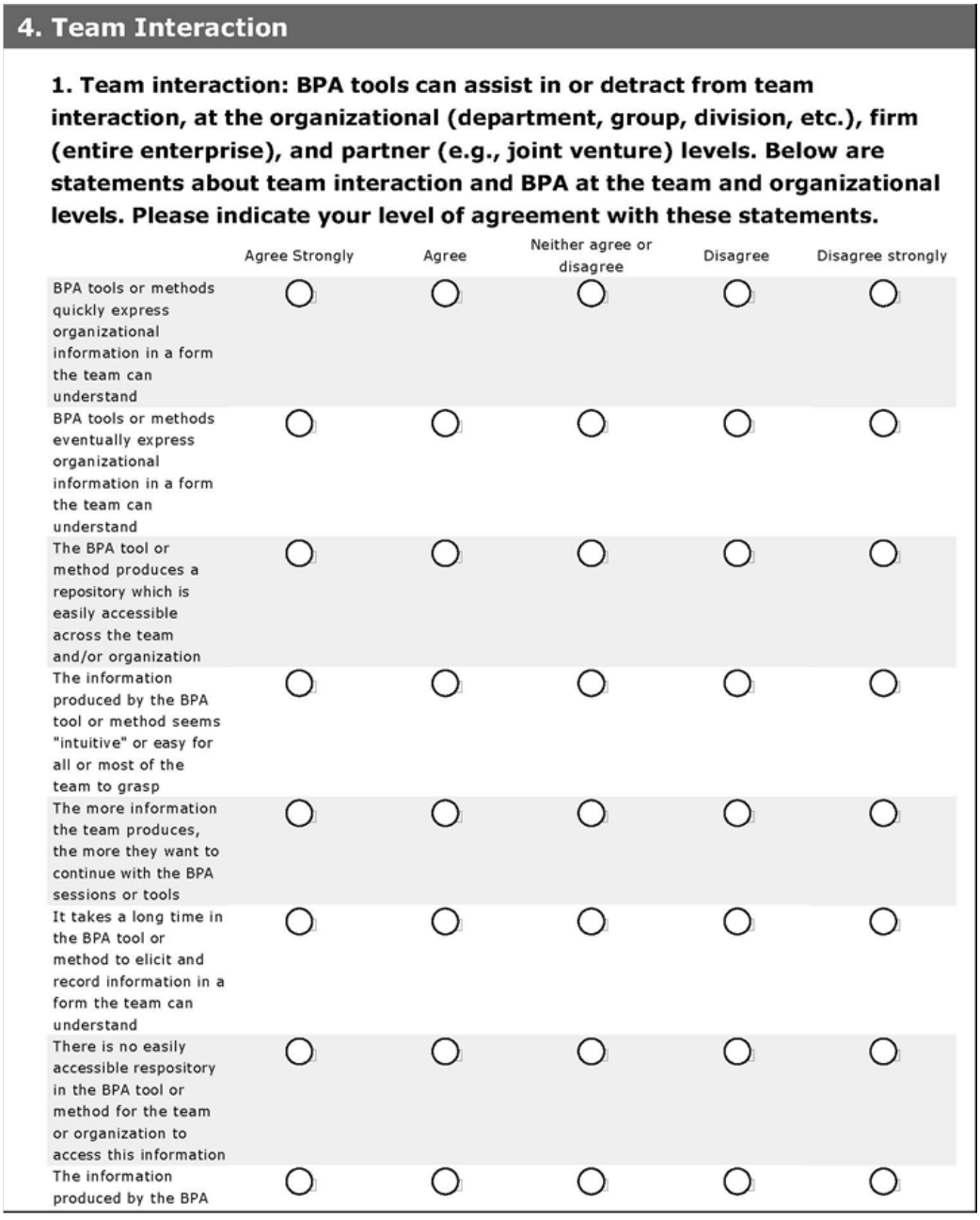
The case study meta evaluation performed in Phase I prepared the list of IT failure concepts, attributes, dimensions, and aspects that needed to be probed in Phase II, as related to structured dialog. A survey instrument is now needed to be crafted to probe these areas with respect to people operating in a business environment over a specific business decision, in order to see how these concepts faired—did structured dialog attributes help or not help the process of early lifecycle activities needed in complex investments such as IT? A survey was conducted among users and IT providers who have applied tools and methods that assist with structured dialog in early IT project lifecycle activities. The survey asked for the respondents' agreement or disagreement with many statements in order to elicit the respondents' impressions of how those early lifecycle activities went and what factors seem to be responsible for that (see Figure 2). Those factors were the dimensions of structured dialog that assist in filling the knowledge gap between users and providers, thus, answering RQ2.

