Persuasive technology as a means for increasing design utilization for the business IS portfolio

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Abstract

The costs of supporting highly complex and low usability software systems are often hidden. Users will often find ways to compensate for low usability by leverage other systems (dumping data to Excel), spending more time in the application (extra clicks, help desk calls), or abandoning the application altogether. We suggest that increased implementation of design can help IT achieve its goals of lower TCO, increased IS portfolio value, and higher customer satisfaction. In order to move design toward a more strategic position, we need to persuade two key constituents to increase their support of and funding for design: leadership and application delivery teams. This proposal will discuss the design principles, persuasive technology principles, design theories, and evaluation criteria that will inform the design, instantiation, and evaluation of OneIT. We will also discuss characteristics OneIT must have in order to present a holistic view of the IS portfolio, and persuade users to increase strategic use of design as a means for achieving organizational goals for IT. Finally, we present a high-level analysis regarding the support and resources that would be required to carry out the research project.

Keywords
Persuasive technology, design, IS portfolio, goal setting, software intensive systems, design theory

Introduction

The costs of supporting highly complex and low usability software systems are often hidden. Users find ways to compensate for low usability by leveraging other systems (dumping data to Excel), spending more time in the application (extra clicks, help desk calls), or abandoning the application altogether. While the IT organization used as a model in this paper is currently implementing processes and systems to track actual time spent on software systems, the other factors mentioned previously remain unmeasured. For example, there are currently no enterprise systems that gather software usage metrics, usability metrics, or code complexity metrics for the entire IS portfolio.

When funding requests for software systems are being compiled, application delivery teams struggle to deliver the quantitative information leadership needs to decide why their project is a better investment than the next project. Leadership in turn lacks the data to make proactive decisions, or to objectively determine which projects truly have the best potential for maximizing ROI. This creates an environment where it is typically the best salesman who wins and not necessarily the project with the highest return on investment (ROI) for the business. This situation leads to mixed results in terms of the value extracted from IT investments across the organization.

The user experience design (UxD) team resides in the service organization and provides on-demand design for business information systems supported by the application delivery teams. The UxD team primarily works on designs for specific projects. However, leadership support would also be needed to allow the UxD team to allocate a portion of their time to the following beneficial activities:

- Strategically analyze our existing application portfolio,
- Proactively grow their knowledge of the business and its needs,
- Stay abreast of technology developments in the market, and
- Periodically delivering proof-of-concept artifacts and position papers presenting strategic design ideas that could benefit the organization.

Design of business IS is not just an on-demand service, but rather a strategic collaboration with teams across IT to deliver maximum value for business users. In order to move design toward a more strategic position, we need to persuade two key constituents to increase their

support of and funding for design: leadership and application delivery teams. The goal of this paper is not to make a case for moving UxD out of the service organization, but rather to increase demand for design as a way of achieving IT goals of lower TCO, increased IS portfolio value, and higher customer satisfaction.

Business IS as it is used here refers to the internal and B2B applications used by employees to deliver value relative to their goals. These goals are a combination of overarching business goals, goals set for employees by their managers, and goals employees set for themselves. The ultimate purpose of this collection of goals is to deliver something that adds value to the business in some way.

In this paper, we will present a proposal for how OneIT would be designed and evaluated as a decision support system that leverages persuasive technology to achieve the stated design goals. Much, but not all, of the data required for OneIT is already available in one form or another across a myriad of systems. However, no projects have been undertaken to consolidate these data sources into a meaningful format that presents a truly holistic view of what it takes to support the business IS portfolio over time.

While the proposal presented here would benefit many groups in IT, the focus of this paper will be on the use of persuasive technology to drive greater utilization of UxD for business IS. This proposal will discuss the design principles, persuasive technology principles, and design theories that would inform the instantiation of OneIT as the IT design artifact. We will also discuss characteristics OneIT must have in order to present a holistic view of the IS portfolio and persuade users to increase strategic use of design to achieve organizational goals.

