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# PROJECT INNOVATION THROUGH EXPLORATION AND EXPLOITATION: REQUIREMENTS PRACTICE IN LARGE-SCALE IS DEVELOPMENT ENVIRONMENTS

*Completed Research Paper*

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## **Abstract**

*The exploration of new opportunities and the exploitation of existing competencies represent two competing logics for innovation and change within organizations. IS projects seeking to foster innovation need to balance these forces, and recognize the distinct role that each plays. Through its essential role in generating a design space between existing problems and design options, the requirements phase of a development project represents a domain where exploration and exploitation need to be integrated. Based on a field study involving interviews with 39 IT professionals managing large and complex development initiatives, we analyze the degree to which prevailing requirements practices incorporate the logics of exploration and exploitation. Our findings focus on key challenges faced by project teams in failing to engage exploration as a necessary element in requirements practice. In addition, we offer several recommendations to enhance the pursuit of organizational innovation by supporting both exploration and exploitation.*

**Keywords:** Requirements analysis, exploration, exploitation, innovation, IS project success, design practice

## **Introduction**

“If we want to build competitive and imaginative products that avoid re-implementing the obvious, we must make creativity part of the requirements process.” (Maiden and Gizikis 2001: 10)

In addressing the essence of design, Simon (1996) noted, “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (p. 111). This perspective draws our attention to the innovative nature of design. System designers need to engender novel solutions to existing and unforeseen challenges. A crucial step in this endeavor is the early stage design process generally referred to as *requirements analysis* or *requirements engineering*. The requirements phase of an IS development project is designed to cultivate a solid foundation for subsequent design and development. Because of the critical role of requirements processes in generating design options, the potential for innovation during the requirements phase of a project is significant. Requirements analysis is particularly important in generating innovative designs, because of its central focus on the generation of new design spaces. Through facets of requirements discovery and management, these processes can empower designers and organizational stakeholders to envision and pursue novel futures. Accordingly, in this study, we explore the degree to which requirements practices support the pursuit of innovation in contemporary information systems development (ISD) projects.

The role of requirements analysis as an engine for innovation has frequently been overlooked. The prevailing emphasis for requirements activities tends to rest on the existing *needs* of the envisioned users, with less focus on the new opportunities that any requirements effort creates. To some degree, this emphasis is embodied in the vocabulary that we employ. The idea of *requirements elicitation* as the initial phase of a development process (Goguen and Linde 1993; Hickey and Davis 2003; Loucopoulos and Karakostas 1995) reflects the assumption that requirements knowledge rests readily available within the stakeholders outside of the development project team, and this knowledge must be gleaned to be articulated (i.e., specified) by the project members (Hansen et al. 2009). By contrast, an emphasis on innovation in requirements practice is too often associated with the folly of a techno-centric approach to design (Saiedian and Dale 2000).

While the innovation-oriented facets of requirements analysis are not explicitly emphasized in the bulk of the requirements literature, they are often tacitly acknowledged. A variety of requirements elicitation techniques, such as protocol analysis (Byrd et al. 1992; Wright and Ayton 1987), prototyping (Alavi 1984; Beynon-Davies et al. 1999), and ethnography (Beyer and Holtzblatt 1995; Goguen and Linde 1993; Viller and Sommerville 1999), have emerged in an effort to move beyond the limitations imposed by the assumption of knowledge residing in users’ heads. Similarly, the *viewpoints* approach to requirements analysis has been developed to support creativity and experimentation among users (Kotonya and Sommerville 1996). Similarly, in the literature on requirements negotiation, requirements conflicts have been recognized as a driver of innovation because of the reflective stance they demand (Easterbrook 1991). Finally, several researchers have called for greater attention to the support of creativity in requirements practice (Cybulski et al. 2003; Maiden and Gizikis 2001; Nguyen and Swatman 2003).

One framework for exploring the drivers of innovation in ISD projects distinguishes between the forces of exploitation and exploration (March 1991). In this perspective, the exploration of new opportunities and exploitation of existing competencies represent two competing logics for organizational change and learning. Exploration is about experimentation and novelty – generating alternatives that differ substantially from existing solutions. In contrast, exploitation is about trial and error learning, refinement, and expansion of existing capabilities. Organizations and system development teams seeking to generate change need to balance these two forces, and recognize their distinct roles in the discovery and management of requirements. Based on its essential role in generating design spaces, requirements analysis represents a critical task where exploration and exploitation need to be balanced. Thus, a fundamental research question motivating our current research is this: to what degree do contemporary requirements practices reflect or accommodate the logics of exploitation and exploration?

The remainder of the paper is organized in the following manner: Section 2 provides an overview of the theoretical foundations for the present study. Specifically, we discuss the forces of exploitation and exploration and their application by researchers over the past two decades. To this end we analyze how some critical facets of contemporary requirements practices identified by Hansen et al. (2009) reflect the forces of exploration and exploitation. The latter provide a set of prevalent requirements themes for our assessment of innovation orientations in current requirements practices. In Section 3 we describe the research methodology employed in the present study.

Section 4 outlines key findings from the analysis, and is followed in Section 5 with a discussion of implications for research and practice of requirements efforts in development projects. Finally, we close with some concluding thoughts.

## **Theoretical Foundations and Premises**

We draw upon two distinct conceptual frameworks for our evaluation of the forces for innovation in contemporary requirements practice. First, we describe two complementary and competing logics of innovation – i.e., exploitation and exploration – as established by March (1991). Thereafter, we discuss trends in the prevailing practice of requirements analysis outlined by Hansen et al. (2009) to determine what influence each innovation orientation plays in contemporary requirements practice.