2. Please indicate your impression about the degree of support your business process analysis method or tool provides in each of these areas. Your impression may be based on anything from entirely subjective feelings to some level of measured evidence.

	Extensive or Complete	Moderate	Some but with shortcomings	Little or none
Team collaboration	◯	◯	◯	◯
Holistic process or enterprise view	◯	◯	◯	◯
Business strategy	◯	◯	◯	◯
Technical strategy	◯	◯	◯	◯
Risk & Compliance	◯	◯	◯	◯
Business process design	◯	◯	◯	◯
Business process implementation	◯	◯	◯	◯
Business process control	◯	◯	◯	◯
Business process modeling and simulation	◯	◯	◯	◯
Business process modeling standards or languages (e.g., BPMN, BPEL, UML)	◯	◯	◯	◯
Support for OASIS SOA (Service Oriented Architecture) Reference Model	◯	◯	◯	◯
Support for Architecture Frameworks (e.g., Zachmann, DoDAF, TOGAF)	◯	◯	◯	◯
Support for Lean/Six Sigma, ISO 9000, or other quality or performance initiatives	◯	◯	◯	◯
Support for enterprise or application data modeling	◯	◯	◯	◯
Business process performance and/or evaluation	◯	◯	◯	◯
Change and configuration management	◯	◯	◯	◯
Integration with systems development function or team	◯	◯	◯	◯
Dashboard available for performance	◯	◯	◯	◯

Figure 2. Survey Instrument Assessment Example

Also, in the survey were questions that connected these dimensions to the aspects in those tools or methods, which seem to lead to the success of structured dialog (see Figure 3). This answered RQ3.



4. Team Interaction

1. Team interaction: BPA tools can assist in or detract from team interaction, at the organizational (department, group, division, etc.), firm (entire enterprise), and partner (e.g., joint venture) levels. Below are statements about team interaction and BPA at the team and organizational levels. Please indicate your level of agreement with these statements.

	Agree Strongly	Agree	Neither agree or disagree	Disagree	Disagree strongly
BPA tools or methods quickly express organizational information in a form the team can understand	○	○	○	○	○
BPA tools or methods eventually express organizational information in a form the team can understand	○	○	○	○	○
The BPA tool or method produces a repository which is easily accessible across the team and/or organization	○	○	○	○	○
The information produced by the BPA tool or method seems "intuitive" or easy for all or most of the team to grasp	○	○	○	○	○
The more information the team produces, the more they want to continue with the BPA sessions or tools	○	○	○	○	○
It takes a long time in the BPA tool or method to elicit and record information in a form the team can understand	○	○	○	○	○
There is no easily accessible respository in the BPA tool or method for the team or organization to access this information	○	○	○	○	○
The information produced by the BPA	○	○	○	○	○

Figure 3. Survey Instrument Team Interaction Question

The survey targeted a sample of a population of users and providers of IT that have used tools and methods in early lifecycle activities that have aspects of structured dialog. A critical set of tools and methods applied in these early lifecycle activities includes BPA tools. These tools help

an organization understand what its current business processes are and produce knowledge in the form of documentation and experiences in the form of team collaboration, that get to not only what people think is going on (which might be expressed, for example, in process documentation within that firm), but what is really going on in terms of what people actually do at all levels of the organization. The tools work in the "as-is" and "to-be" spaces, telling the firm what it is they really do, and then allowing the firm to explore what it is they might do with an IT system or other transformative change. Users and providers of BPA tools are found in a number of organizations, including BPA tool user groups, professional societies, and attendees of relevant conferences. Since BPA tools form a class of processes within the field of System Engineering (SE), and we wanted as general a group of users of these tools as possible (as contrasted with members of tool user groups, which would usually only be users of that specific tool), we surveyed members of the International Council of System Engineers (INCOSE). From the survey, it is found that organizations are using business process analysis tools with dimensions of dialog-based methods and they are experiencing success as a function of these tools. The survey responses came largely from dedicated, recent users of BPA methodologies (see Yu & Wright, 1997, for a list of such tools) who have obtained definite results by applying these tools. The survey's conceptual framework as indicated in Figure 4.