Persona and Goal Analysis

In order to move design toward a more strategic direction, we need to persuade two key personas through the OneIT system: leadership and application delivery teams. Leadership and application delivery teams have different goals they want to accomplish in addition to their common goals for the organization.

Leadership is concerned with justifying IT as a cost center by demonstrating the value they provide. This is done primarily through hard metrics (e.g., cost vs. business benefit, data center uptime, outage resolution, etc.) presented to senior leaders in the company.

These hard metrics are also invaluable when it comes to driving IT organizational change, which can be especially onerous in the absence of credible metrics that make a solid case for why teams should pursue one set of activities over another.

Application delivery teams are more concerned with delivering value as defined by their business customers. This value is often measured in number of enhancement requests fulfilled, on-time and on-budget delivery of new projects, and business customer satisfaction. Hard metrics important to leadership like cost vs. benefit analysis can often be hard to quantify especially when the business value is more qualitative. This makes using hard metrics with business customers challenging since other factors of customer relationship management take higher precedence.

As part of the system implementation project, ethnographic interviews would be conducted to further define these personas and goals, and the details of the persuasion context required for OneIT to be successful.

OneIT as Design Artifact

Currently, there does not exist a single location where IT can quickly and easily obtain a holistic view of the true cost of software systems. In addition, key metrics about usage, usability, and abandonment are not being captured consistently, or any many cases, at all. By gathering these additional metrics and creating a holistic view of all metrics related to business IS we propose that design can greatly improve key organization metrics related to TCO, portfolio value, and customer satisfaction.

We propose the use of persuasive technology as part of a new decision support system (DSS) called OneIT. In addition to incorporating elements of persuasive technology and DSS, OneIT is also an example of software-intensive systems, which are a complex blend of "software, people, computers, and other devices" that are combined to deliver value to end users (Freeman et al. 2004). Freeman et al. (2004) goes on to say that design will be critical in "conceptualizing, framing, implementing, commissioning, and ultimately modifying complex systems – not just the activity following requirements specification and before programming, as it might be translated from a stylized software engineering process."

As it relates to design, the goal of OneIT would be to motivate constituents to utilize more UxD services as a way to achieve their goals of lower TCO (leadership) and greater customer satisfaction (application delivery teams). OneIT would provide a global view of the portfolio using a combination of dashboards, graphical representations, tabular data, and communication modes. Persuasive events would encourage behavior that motivates teams and leadership to implement target behaviors in areas of high cost, high complexity, low usage and/or low usability that would benefit most from design. By encouraging leadership and application delivery teams to utilize design strategically, the organization can better leverage the unique capabilities of designers to discover innovative ideas that provide utility and usability to business users.

The following design propositions are presented as ways IT can lower support costs and improve the functional robustness and usability of software systems:

- Leverage best-in-class third-party and open source systems and components with an emphasis on web services to reduce our support costs of complex custom software
- Build custom software and components as a means to fill gaps not satisfied by systems and components available in the marketplace, or to provide functionality that represents strategic advantage for the organization
- When full custom-build software systems are needed, develop a strategy for building interfaces that provide business users with firmness (no bugs or downtime), commodity (suitable for the intended purpose), and delight (pleasurable user experience) (Kapor 1990; Winograd 1996).
- Ensure that all designs utilize best practices that improve scalability for future business needs, and accommodate refactoring or re-platforming as newer technologies become available.

These propositions would be incorporated into OneIT as part of the persuasive intent and then evaluated to determine their efficacy.

Persuasive Technology

The Persuasion Context

Chatterjee et al. (2009) present a view of persuasive technology as proposed by Fogg (2003): "persuasive technology [is] any interactive computing system designed to change people's attitudes and/or behavior," and that "interactive computing technologies can play three roles:…[they] can be persuasive by making target behavior easier,…by allowing people to explore cause-and-effect relationships…[and] by rewarding people with positive feedback."