### ***Exploitation and Exploration***

March (1991) offers exploration and exploitation as competing archetypes of organizational learning and change, and thus two key innovation orientations in organizations. These innovation orientations provide distinct logics for how organizations learn to compete and how they organize, strategize, and execute. *Exploration* is about discovering new opportunities by searching, identifying, and garnering competencies through critical reflection, or double-loop learning (Christensen 1997; Eisenhardt and Tabrizi 1995; Fredrickson 1984; Henderson and Clark 1990; Imai et al. 1985; Kim 1998; March 1991; Nonaka 1994; Pisano 1994; Tushman and Anderson 1986b; Winter and Szulanski 2001). Exploration behaviors are associated with a range of terms, including search, discovery, experimentation, risk taking, and radical innovation. In contrast, *exploitation* extends and refines an organization's existing competencies through repeated actions that follow trial and error patterns, or single-loop learning (Dierickx and Cool 1989; Eisenhardt and Martin 2000; Nelson and Winter 1982; Nonaka and Takeuchi 1995). Exploitation is about harnessing "old certainties," and it instigates behaviors that can be characterized with labels such as refinement, implementation, efficiency, production, selection, and incremental change.

Exploration and exploitation function like fire and ice from the perspective of organizational design (Brown and Eisenhardt 1997; Tushman and Anderson 1986a): they require contradictory structures, processes, strategies, capabilities and culture. Exploration is supported by organic structures, loose coupling, improvisation, chaos, and emergence. Conversely, exploitation draws upon mechanistic structures, tight coupling, routinization, bureaucracy, and stable environments. Returns from exploration tend to be temporally distant, and therefore they are uncertain and highly variable, while exploitation yields returns that are short term, with higher certainty and lower variance (Levinthal and March 1993; March 1991). Due to these countervailing tendencies (March 1991; Meziar and Glynn 1993), allocating resources between exploration and exploitation poses an essential tension for managers (Gibson and Birkinshaw 2004; He and Wong 2004). Despite their benefits, each form of logic has distinct downsides. On one hand, exploitation fosters inertia and reduces the capacity to adapt and seize new opportunities. On the other hand, exploration slows down the speed with which existing competencies are utilized (March 1991). Inattention to these tensions causes dysfunctional learning when either exploration or exploitation is unilaterally adopted or preferred (Levinthal and March 1993; March 1991). The trial and error learning and successful adaptation advocated in exploitation biases management to focus solely on current capabilities – at the expense of new opportunities – thus causing these capacities to become core "rigidities." Search for efficiency leads to myopic learning and competency traps (Levitt and March 1988). In contrast, when organizations engage in excessive exploration, continued "failure leads to search and change which leads to failure which leads to more search, and so on" (Levinthal and March 1993: 105-106). Organizational learning becomes random and chaotic: managers continuously explore and fail to allocate resources to leverage existing competencies. Table 1 provides a systematic juxtaposition of exploration and exploitation in the context of innovation.

Scholars have increasingly asked how organizations can avoid competency traps by learning to tack between exploration and exploitation. To do so organizations must be able to allocate resources dynamically through continual acquisition, integration, re-combination, and removal of capabilities (Eisenhardt and Martin 2000; Lant and Meziar 1992). These re-allocations shift the organization's learning focus through punctuated moves between exploration and exploitation (D'Aveni 1994; Eisenhardt and Martin 2000; Prahalad and Hamel 1990; Teece et al. 1997). For IS design innovation, this means that software developers must learn both to explore and exploit technologies, services, and processes- especially through their requirements analysis efforts. In short, they must

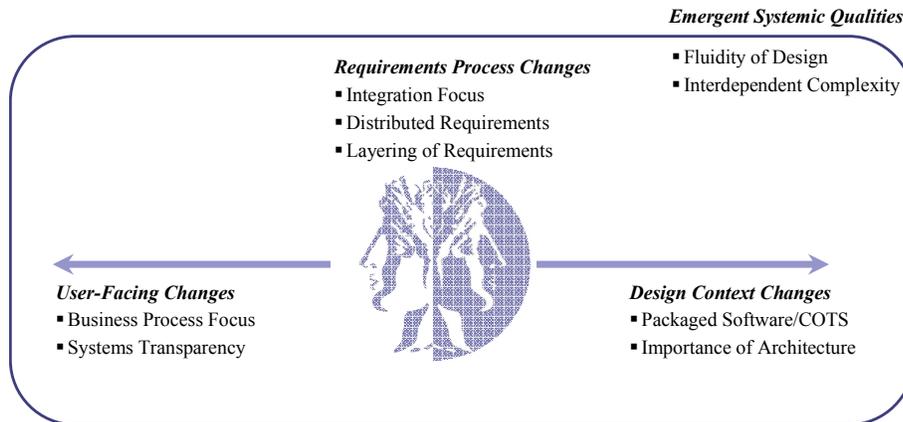
learn to shift between exploration and exploitation in a punctuated manner while they develop design visions for future software.

**Table 1. Indicators of innovation capability type (adapted from March 1991)**

<b>Dimension of Innovation</b>	<b>Exploitation-based Innovation</b>	<b>Exploration-based innovation</b>
Process	Localized and follow procedure; Refining exiting processes	Open-ended and spontaneous; Experimenting with new ideas in search for new options
Boundary	Restricted	Permeable
Scale	Incremental	Incremental/ Radical
Orientation	Convergent	Divergent
Control	Low ambiguity	High ambiguity
Risk exposure	Short-term process with immediate, almost certain benefits	Long-term process with risky, uncertain outcome
Motivation	Efficiency, accuracy gains	Making a difference, rejuvenating
Expected Value	Operational Efficiency; Reaping value from what we already know	Breakthrough; Generating value from realizing new possibilities