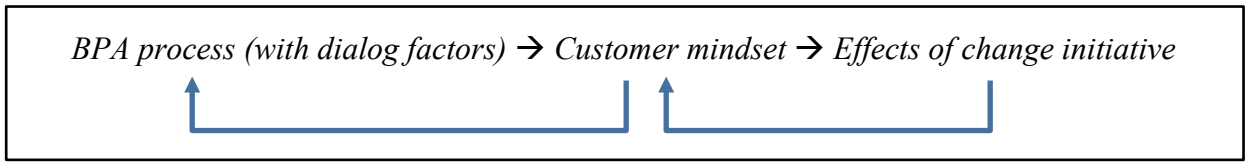


Figure 4. The Survey's Conceptual Framework

In other words, the BPA process produces a customer mindset, which then influences the change initiative. As the change initiative is implemented, the customer mindset is affected, which influences the BPA process and team dialog. Were dialog dimensions (obtained from Research Phase I) in the BPA tools used? Yes. Was project success noted? Yes—both qualitative and quantitative. Because it is known empirically that implementation failure rates vary between 40-95% of all IT projects, and the projects reported on by the respondents seemed to succeed at a higher rate, the suggestion is that the dialog factors studied in the survey helped produce an environment, which improved the potential for success. Again, empirically, IT projects traditionally have deep problems in areas like team collaboration (& other proxies for the term "dialog"), as Research Phase I showed.

To show the relationship between the parts of RQ2 and RQ3 that support the contentions made in the interpretation of the survey data, crosstabs were run on the survey data. Cross-tab graphs were run for every survey item against every other one, and the responses track across the survey. So, for example, where success metrics were good (lower cost, higher revenues, better team morale, etc.) one would also see correspondence with dialog-related aspects (better team collaboration, helpful information structuring, team felt that they got good meaning out of the work they did, etc.).

To show the relationship between the parts of RQ2 and RQ3 that support the contentions made, crosstabs were run. An example of one of those crosstabs is included in Figure 5 Crosstab example below, including one survey question and related responses.