Oinas-Kukkonen et al. (2009) present three elements of the persuasion context that must be taken into account when designing persuasive technology: the intent of the persuasion, understanding the persuasion event, and defining and/or recognizing the strategies in use. The full view of the phases of persuasive systems development as proposed by Oinas-Kukkonen et al. (2009) is presented in the figure below. An initial analysis of the persuasion context as it relates to OneIT is outlined here as well.

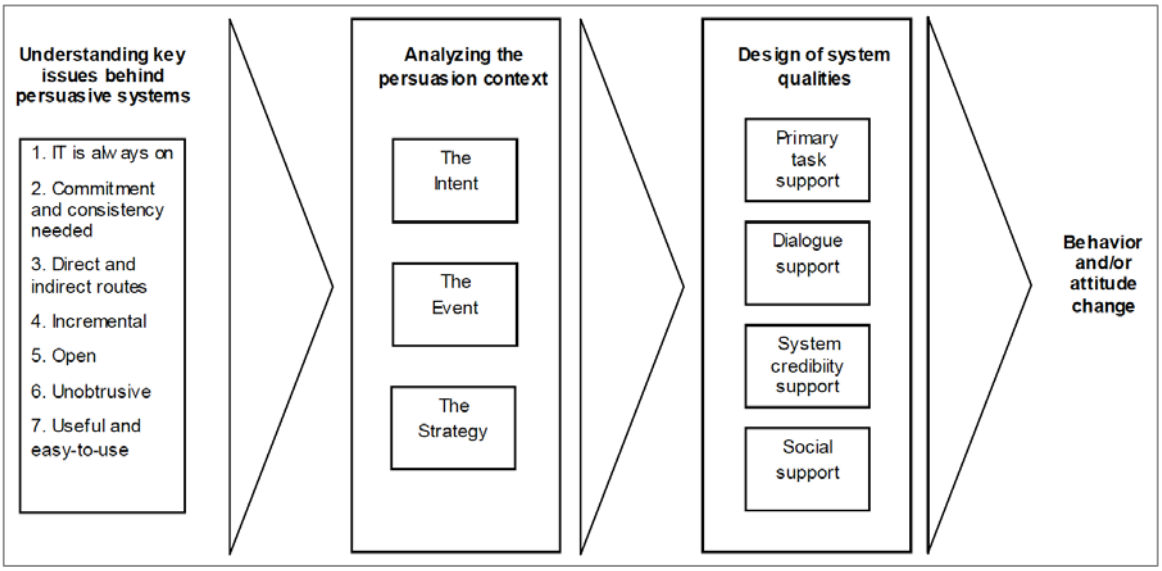

Figure 1: Phases in Persuasive Systems Development

The Intent. The persuasion intent for both personas can be summarized as such: The goal is to show personas the true TCO of their application portfolio, including qualitative and quantitative metrics, and then persuade them to set goals and take actions that lead to better TCO by increasing funding and support for design. The primary source of intent for OneIT will be exogenous, which is defined by Oinas-Kukkonen et al. (2009) as "those who give access to or distribute the interactive technology to others."

For OneIT to be effective it must be used by the entire IT organization and this requires open support and encouragement from leadership to drive consistent usage. The goal is to achieve behavior change but with the understanding that underlying attitudes often steeped in old IT methods (waterfall; developer plays all project roles), old technology (specific technology is in the dated or obsolete stages of maturity), or old ways of thinking (enhancing old systems has better ROI than rebuilding) heavily influence current behaviors.

We agree with the authors that changing previous attitudes and effecting permanent behavior change increase the difficult of implementing persuasive technology and effecting behavioral change. However, our initial analysis of the environment suggests OneIT must be able to drive user intentions toward permanent behavior and attitude change in order to be successful.