***Contemporary Requirements Themes***

As IS development environments continue to change, so too must the practice of RE. Indeed, RE tools and processes have evolved in the wake of such innovations as distributed development (Damian et al. 2003), open source (Scacchi 2009), and agile development methodologies (Paetsch et al. 2003). In a study of the prevailing requirements practice of leading design professionals, Hansen et al. (2009) develop a framework for thematizing key trends in contemporary RE. Specifically, they call attention to salient themes in prevailing practice and discuss the conceptual relationships between these themes. In the present study, we use the themes identified by Hansen et al. (2009) as an organizing framework to assess the degree to which current requirements practices embody the competing innovation orientations of exploration and exploitation. These themes include: 1) business process focus, 2) systems transparency, 3) integration focus, 4) distributed requirements, 5) the layering of requirements, 6) packaged software orientation, 7) centrality of architecture, 8) fluidity of design, and 9) interdependent complexity. The framework of how these themes relate to different facets of requirements analysis is presented in Figure 1. Next, we provide a short summary of each of the themes.



**Figure 1. An Emergent Requirements Landscape (from Hansen et al. 2009)**

One class of themes identified in the study can be dubbed *user-facing changes* – trends in requirements analysis and systems development that directly impact the experiences of users or subject worlds. *Business process focus* refers to a perceived shift among IS design professionals from a focus on a particular application and its associated work practices to a focus on chains of work practices – or business processes – within which a given set of applications is situated. This trend implies that requirements for specific artifacts increasingly flow from the holistic understanding of the relevant business processes they are intended to support. *Systems transparency* highlights the growing tendency among business users and consumers to demand transparency across software applications. This theme underscores the increased concerns of users for the design of a seamless and uniform user experience. Specifically, the authors note, “While a great deal of traditional requirements literature focuses on the notion of usability associated with a specific application, systems transparency calls attention to unified usability of a portfolio of applications” (Hansen et al. 2009: 67).

The second class of themes, labeled *requirements process changes*, focuses on transformations within requirements processes themselves. *Integration focus* denotes efforts associated with making user experiences possible through integrating applications and system components. Rather than emphasizing the creation of new systems components, design energies are increasingly directed toward integration across existing applications and capabilities. As a result, IS design professionals frequently understand their role more as systems integrators than as traditional systems developers. The phenomenon of *distributed requirements* refers to increased distribution of requirements processes across functional, organizational, and geographic boundaries. The diversity of stakeholders and socio-technical inputs to the requirements process have expanded tremendously in recent years. Vendors, consultants, enterprise architects, development teams, business stakeholders, and individual users all play significant roles in articulating and implementing requirements. Furthermore, a wide variety of legacy systems, commercial-off-the-shelf (COTS) components, and regulatory domains serve as distinct sources of input to the requirements process. Importantly, this trend reflects a broader degree of distribution than one sees in the literature on distributed requirements engineering, which focuses on the requirements analysis enacted by geographically distributed teams (e.g., Damian 2001; Damian et al. 2003; Jarke and Pohl 1994). Finally, the *layering of requirements* reflects the observation that contemporary design efforts generally entail several layers of requirements. These layers may be associated with differing levels of abstraction, design focus, user-orientation, or timing. This layering goes beyond the traditional transition through business, functional, and technical requirements to include layers based on levels of organizational analysis (e.g., enterprise architecture requirements, application requirements) and the volatility requirements (e.g., persistent/stable vs. volatile requirements).

The third class of themes focuses on changes in the technical context of design. *Packaged software orientation* captures the preference for the use of COTS over the development of separate novel applications. In the study, the vast majority of respondents indicated that their organizations advocated a “buy and customize” rather than build approach to systems development (Hansen et al. 2009). The authors note the challenges that this poses to a traditional perspective of requirements analysis: “In contrast, to the traditional claim that requirements processes should focus on the ‘what’ of a design effort without respect to ‘how’ it will be achieved, the use of COTS implies that much of the ‘how’ is already established at the outset of a requirements effort” (p. 70). *Centrality of architecture* refers to a growing recognition of the importance of IT architectures in establishing the context for requirements processes, with designers emphasizing the importance placed on adherence to established architectures in their firms and projects. Importantly, this trend is understood to be a reaction to the challenges of integration complexity in modern IS development environments.

Finally, Hansen et al. (2009) identify *emergent systemic qualities*, which result from the interplay of the other forces. The concept of *fluidity of design* highlights the growing appreciation among design professionals and their clients for the continued evolution of design artifacts. Designers are moving away from the perception of a completed design project and toward the recognition that most projects form a single step in an iterative process. One upshot of this trend is firms no longer attempting to define a comprehensive set of requirements ahead of time. The final theme highlighted by Hansen et al. (Hansen et al. 2009) is dubbed *interdependent complexity*. This concept captures the notion that, while application development complexity has declined, it has been subsumed by complexity at the level of integration between multiple components of an organization’s IT landscape.

## **Research Methodology**

We conducted a field study involving semi-structured interviews with IT managers and design project leaders in the United States and Europe. The data collection efforts were structured around an interview protocol designed to elicit responses to a number of distinct aspects of the participants' design experiences, including a discussion of current design processes; perceived impediments to the discovery, specification, and management of user requirements; perceived drivers of change in requirements and design practices over the preceding five-year period; and envisioned changes to the practice of systems design in the near future. The core protocol remained constant throughout the data collection process, however, in line with the grounded theory concept of constant comparison, some questions were added to the protocol based on new insights (Glaser and Strauss 1967). In addition, interview participants were encouraged to freely express their thoughts on any topics which they felt were relevant to requirements processes and contemporary design efforts.