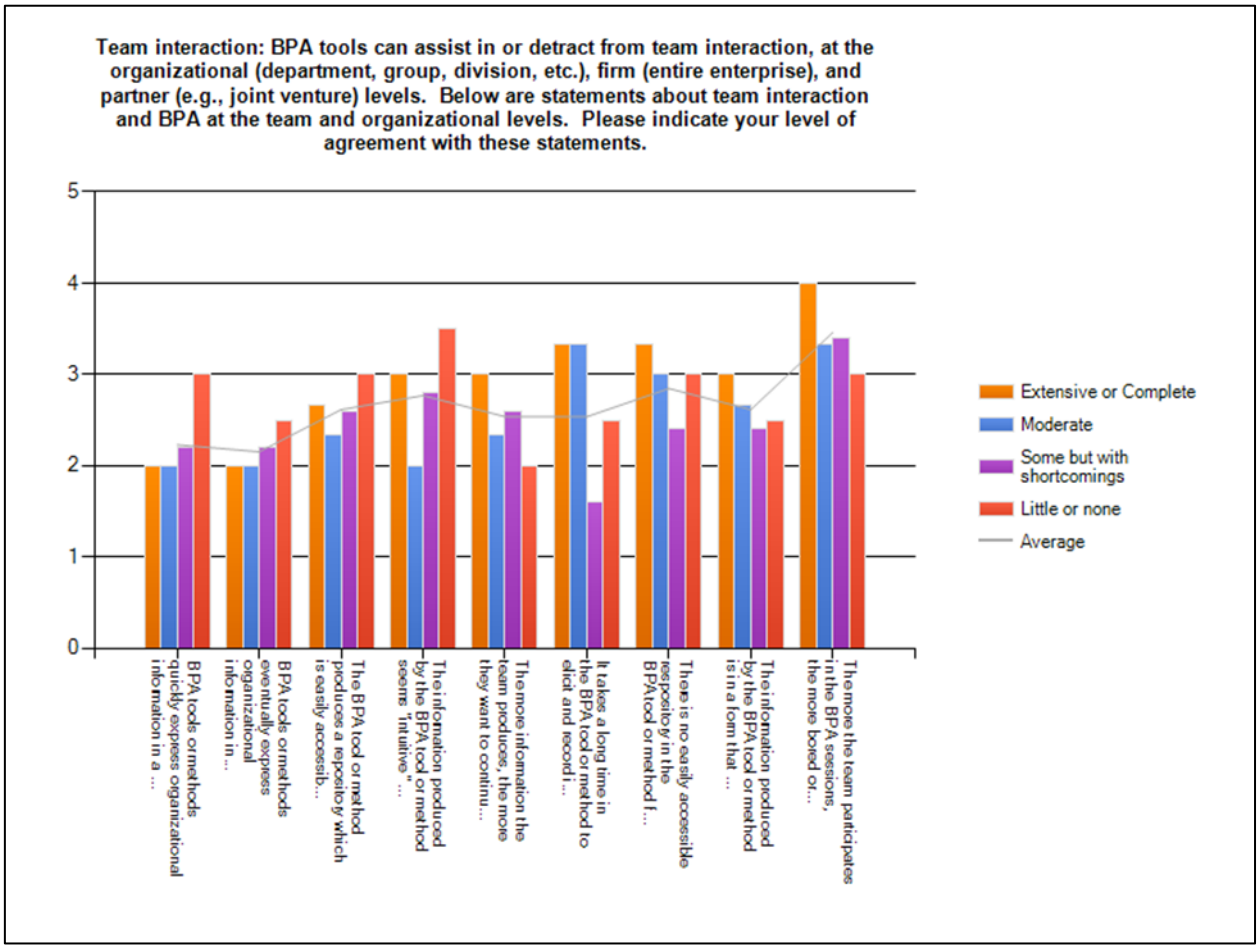


Figure 5. Crosstab Example

It is valid to ask whether there is a relationship between the trends seen from analysis and proxies of project success. Indeed, there appears to be a relationship between the data and overall project success measures. This was probed with questions about success factors, including everything from cost and revenue to team morale, desire to continue sessions, and management impressions. There seems to be a reinforcing effect between experiences with BPA tools and the team's feelings about project success. Since it can be difficult to robustly measure project success or failure directly (e.g., in directly improved or decreased project costs or profits, as contrasted with what the project might have done without these methods), these proxies are important because they reinforce the respondents' statements about what they said happened during the project. With human teams, perceptions of success or failure can become self-reinforcing and help produce success where they might not otherwise be able to do so (e.g., because they may not possess all the skills in the team or budget), or produce failure in spite of the fact that the team really could succeed if the members put their minds to it. Therefore, it is

critical for new methodologies like BPA to produce effects in success proxies at the same time the tools may be reducing costs directly, especially for complex endeavors like the acquisition of IT in a company where IT is not a core competency.

Answer to RQ2 – Foundational Elements for Decision Framework – Extending the survey results and meta evaluation of failure factors brings us to a conceptual model for systematically dealing with failure factors, shown in Figure 6.