The Persuasion Event. Providing users with persuasive technology that encourages them "to set goals and to discover ways for achieving them in [a] systematic and effective way" is highlighted as a key component of good persuasive systems (Oinas-Kukkonen et al. 2009). In OneIT, leadership would set organizational goals in the system and all IT teams would be expected to set their own goals relative to IT leadership goals and those of their business partners.

We propose several areas where OneIT would drive behavior changes for the leadership and application delivery team personas, and have outlined them in Table 1: Persuasive Intent for Leadership and Application Delivery Teams. We focus our analysis here on the persuasive intent and event. The persuasive strategy will be defined during detailed design of OneIT.

Persuasive Intent for Leadership and Application Delivery Teams	
Persuasive Intent	**Persuasive Event**
Behavior Change: Dedicate fewer resources to enhancing/supporting low utilization components or systems, and divert those resources to design efforts that can uncover high ROI opportunities and design high utilization components or systems to better support business needs.	What could we save in support costs by shutting down the bottom 1-*n*% of pages, components and/or systems that have low utilization (e.g., low hit rate relative to other system pages)? What areas would benefit by diverting those savings to high-need or high-ROI activities?

Persuasive Intent for Leadership and Application Delivery Teams	
Persuasive Intent	**Persuasive Event**
Attitude Change: This system or component is business-critical and we can't live without it regardless of what the metrics say.	
Behavior Change: Decrease support of custom software by leveraging more third-party and open-source systems, as well as custom-built components and systems that can be expanded using design best-practices and web services to meet our specific business needs. *Attitude Change:* Nothing exists in the marketplace that does contact management (or other functional category) the way we need to do contact management; hence we need to build and continue supporting fully custom-built contact management systems.	What are the functional categories of our business IS portfolio is delivering functionality for, and what is the spread of components and systems across those categories? (e.g., How many systems have a contact management component? What could we save by moving to a common framework(s) for the entire organization?)
Behavior Change: Leverage design best practices to increase systems' ability to meet customer needs with less complexity, and to increase customer satisfaction and IT credibility by delivering rich, high-quality user experiences. *Attitude Change:* It's an in-house system used by employees; it doesn't need to "look pretty."	How much additional time do we estimate users are spending navigating through systems with high complexity and/or poor usability? (e.g., click stream analysis and eyeball tracking)
Behavior Change: Leverage ethnography and design best practices to define the core functional needs, and satisfy those functional needs with a more efficient, higher quality, and highly scalable interaction framework.	What could we save by winding down dated and obsolete stage mature technologies or highly complex code bases, and redesigning systems to work on newer technologies? (e.g., continuing to support old code vs. rebuilding on newer technology

Persuasive Intent for Leadership and Application Delivery Teams	
Persuasive Intent	**Persuasive Event**
Attitude Change: This system will "never" go away because it's been around for 10 years, is critical to the business, and is too complex to ever be re-platformed.	and winding down support for that old code)

Table 1: Persuasive Intent for Leadership and Application Delivery Teams

The Strategy. OneIT will need to employ a combination of both direct and indirect strategies for persuasion. At a high-level, indirect processes like visual queues and less rich media will be used to trigger heuristics that drive initial behavior (Oinas-Kukkonen et al. 2009). However, indirect processes must also be accompanied by direct processes when a more careful evaluation of the intent and event are required before the user can move forward (Oinas-Kukkonen et al. 2009). For example, leadership may rely heavily on indirect processes throughout the year to track progress but both leadership and application delivery teams would require a more direct persuasion strategy when reviewing funding requests.

Design Considerations

Oinas-Kukkonen et al. (2009) propose four categories of principles for consideration when designing persuasive technology: primary task, dialogue, system credibility, and social support. While OneIT will provide all users access to the same overall functions, the specific data and persuasive context elements will change based on goals and objectives of the general persona, team, and individual employee. The tables below included the principles and definitions proposed by Oinas-Kukkonen et al. (2009) and how these might be implemented for OneIT.