To foster external validity and to address threats to the internal validity of the study, we sought participation from individuals and firms engaged in a wide variety of design environments. To ensure faithful representation from leading edge and mainstream organizations, we sought participation from design project managers and senior technology leaders within a range of Fortune 500 organizations and leading government laboratories. Thus, our sampling approach reflects a purposeful bias toward innovative and large, complex systems in an effort to focus on practices associated with the most challenging development projects that involve high levels of innovative tasks. The systems development efforts carried out by the organizations ranged from tens to hundreds of man-years. System development costs ranged from several million to hundreds of millions of dollars. A total of 30 interview sessions were conducted, with 39 individuals participating. In order to protect the confidentiality of respondents, no statements from the interviews are attributed to specific individuals or firms.

All interviews were transcribed to support formal analysis of the data. Interview transcripts were coded using Atlas.ti, an interpretive analysis application. The theoretical foundations reflected in the emergent RE themes and the notions of exploration and exploitation provided a preliminary coding structure for the data. The aim of the analysis was to identify distinct patterns in requirements and design processes as they relate to the orientations of exploitation and exploration within the nine recurrent RE themes. In line with a grounded theory approach, additional codes were created during the coding as new relevant topics or recurring issues began to surface (Glaser and Strauss 1967). The preliminary coding was conducted by one of the researchers. The code structure was then iteratively revised by the research team, until the researchers determined that all relevant concepts were reflected in the coding outcome (Eisenhardt 1989). Several of the interview transcripts were coded repeatedly as the final coding structure emerged.

## **Findings**

Several of the requirements trends reveal a distinct and intimate connection to the exploration and exploitation orientations. These connections were more prevalent in some of the themes, but all of them present a clear tendency to be associated with one of the innovation orientations – in most cases towards exploitation

### ***Business process focus***

The focus on business processes in design efforts reflects an attempt to move away from a traditional technology – centric approach to requirements analysis. Specifically, the emphasis now on determining system requirements that accommodate existing business processes implies a desire to 'limit' significant changes to existing business processes based on the capabilities of novel IT components. One designer described the emphasis in this way:

*“Let's understand your job ... Then let's start deciding and talking about technology and what technology is appropriate to solve a business need, rather than coming to you with a great technological gizmo and have you change your business processes to fit the technology.”*

In this regard, the focus on existing business processes suggests a strong orientation toward exploitation of existing business structures. However, some of the respondents suggested that the integration of business process analysis is undertaken in an effort to ensure consistency between technology and business processes – creating space for innovation of both fronts:

*“The ideal is that the requirements development process is a collaborative process where folks, both parties, the IT folks and the client, sit down, they start talking through what is it you want to do, and how do you want to do it. And there’s a conversation that should be taking place about what are the business processes that you’re changing, that you’re adding to, that you’re adding, you’re subtracting, you’re deleting, you’re modifying.”*

Thus, the business process focus in contemporary requirements analysis creates the potential for seeking a more dynamic balance of exploitation and exploration, depending upon the dominating approach adopted within a given organization.

### ***Systems transparency***

The move toward greater transparency of underlying application boundaries for system users suggests the potential for both innovation orientations in requirements analysis. From the perspective of exploitation, systems transparency allows users to leverage their existing competencies without breaking their process to navigate the interfaces between multiple platforms:

*“I see that the desire from the customer side is much more for applications to cross whatever artificial boundaries exist in terms of data sources and in terms of small little systems coming together.”*

At the same time, the elimination of arbitrary boundaries enables users and organizations to fundamentally rethink the nature of the environment within which they operate. This creates the potential for new configurations and explorations that are more dynamic and open-ended. One respondent who works on the design of embedded systems (in this case, in the automotive sector) describes the potential this way:

*“You actually start redefining what the boundaries of the automobile are. So at this point, up until now all I’ve said is based on the tacit assumption that the vehicle is what you see and what you see is what you get, basically it’s a physical entity. But really the vehicle is in fact a component in a much larger information space.”*

Thus, it appears that demands for systems transparency have been raised to enhance the capacity for exploitation on the part of individual and organizational users, but that the emergence of systems transparency may yet create the potential for exploration by breaking established ways of thinking about the flow of information.

### ***Integration focus***

A growing emphasis on system integration over greenfield development implies a fundamental change in the role of requirements analysts. Specifically, this trend suggests a shift of IT professionals from being the designers of novel system environments to being the integrators of existing IT components. Several respondents highlighted this shift:

*“And that really changes IT people from being raw functional application creators, to being more of, you know, performance architects trying to design a user interface ... I think that role in what an IT person needs to be savvy on, definitely changes.”*

*“Unfortunately what that has done for those of us in IT is changed us from application developers into systems integrators, because a lot of the recent acquisitions of systems have kind of been small isolated items.”*

This shift suggests a significant transfer from technical exploration to exploitation strategies, as the technical vision-generating skills of IT professionals become less critical in the requirements processes. In this new environment, requirements efforts are oriented toward making existing components work together effectively rather than fostering a new technological vision of how organizational needs might be addressed. Accordingly, the requirements themselves are more often about interdependencies between systems than separate and new functional capabilities.

### ***Distributed requirements***

The diversity of stakeholders and socio-technical inputs to a design process has expanded significantly in recent years. The notion of distributed requirements highlights the broad range of requirements inputs in any contemporary systems development effort. In addition to the multiple sets of stakeholders *within* the organization (e.g., users, distinct business units, executive leadership), IT professionals must consider functional and non-functional requirements that flow from a range of external parties, including vendors, consultants, suppliers, business partners, and governmental or industrial regulators. This expansion of the social, technical, and institutional landscape from which requirements may be drawn suggests support for forces on both sides of the exploitation-exploration distinction.