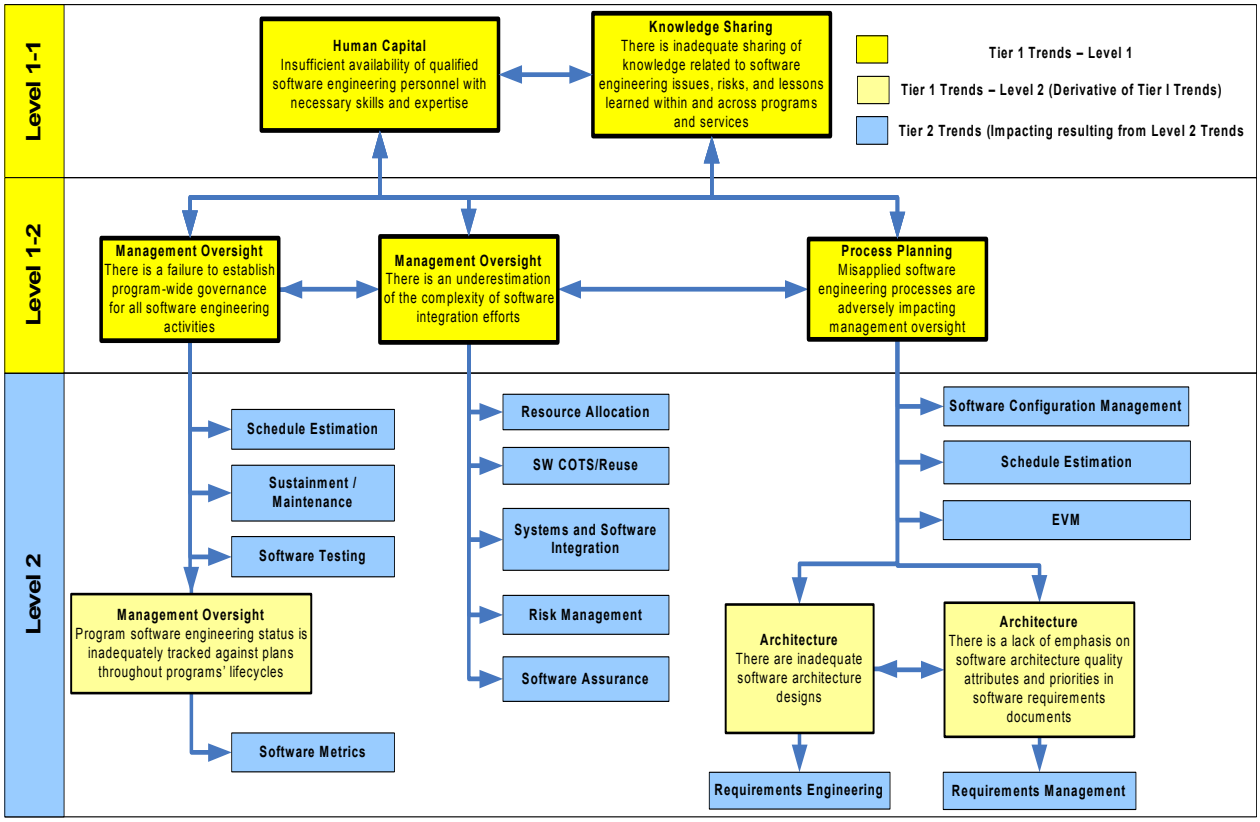


Figure 6. Conceptual Model for Relating Failure Factors to Solutions

The decision model elements that relate to this conceptual model include:

1. Clarification of the purpose of the new IT/IS system (Architecture, Management Oversight)
2. Improving team dynamics to enable better collaboration (Human Capital, Knowledge Sharing)
3. The production and use of shared meaning (Knowledge Sharing)
4. Creation and use of common language (Knowledge Sharing)
5. Shared experience (Knowledge Sharing, Management Oversight)
6. Repetition and continuation of dialog (Knowledge Sharing, Process Planning)
7. Making a specific shared decision (Management Oversight, Process Planning)

Each of these areas has a relationship to program success and prevention of systemic failure factors. These factors form the foundation of the conceptual framework for management

decision-making—such a framework needs to incorporate each of these factors to a sufficient extent that a critical mass is reached for program success.

Answer to RQ3 – Aspects of Tools and their Use that Facilitate Structured Dialog - Tool aspects include factors that aid personnel participation, particular technical documentation or use, ongoing team activity and repetition of experience, and information sharing. Tools that support wide team involvement can potentially enable program success. This needs to involve management at all levels, to facilitate sponsorship or championship, as well as enable joint decision-making that will not be arbitrarily delayed because the tool does not easily involve management. Business process owners and business process users/customers probably need to be involved in tool use. The collection and promulgation of suitable information is important to the early lifecycle activity. So, tools that aid this process, including verifying and validating that relevant information is correct and usable, may track with program success. This includes information sharing, such as between an enterprise and its customers or partners. The knowledge itself may still be complex and/or complicated (reflecting the specific nature of the information captured), but the team can use it. Tools also should help articulate and manage risk in the program, and should help the team achieve earlier and more complete understanding. The team probably should be mature with respect to its use of processes and discipline, and management should be buying in to the use of dialog in early lifecycle activities well, because the absence of either of these can confound project success. Importantly, it is not about what specific tool is used; it is more about what occurs during the tool use that is important. In other words, a given service or capability within a tool is not so much important as long as it supports the aspects given in this section, and reinforces good team behavior. Continued tool use can aid continued program success—which aids team maturity. Employing a diversity of team members and roles is important, especially to ensure that the information recorded in the tool is complete, usable, and actually used.