Primary Task Support	
Principle	**Proposed Implementation for OneIT**
Reduction A system that reduces complex behavior into simple tasks helps users perform the target behavior,	Compile data from relevant sources reducing processing overhead for users. Users set goals, track progress, and

Primary Task Support	
Principle	**Proposed Implementation for OneIT**
and it may increase the benefit/cost ratio of a behavior.	simulate different decision options all within the same system.
Tunneling Using the system to guide users through a process or experience provides opportunities to persuade along the way.	Offer suggestions for system enhancements or new projects based on the current portfolio performance, and goals set by users.
Tailoring Information provided by the system will be more persuasive if it is tailored to the potential needs, interests, personality, usage context, or other factors relevant to a user group.	Views are customized based on the persona and then customized further for the actual user and their team. Recommendations are provided based on information relevant to their domain and mental model.
Personalization A system that offers personalized content or services has a greater capability for persuasion.	Implementation of information architecture best practices would focus on presenting data in the order of importance for users.
Self-monitoring A system that keeps track of one's own performance or status supports the user in achieving goals.	A personal goal monitor can be customized at various levels to show users how they are progressing relative to their goals, goals for the organization, and goals of their peers.
Simulation Systems that provide simulations can persuade by enabling users to observe immediately the link between cause and effect.	Simulation capability provides users with the option to analyze and compare the effect of one or more actions before those actions are taken. This can be used to simulate the impact of taking system recommended actions vs. actions the user chooses on their own.
Rehearsal A system providing means with which to rehearse a behavior can enable people to change their attitudes or behavior in the real world.	Simulations are beneficially in helping users "rehearse" the actions they may want to take and which ones would have the most impact.

Table 2: Persuasive Technology Principles: Primary Task Support

Dialogue Support	
Principle	**Proposed Implementation for OneIT**
Praise By offering praise, a system can make users more open to persuasion.	Alerts would be displayed when users had successfully achieved a goal. Visual queues would convey positive feedback to users if they are on-track to achieve their goals, or are outpacing alternative options they did not select from the simulation.
Rewards Systems that reward target behaviors may have great persuasive powers.	A reward system would assign virtual points for achieving certain target behaviors. These virtual points could then be used in real life to obtain something of value for the user or their team (e.g., company funded team outing for the team with the most points at quarter or year end).
Reminders If a system reminds users of their target behavior, the users will more likely achieve their goals.	Alerts would remind users of goals and tasks they need to achieve during the time frame they have defined.
Suggestion Systems offering fitting suggestions will have greater persuasive powers.	Good knowledge management and tracking of all goals in the system would improve the quality of suggestions over time and thus increase users desire to consider system-recommended actions.
Similarity People are more readily persuaded through systems that remind them of themselves in some meaningful way.	Avatars, nicknames, team names, personal blogs, profile pictures, and a selection of style sheets allow users to customize the system so it reflects who they are.
Liking A system that is visually attractive for its users is likely to be more persuasive.	Incorporate highly appealing visual style including, but not limited to, a well-chosen color palette, cutting edge graphs and charts, and appropriate fonts.
Social role If a system adopts a social role, users will more likely use it for	Blogs, wikis, and comments encourage social networking and sharing of ideas within the team

Dialogue Support	
Principle	**Proposed Implementation for OneIT**
persuasive purposes.	as well as with other teams.

Table 3: Persuasive Technology Principles: Dialog Support

System Credibility Support	
Principle	**Proposed Implementation for OneIT**
Trustworthiness A system that is viewed as trustworthy will have increased powers of persuasion.	Raw data and calculations presented to users must be thoroughly tested before launch and validated periodically to ensure they are accurate.
Expertise A system that is viewed as incorporating expertise will have increased powers of persuasion.	Knowledge management using wiki and blog technology can provide information and advice from subject matter experts in various domains across IT and other credible third-party sources. The system should ideally incorporate capability to learn patterns over time and provide more refined expert recommendations.
Surface credibility People make initial assessments of the system credibility based on a firsthand inspection.	All information and functions presented to the user make sense and fit with their mental model and with the overall goals they want to achieve.
Real-world feel A system that highlights people or organization behind its content or services will have more credibility.	The support team along with authors of blog and wiki content are identifiable by name, and are easy to contact through the system.
Authority A system that leverages roles of authority will have enhanced powers of persuasion.	Quotes, comments, and statements from leadership about the content presented to users lend an air of authority and purpose to the system.
Third-party endorsements Third-party endorsements, especially from well-known and	Quotes, comments, and statements from people outside IT can communicate the value that