On the exploration front, distributed requirements create the potential for novel insights and diversity generation as new perspectives emerge and need to be integrated into an organization from external parties. The engagement of third-party development partners creates an effective mechanism for expanding the organizational knowledge base. Several respondents commented on this dynamic potential:

*“And that’s actually some of the benefits of bringing an organization like ours to a client is because we bring those new, you know, new ideas, new ways of doing things and showing them, you know, what’s possible with respect to the different requirements and capabilities.”*

*“But it may not be the optimal solution. And again I go back to that’s where the third party solution, the third party technology helps. Because it allows them to see something that is dramatically different than what they have today. And then it allows them to begin to think, “How can I do my business process a different way? And then as I look at this new technology, what are the things that it doesn’t do that it needs to do for me to be able to achieve?” And that’s something...”*

Despite the support of exploration forces within design efforts, the distribution of requirements also reinforces exploitation-oriented strategies. Because of the complexity that new requirements create, requirements distribution often prompts IT professionals to adhere more stringently to process and architectural guidelines. For example, IT professionals increasingly rely on a relatively small set of heuristics to manage prioritization and the resolution of requirements conflicts. As a respondent noted:

*“Sixteen hundred different requirements, and they’re pretty big requirements, you set the edict that the maximum number of requirements that can be accommodated is a thousand. And you force the business to knock out six hundred out of sixteen hundred. I mean it’s over 30%, it’s over 30% of their requirements. You have to force that kind of painful decision making where people are just in pain knocking off requirements.”*

### ***Layering of requirements***

One of the bases for the layering of requirements is the volatility, or differences in time horizons, associated with specific requirements. Requirements that are expected to persist over an extended period of time demand distinct approaches from requirements that change rapidly, and in less-predictable ways. This phenomenon is particularly relevant in the design of embedded systems and product lines because the requirements volatility for the embedded artifact in a product differs significantly from that of the underlying system, as the following statement illustrates:

*“In terms of being able to span the feature space if you will, cover it, there’s a timeless element to it – people always want some aspect ... There’s a piece that changes with very slow clock speed, that’s the package and physical aspects of it. And then there’s the fast cycle, fast clock speed, aspects. So there’s really...there’s a [stable] component, there’s one that really changes very slowly, and there’s one that changes very fast.”*

Even in traditional information systems, the potential for layering based on the temporal volatility is significant, as designers determine which requirements represent the most certain elements of a platform. For example:

*“Because you’ll get 75% of the way down the path with that first pilot project but then what you define is what is the next level of requirements that are required to mature that nonfunctional solution, that*

*nonfunctional capability, the technology capability. What happens is then you can layer the next on and mature it and then build more application onto it. That's the approach we use but in order to do that, what do you have to have? You have to have that technology blueprint and you have to be very proactive, very proactive."*

The approach to layering requirements based on volatility offers a clear conceptual link to innovation orientations of exploitation and exploration. Exploitation focuses on processes with low variability and high levels of certainty, and the returns from exploitation are temporally proximal. Conversely, exploration relates to processes or resources that are highly variable and uncertain, with temporally distant returns.

Thus, the layering of requirements based on volatility can be understood as a strategy for balancing the forces of exploitation and exploration in systems development environments. Design team members create layers of requirements based on the degree of certainty that they represent. Highly certain requirements can be pursued immediately through the application of existing processes and competencies (i.e., exploitation). Yet, the designers maintain an awareness of requirements which are highly variable for possible inclusion as a platform matures (i.e., exploration).

### ***Packaged software orientation***

The preference for the use of COTS packages over traditional "green field" development is closely linked to the integration focus and distributed requirements phenomena. As one respondent noted:

*"I see more of that happening in today's world, where the client is getting away from having their own custom solutions to buying solutions that are in the marketplace ... packaged solutions and then integrating them together."*

This movement away from customization and in-house development implies a stronger emphasis on exploitation. Designers and managers are seeking to minimize development costs by adopting run-of-the-mill solutions that are available in the market. In consequence, requirements processes that rely on COTS packages assume that exploration rests with the vendor and its capability to distill "best practices" rather than residing in an internal IT project team. This was reflected in multiple respondents' observations. For example:

*"When new development exists, our clients tend to have a preference to go into third party packages. Where they buy the third party package, they do the gap analysis, and then do the integration work."*

*"Requirement specification languages/semantics/notations are influenced by the IS development platform and approaches proposed by the corresponding vendor."*

Here again, the shift in roles for IT project team members from being developers to being component integrators is quite apparent. This suggests the potential for exploration on the part of IT professionals may be increasingly limited.

### ***Centrality of architecture***

The emphasis that many firms have placed on creating a stable, enterprise-level architecture is a reaction to the perceived growing complexity in integrating the diverse elements of a firm's IT portfolio and infrastructure. This centrality of architecture is a key source of design constraints, or *non-functional requirements*. As one respondent noted:

*"The architecture determines the scope of application functionality and requirements which [a team] can do and if you look at the sort of future evolution it may be that you make currently the right architecture choices but maybe two years down the road another requirement emerges and you are stuck."*

As this statement illustrates, the increased deployment of enterprise-level architectures offers a clear espousal of an exploitation logic. In fact, explorations are deliberately limited in an effort to manage the overall IT complexity. Many respondents observed that this now severely hampers the design personnel's attention to discovery:

*"There are several groups within IT whose focus is to design 'go forward' technologies and standards. Once again, down at the lower echelon of IT development, it's a bit frustrating that some of those decisions are made without benefit of either external customer requirements or even internal IT requirements."*

### ***Fluidity of design***

There is now a growing recognition that designed systems are never really "complete" – i.e., designs will remain "fluid" for most of the life of a system. This supports the potential for exploration in ongoing requirements efforts. By designing with an eye to openness and the evolution of a platform, IT professionals now need to support a search for novelty and discovery within their organizational environment.