The top tool features/aspects that may be important include those features that provide a holistic or enterprise view (to provide context to the team), focus on business strategy (again providing context), focus on business process design (to make sure the right thing is getting done right in the organization), integration with the systems development team (to complete the transition between tacit, explicit, & then embedded knowledge), support for change or configuration management (to update project understanding as team understanding evolves), and specific support for certain organization imperatives, such as Lean Six Sigma, etc. Regardless of the specific features or capabilities provided, the tool should produce qualitative success, which can reinforce team behavior and make people want to use the tools more. This can produce improvement in project success, better fulfillment of felt needs, and ultimately program success. This can also include reduction in customer risk, earlier and more complete project understanding (evidencing better knowledge recorded earlier in the lifecycle), and a perception that the team has a greater ability to hit organizational and firm goals. Team behavior can then be reinforced to follow through on transformation initiatives.

Still, what appears missing from many decision methods discussed in the literature (Albayrak & Erensal, 2009; Burt, 2003; 2006; Chermack, 2005; 2007; Kester, 1984; Kim, Choi, & Kim, 1999; Kowalski, Stagl, Madlener, & Omann, 2009; Rowland & Parry, 2009; Senge, 1994; Visser

& Chermack, 2009; Xu, 2009) is the treatment of knowledge itself as something to be separately analyzed and facilitated, which the research completed to this point has demonstrated the importance of. The decision model (see in Figure 3) proposes attempts to fill that gap. A decision model should act in concert with more analytic models to ensure coverage of difficult areas such as conversion of tacit to explicit knowledge. It can deal with some of the problems articulated above, including elicitation of group members' information, iteration to attain sufficient information to make a good decision, team composition, and user interaction, among others. Specifically, according to Pettigrew and Fenton (2000), the model should "create an organizational dynamic around partnership-based exchange relationships, which foster effective internal linkages around collective intellectual capital" (Rowland & Parry, 2009, p. 536). The decision framework elements can create such an organizational dynamic. These elements should be aided by a coordinated tool environment or dialog methodology (not necessarily requiring a separate IT system, but at least a facilitated methodology). This is to ensure that these activities can be suitably time-boxed and structured.

Limitations and Constrains

It is important to highlight that this research was performed in relation to a subset of government and commercial programs, and that, while the findings are positive, they are not more generally portable without further research. Also, these findings were reported at particular lifecycle steps (including early phases such as concept definition, architecture, business process modeling, architecture, & development) and do not necessarily hold outside of those lifecycle steps. Further research is needed to see how these benefits accrue over the entire lifecycle, including not just acquisition and development activities, but the entire cycle of deployment and use as well. There was not sufficient time to explore programs across their entire lifecycles, so this represents an opportunity for additional work.

The BPA tools explored through the survey instrument in research Phase II (including IDS Scheer ARIS, IBM/Telelogic System Architect, iGrafx, Business Genetics xBML, & Tibco Software iProcess Suite) represent the given respondents' experiences with their chosen method or tools used in support of structured dialog. Therefore, the conclusions reached cannot necessarily hold in a more general sense without further research. The research validated the concept of a knowledge framework that focuses particularly on the surfacing of tacit knowledge in early investment lifecycle activities. Since the domain of tacit knowledge in humans and their social organizations is obviously quite broad, care should be taken when attempting to apply the conclusions to other contexts. In addition, teams were studied that usually had some motivation to change. This research explores the impact of this in the context of critical social theory, particularly in the area of developing emancipatory interest to free the team from the constraints of an as-is problematic situation. That being said, teasing out the different impacts on the team process and assigning these impacts to the tools used or team motivation are difficult. Care should be taken, then, in applying these conclusions more generally. There has been an increasing propensity for IT vendors and consumers to specify and attempt to create very massive projects entailing lots of software, which also seem to have a significant likelihood of failure (e.g., Federal Bureau of Investigation (FBI) Virtual Case File, Federal Aviation

Administration (FAA) replacement for air traffic control systems, etc.). This research does not explore the dimensions in software failure perhaps entailed by sheer size, which may be independent of those factors controllable through specification and use of a knowledge framework.

Going into the research, all the dimensions of structured dialog that may play a role in enabling IT success are not known. However, there is a need to know enough to get the survey going. This required a balance of closed-ended and open-ended questions. This work aimed to seed the survey with sufficient dimensions and factors that probe user and provider experience. Yet, the aim was also to leave it open for users and providers to include other dimensions, which might not have occurred to the researcher. It is possible that this balance was not fully achieved, and therefore, may have missed some relevant dimensions and aspects. The pre-pilot survey activities should have helped mitigate this to some degree, by focusing experienced professional and academic attention on these subtle dimensions.