System Credibility Support	
Principle	**Proposed Implementation for OneIT**
respected sources, boost perceptions on system credibility.	IT has provided by implementing the goals they set for themselves via the system.
Verifiability Credibility perceptions will be enhanced if a system makes it easy to verify the accuracy of site content via outside sources.	Users should be able to access information about the source of data and when it was last updated. Detailed raw data dumps should also be made available where appropriate and where impact to network performance would be minimal.

Table 4: Persuasive Technology Principles: Credibility Support

Social Support	
Principle	**Proposed Implementation for OneIT**
Social learning A person will be more motivated to perform a target behavior if (s)he can use a system to observe others performing the behavior.	Providing all IT users with full visibility of other teams goals and progress allows them to see how other teams or individuals have implemented target behaviors and the resulting impact.
Social comparison System users will have a greater motivation to perform the target behavior if they can compare their performance with the performance of others.	Dashboards comparing performance across IT encourages teams to pursue their goals, and proactively modify goals where they feel they are not keeping pace with their peers.
Normative influence A system can leverage normative influence or peer pressure to increase the likelihood that a person will adopt a target behavior.	Dashboards displaying a team or individual's contribution to the overall goals can exert pressure on those who are not implementing the target behaviors consistently or at all.
Social facilitation System users are more likely to perform target behavior if they discern via the system that others are performing the behavior along with them.	Dashboards showing progress and performance across IT help to reassure teams that others are also working towards target behaviors.

Social Support	
Principle	**Proposed Implementation for OneIT**
Cooperation A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to co-operate.	Metrics and system suggestions can encourage teams to collaborate with other teams to reach mutual goals.
Competition A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to compete.	The drive to be the best encourages teams to set more ambitious goals that can be beneficial to IT's overall performance.
Recognition By offering public recognition for an individual or group, a system can increase the likelihood that a person/group will adopt a target behavior.	Recognizing top performing individuals and teams on the system's homepage or other areas of the site further encourages the recognition recipient as well as their peers to continue working toward their respective target behaviors.

Table 5: Persuasive Technology Principles: Social Support

Review of Relevant IS Theories

Design Theory

While the building of design theory has proven challenging for IS researchers, some progress has been made in the field in terms of how to conduct design science research. We will review how OneIT design can be informed by the design science research methodology (DSRM) proposed by Peffers et al. (2008), and the design-science research guidelines proposed by Hevner et al. (2004).

Peffers et al. (2008) reviewed existing literature and published a paper related to the development of design science research methodology. The authors provide the following definition of design science research:

> "'Design science…creates and evaluates IT artifacts intended to solve identified organizational problems.' It involves a rigorous process to design artifacts to solve observed problems, to make research contributions, to

> evaluate the designs, and to communicate the results to appropriate audiences. Such artifacts may include constructs, models, methods, and instantiations. They may also include social innovations or new properties of technical, social, or informational resources; in short, this definition includes any designed object with an embedded solution to an understood research problem" (Peffers et al. 2008).

Hevner et al. (2004) propose that for "the design-science paradigm, knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact." To facilitate Hevner et al.'s proposal, they present seven guidelines aimed at "[informing] the community of IS researchers and practitioners of how to conduct, evaluate, and present design-science research:"

- Guideline 1: Design as an artifact
- Guideline 2: Problem relevance
- Guideline 3: Design evaluation
- Guideline 4: Research contributions
- Guideline 5: Research rigor
- Guideline 6: Design as a search process
- Guideline 7: Communication of research.