*"In terms of spanning the feature space, you do freeze some aspects of the feature space and other aspects you fade, like design – keep it dynamic, keep it open."*

Importantly, the acknowledgement of evolution in design doesn't simply imply a change of emphasis for IT personnel, but it creates a new role for users. This is the realm of co-design and the fostering of exploration on the part of users:

*"If you say, 'Well, since I don't really understand what the consumers actually prefer and since its change is faster than I can change [the artifact], how can I design in ways that somebody else can fiddle around with it?' It's invention in the hands of the owner – how you design your systems in a way that you make that possible."*

### ***Interdependent complexity***

The growing complexity that IT professionals now observe in managing heterogeneous components of their systems portfolios has led many organizations to place a renewed emphasis on the adherence to existing processes. Similar to the role of architecture, the management of complexity between system modules, platforms, use contexts, and new business models (e.g., software as a service) limits exploratory behaviors on the part of organizational actors. Such explorations are perceived to be a threat to the stability of an IT environment necessary for keeping the organization viable. In this regard, the IT designers are expected to act as the enforcers of current organizational structures:

*"The IT function of [respondent's firm] is focused on the customer's self-service capability and the internal solutions we create for our operations and so we have a very specific governance process and development process or methodology that we use for all that. And now these [client] groups are out creating their own systems, their own solutions or products for customers. Now they're saying, 'Hey, you know what? There's some gold in those darn hills in your big data warehouses that are generated by your internal systems' ... And so now they say they want to tap into that, and we say, 'What's your methodology? What's your rigor to insure that those highly integrated systems are properly managed and properly looked after from a change control perspective so that a seemingly innocuous change in one area doesn't have a huge ripple effect all the way to the customer?'"*

*"Typically the organizations that are doing the design and development of the embedded projects and software tend to be in a more rigorous level both in terms of getting customer buy off on the specification requirements as well as the methodology that's used. They tend to be more at a minimum, CMMI Level 3, but typically a 4 and in many cases a 5."*

Thus, the increased complexity of organizational IT environments has necessitated a policing function among design professionals. The perception of risk associated with the interdependent complexity of systems components favors a logic of exploitation in managing systems development projects.

The findings in this study reveal a diversity of forces with respect to the relationship between prevailing requirements themes and the innovation orientations of exploitation and exploration. These relationships are summarized in Table 2. We have characterized the impact of each of the themes on the innovation orientations in one of three ways – 1) reinforced (i.e., the theme strongly supports the relevant orientation), 2) partially supported (i.e., the theme entails the potential for the relevant orientation to be sustained), or 3) diminished (i.e., the theme implies a reduced likelihood that the relevant orientation will be observed).

**Table 2. Relationships between requirements themes and innovation orientations**

Requirements Theme	Exploitation	Exploration	Key Observations
Business process focus	Reinforced	Partially supported	Exploration may be supported when the novel processes are considered
Systems transparency	Reinforced	Partially supported	Exploration is indirectly enabled through the elimination of arbitrary boundaries
Integration focus	Reinforced	Diminished	Shifts IT project team members from design to integration
Distributed requirements	Partially supported	Reinforced	Creates a more diverse base for inputs and design concepts
Layering of requirements	Partially supported	Partially supported	Functions as a mechanism for balancing exploration and exploitation
Packaged software orientation	Reinforced	Diminished	Design innovation is assumed to rest with the vendors
Centrality of architecture	Reinforced	Diminished	Emphasis on architecture is a response to rising complexity
Fluidity of design	Partially supported	Reinforced	Fosters the potential for change
Interdependent complexity	Reinforced	Diminished	Renewed emphasis on rigor in executing existing IT project methods

On balance, we find that several of the themes reinforce an emphasis on exploitation at the expense of exploration in systems development projects. However, the potential for exploration remains in a number of the themes analyzed, most notably the themes of *distributed requirements*, *fluidity of design*, and the *layering of requirements*. Interestingly, a broader review of these relationships suggests the presence of countervailing forces in the dynamics of contemporary design projects. These discrepant forces and the corresponding insights for practicing IT professionals are discussed in the following section.

## Discussion

The findings outlined in this study have significant implications for both ISD professionals and the IS research community. With respect to IS project team members, the study implies the need for mechanisms to balance the orientations of exploitation and exploration in the pursuit of innovative design solution. We also see that such mechanisms may already be emerging in design practice. For the IS researchers, the study suggests areas for fruitful inquiry as the environments of IS development continue to change in the coming years.

## ***Implications for ISD Practice***

### **Balancing the Drivers of Exploration and Exploitation**

Our findings suggest that there are countervailing forces afoot in contemporary requirements practice. Several of the themes analyzed imply a redefinition of the role of IT development professionals away from an emphasis on vision generation and toward a more mechanistic role as systems integrators. The key themes of *integration focus*, *centrality of architecture*, *packaged software orientation*, and *interdependent complexity* all support the perception that IT professionals' efforts are increasingly oriented toward making existing components work together effectively rather than designing new solutions to an organization's informational needs. In short, most requirements and IS-related innovation is about efficiency and control, and much less about discovery and novelty. In contrast to this integration-oriented trend, we see that IT functions are still expected to champion innovation throughout their organizations. The perception that IT professionals should be involved in innovation behaviors that revitalize the organizations persists. For example, with the growing recognition of the *fluidity of design*, we see that ISD project team members are central to keeping the development environment open to change and organic evolution through the facilitation of co-design efforts with users. Given the presence of these conflicting roles for IS development personnel, how can we make sense of the emergent function of ISD projects?