Future Research

Structured dialog achieves a phenomenologically based organizational epistemology that can facilitate more accurate acquisition and development of IT, and subsequent transition into IS that an organization should use in the manner needed and intended. In addition, this epistemology underlies the process, and products, of successful IT/IS architecture. Pursuing these aspects, both to improve architecture, and to prevent ongoing problems with IT systems implementations, would be helpful. IT investment can be traced to a set of causal factors (in parentheses - Figure 6) that are directly related to architecture:

1. There is a frequent failure to establish program-wide governance for all software engineering activities. Governance is frequently available at the "system" (platform) level but does not include software at the enterprise level, per se (Management Oversight).
2. There is an underestimation, or a lack of recognition, of the complexity of software integration efforts. This also includes a lack of rationalization of complex interfaces and integration, through architecture and design (Management Oversight).
3. Program software engineering status is inadequately tracked against plans throughout programs' lifecycles (Management Oversight).
4. Immature software engineering processes can adversely impact management oversight (Process Planning).
5. There is insufficient availability of qualified software engineering personnel with necessary skills and expertise (Human Capital).
6. There is inadequate sharing of knowledge related to software engineering issues, risks, and lessons learned within and across programs and services (Knowledge Sharing).
7. There are inadequate software architectures—they are not easily or adequately documented, communicated, measured, or evaluated, and are not usable by communities outside the architecture community (Architecture).

8. There is a lack of emphasis on software architecture quality attributes and priorities in software requirements documents (Architecture).

A long-term follow-up including regular and ongoing contact with the programs surveyed will potentially demonstrate that early lifecycle dialog improves the likelihood of program success. Because of the length of time required for determining program success (which could be many years in a Federal or Commercial program, for example), this measurement would need to be pursued later. So, only the foundation is being laid now through this research, and it is possible that the conclusions will not be completely supported when the program conclusion are reached. Therefore, all that can be done is adjudicate whether the early lifecycle activities seem to have taken place in a manner that is more focused and better than such activities, which have taken place in other programs. Based on other research, that sets a suitable foundation, but it is not complete with respect to this research. So, the conclusions that can be reached will still only suggest that future success is more likely.

Conclusion

There is perhaps a disconnect between technology as-created and as-used that may lie at the foundation of frequent failure in cost, schedule, and/or performance of IT/IS. This disconnect might be reconciled through focus on the socially constructed and emergent nature of IT as it enters and is used by an organization. This study helped create a conceptual decision framework for that reconciliation, based on a hermeneutic analysis of IT/IS failure factors, synthesis of those factors into tools to systematically analyze felt needs and requirements in IT, followed by a structured dialog with the business/mission process community and technologists. The dialog achieves a phenomenologically based organizational epistemology that can facilitate more accurate acquisition and development of IT, and subsequent transition into IS that an organization should use in the manner needed and intended. In addition, this epistemology may underlies the process, and products, of successful IT/IS architecture.

The contribution of this research is that it balanced positivist and interprevist/phenomenological techniques to take the ongoing and seemingly intractable root causes of continuing failure in IT, then map systemic fixes to surveyed success factors, while then determining that those root causes were in fact fixed or avoided. While research going back to the 1970's has had much to say about IT failure, there have been few practical methods that tell businesses and management what to do to prevent it. There have been many 'flavors of the day' in new techniques and paradigms that all claim to fix the sins of the past, and yet, those sins are still with us. A key aspect missing from a practical unfolding of these root causes is a study of the social roots of every systemic root cause, with its pernicious logical extension into the documented phenomenon of resistance (where the team builds in future failure by giving up before they even start). Technology represents the conversion of invention into innovation – a use of invention for practical and profitable financial as well as technical aims. Technology always represents potential success, and yet, it is frequently difficult to use, difficult to understand, and sits outside of many people's core competence. Rigorous teamwork and management based on recognition of the importance of tacit knowledge is required – to help the team become successful (with

technology, & with many other tools and methods) in a way that is based on how they structure and use any knowledge.

There are many applications of this work outside the domain of IT. All investment evaluation and justification needs a more systematic approach than relying on someone's 'gut.' That being said, the knowledge in that 'gut' is not necessarily completely objective, so the domain itself will always be heavily 'human.' However, if it is possible to enable people to confront their own subjectivity and weave it in as one among many salient factors, improvement in satisficing and the individual's—and the team's—ability to reconcile their bounded rationality.

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