The findings from the study support an interesting observation related to this apparent paradox around the role of IT professionals within organizations. Namely, that IS development personnel stand at a crossroads between the conflicting drivers of exploration and exploitation. From the insights of our respondents, we argue that many of the developments within the broader business marketplace represent forces that emphasize exploration. For example, the distribution of requirements across geographic, social, and institutional boundaries is a reflection of the perception that organizations must look "outside their walls" for a sound understanding of the dynamic, rapidly-evolving markets in which they participate. Business partners, consultants, and regulators represent important bases of knowledge in an increasingly networked business environment. Without this outward-looking approach, organizations would risk falling out of step with the demands of the marketplace. Similarly, the *fluidity of design* concept can be seen as a reflection of the dynamism of the broader evolution of IT. Organizational leaders can no longer afford to believe that large scale systems can be implemented and left alone for an extended period of time. With the continual emergence of new IT resources and novel approaches to IT management (e.g., cloud computing), organizations are frequently forced to acknowledge the necessity of an evolutionary perspective on their own IT investment decisions. Thus, the marketplace is sending organizational leaders and IT professionals a consistent message of change, uncertainty, and complexity.

In reaction to this exploration-intensive external outlook, organizational leaders have enacted a series of *internal practices* designed to minimize the ambiguity which they encounter – pursuing the certainty of exploitation. In the reflections of our study respondents, we can develop a salient image of the challenges facing their design efforts. As the complexity of their systems development environments has expanded, IT professionals have pursued a number of measures to simplify and manage their growing complexity. To a significant extent, many of the themes discussed in this study can be seen as efforts toward this end. For example, the preference for COTS platforms, the emphasis on enterprise architectures, and the focus on integration of existing IT components and prevailing business practices all reflect the desire to limit capital expenditures and foster a systems landscape that can be more easily understood and coordinated. In addition, many of our respondents observed that speed-to-market demands have been greatly increased:

*"Well certainly time is a big [consideration]. It's always...everything's got to be done fast - fast, fast, fast. And I think what happens is that companies tend to architect for the here and now."*

Thus, from a management perspective, a strong case can be made for each of the exploitation-enhancing changes in ISD project methods. In the face of complexity and ambiguity, a strong adherence to internal discipline and rigorous planning is a natural coping strategy.

Finally, we observe that organizational ISD leaders are developing methodological approaches that enable them to balance both the uncertainty of the marketplace (exploration) and the internal imperative for control (exploitation). The layering of requirements that we have discussed reveals such an approach. IS development teams have begun to bracket differing sets of requirements so as to focus on those which they can effectively tackle and still maintain a peripheral awareness of less certain factors on the development horizon. Furthermore, the reflections on the fluidity of design suggest that IT leaders have made a concerted effort to educate managers regarding the need for an evolutionary perspective. Figure 2 provides a graphical representation of the exploitation-exploration balancing act that IT professionals are enacting.

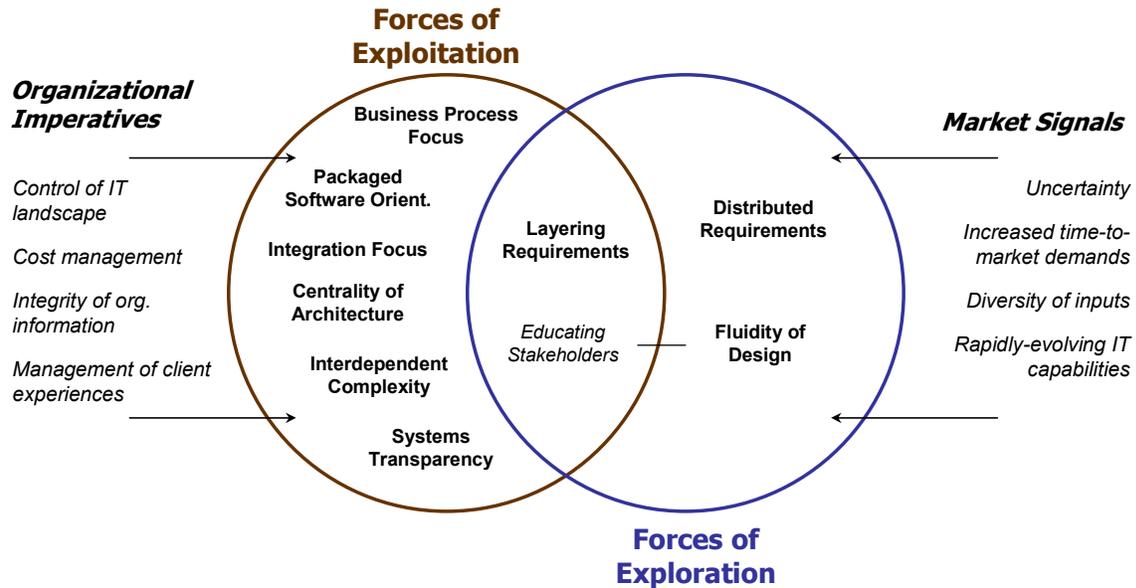


Figure 2. Balancing Exploitation and Exploration in IS Development Environments

### Enhancing the Exploratory Capacity of Requirements and Design

While we recognize the value of exploitation-enhancing measures in prevailing requirements practices, the findings from our study suggest that IS development teams run the risk of abdicating their exploratory role within an organization. One of the most critical insights that flows from March's exploitation/exploration framework is that an organizational environment that relies too heavily on the logic of exploitation sets itself up for failure in the long term. As March (1991) notes, "Since long-run intelligence depends on sustaining a reasonable level of exploration, these tendencies to increase exploitation and reduce exploration make adaptive processes potentially self-destructive" (p. 73). This is particularly true of organizations in intensely competitive marketplaces, where finishing near the top of the market is critical. By reinforcing limits on the capacity of organizations to learn and adapt, a heavy exploitation focus creates the potential for a firm's market position to be degraded rapidly in the face of novel market developments.

What implication does this have for organizations in which requirements practices, and the broader design outlook, reveal an exploitative shift? It suggests that measures should be taken to ensure the re-introduction of exploratory facets in IS development projects. As we have noted, the requirements phase of a design project is uniquely positioned to support the generation of innovative ideas because of its role in determining the design space – i.e., the range of design possibilities. Yet, several of the professionals we interviewed noted that their organizations make no explicit effort to ensure that their requirements resulting designs are truly innovative.

Fortunately, some guidance can be gleaned from those respondents who did note a mandate for innovativeness. A range of exploration-oriented activities were discussed, including broad-based research, enhanced learning opportunities for organizational members, and fostering input from all stakeholders. Some of our respondents noted that their organizations have an accommodation for general research. This research can take multiple forms. The

maintenance of a traditional research and development, or “technology futures,” function can ensure that some members of the firm are dedicated to the generation of novel solutions, which can be fed back into the requirements process on a specific IS development project:

*“We have a formal R&D group and structurally they are tied at the hip with our architects. As a matter of fact they report up to the same boss. So each decent size effort that comes through, and again we don’t have a hard number to it, but a big effort, the R&D group is always weighing in and balancing what we’re trying to do tactically with where we want to go.”*

Employees may also be encouraged to access external research from private sector sources such as Forrester or Gartner. Finally, research efforts may include market scanning to identify developments in the marketplace that may be worthy of consideration.

Opportunities for individual and group learning are another avenue for fostering innovative ideas. One respondent remarked that members of their project teams are encouraged to attend conferences where new technologies and development approaches are introduced. While this participation is a clear cost to the organization, it encourages design team members to broaden their perspectives on what is possible. These perspectives are then brought back to the organization to support wider learning and exploration.

A third suggestion is for the development of an employee feedback mechanism whereby all organizational members (not just those engaged on a design project) are encouraged to submit their suggestions for improvement to business processes or IT capabilities:

*“I think every line employee has been empowered to look at innovation and provide suggestions and ideas so, you know, we do keep our eye on innovation, and try new things and let people look at things that are cool and try to figure out if there’s a way to use those.”*

Finally, empowering design personnel to generate and promote innovative concepts offers a range of benefits. This means that management must support design-driven search even when the direct payoffs are not immediately clear. This may also demand a rethinking of many traditional assumptions about the requirements domain. As a prominent IT visionary remarked:

*“I mean a ‘requirement’ is something you need. A vision is something you dream. So, unless you claim you need what you dream, I guess you’re in a pickle.”*

### ***Implications for IS Research***

This last point raises the question of implications of these findings for IS research. How can IS researchers assist practitioners in determining under what conditions either a logic of exploration or one of exploitation is most appropriate? In circumstances where exploration is important, what can IS researchers propose in an effort to foster such an approach? Several considerations are relevant in this regard. First, the present research could be enhanced through an analysis of the ways in which the key trends in contemporary RE differentially reflect the logics of exploration and exploitation when applied to distinct facets of an application domain, such as technologies, services, and business processes. Our findings suggest that such elements will reveal different patterns of exploration and exploitation, but these distinctions were not explored in the present analysis.

Second, a thorough articulation of mechanisms through which requirements practitioners can introduce novel concepts while maintaining the efficiencies gained in a shift toward exploitation would be valuable. The suggestions raised in this discussion have flowed from the experiences of the study respondents, but there are undoubtedly additional process- or artifact-oriented measures that could be advanced. This endeavor would be a worthwhile area for additional research.

Finally, the assessment of exploration-oriented design practices could be effectively introduced in several areas of current requirements research. Much of the research on *requirements elicitation* has tacitly addressed the need for innovative thinking in requirements practice. This focus could be made more explicit through the investigation of discovery methods that facilitate ground-breaking innovation. Similarly, research on *requirements negotiation* could be augmented with an emphasis on approaches to prioritization and negotiation that enable organizations to maintain

sufficient levels of “positive” risk and future-oriented vision. Finally, the study of *value-based requirements* is well positioned to investigate the long-term economic value (e.g., options) associated with the logic of exploration. An explicit emphasis on the ways in which firms can value discovery and radical innovation would be desirable.

### **Limitations**

The present study applies an interpretive research approach. We believe that this methodology is an appropriate reflection of the research questions and focus, but it is important to note we make no claims to statistical generalizability. Rather, we argue for the *theoretical* generalizability, that is, the theoretical perspective outlined in this study offers a valid mechanism for assessing requirements dynamics in design environments that are structurally similar to those considered in the study. Therefore, the fundamental value of the approach is to provide an insightful framework for assessing the dynamics of innovation within requirements efforts. In addition, we note that neither the present study nor the preceding analysis provided by Hansen et al. (2009) explores the relative intensity of the various trends in requirements practice (e.g., the relative impact of *business process focus* versus that of *interdependent complexity*). Additional data in this regard could impact our conclusions regarding the emphasis on exploration and exploitation in current RE efforts.

### **Conclusion**

In this study, we have considered the degree to which contemporary requirements practices reflect the innovation logics of exploitation and exploration. By analyzing contemporary requirements trends with respect to the dichotomy of exploitation and exploration, we have mapped the salient themes in requirements practice with respect to what they tell us about organizational preferences for short- and long-term thinking and tolerance for novelty and risk. Our findings suggest that many of the trends in contemporary requirements analysis reflect a shift toward exploitation at the expense of exploration. We argue that this is in large part a coping mechanism in reaction to the ambiguity and complexity driven by external market developments. Building upon the insight that exploration is essential for the long-term success of organizations, we argue that ISD professionals and project leaders will benefit from taking measures to ensure broader experimentation and discovery in their design efforts.

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