We include the guidelines and descriptions presented by the authors in their 2004 paper along with an analysis of how these guidelines would apply to OneIT implementation as IT artifact.

Design-Science Research Guidelines		
Guideline	**Description**	**Implications for OneIT**
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.	OneIT is the IT artifact presented in the form of an instantiation (system implementation).
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.	The relevant problems include measuring, managing and reducing TCO through activities such as decreasing complexity and increasing scalability; measuring, managing and increasing value of the business IS

Design-Science Research Guidelines		
Guideline	**Description**	**Implications for OneIT**
		portfolio; and increasing customer satisfaction through the delivery of rich, highly functional and highly usable business IS.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.	OneIT will be evaluated against a number of metrics related to "functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality attributes." (Hevner et al. 2004). The primary design evaluation methods that will be utilized for OneIT will be observational, analytical, testing, and descriptive (Hevner et al. 2004).
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.	The contribution of OneIT will mainly be in the design artifact, more specifically, how to leverage design as a strategic partner for realizing lower TCO, increased IS portfolio value, and increased customer satisfaction.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.	Rigor and relevance will need to be balanced to ensure that "excessive formalism…[and] an attempt to be mathematically rigorous" do not lessen the

Design-Science Research Guidelines		
Guideline	**Description**	**Implications for OneIT**
		relevance of OneIT for practitioners (end users). Research rigor will be "derived from the effective use of the knowledge base – theoretical foundations and research methodologies, …behavioral theories and empirical work" to "understand why an artifact works or does not work" (Hevner et al. 2004).
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.	Design best-practices and processes will be used to explore "the set of possible design solutions" that represent "satisfactory solutions, i.e., satisfying, without explicitly specifying all possible solutions." Usability testing with end users will help to determine which design solutions would work best for a given environment, scenario, and persona (Hevner et al. 2004).
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.	Research results will be documented so other researchers can "understand the processes by which the artifact was constructed and evaluated" in an effort to promote repeatability, build the knowledge base, and

Design-Science Research Guidelines		
Guideline	**Description**	**Implications for OneIT**
		enable further research that builds cumulative research (Hevner et al. 2004). The documented research results will also be used to communicate to practitioners "the importance of the problem and the novelty and effectiveness of the solution approach realized in the artifact" (Hevner et al. 2004).

Table 6: Design-Science Research Guidelines

Media Richness Theory

We proposed earlier that leadership would need to openly support and encourage the use of OneIT in order for it to be successful. While this is important, a business mandate does not exempt the system from adopting good design principles. One of those principles is to ensure that the media and presentation are a fit for the users needs in order to ensure appropriation and adoption (Dennis et al. 2008). This will be accomplished by leveraging a combination of media (the system itself, email alerts, success stories in team newsletters, etc.) to achieve maximum benefit (Shahriza et al. 2005; Watson-Manheim and Belanger 2007).

Ethnographic interviews will be invaluable for providing a better understanding of "the nature of the individuals and the context in which they will work, as this may suggest differing requirements for media capabilities" (Dennis et al. 2008).

Unified Theory of Acceptance and Use of Technology

Ventatesh et al. (2003) proposed a unified theory of acceptance and use of technology (UTAUT) that brought together constructs from various existing theories. UTAUT seeks to address the issue researchers often face where they are compelled to select a limited

theory or construct set to define their research. This results in the loss of insight that can inform their research and analysis since otherwise valuable constructs from different theories may be omitted (Venkatesh et al., 2003).

Venkatesh et al. (2003) highlights four out of the seven constructs that were deemed to be significant determinants of user acceptance and usage behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions. These four factors will be key to the success of OneIT. The ethnographic interviews and requirements analysis will provide deeper insights into how each of these constructs will be impacted by various environmental factors, and how the design will need to respond to those factors.

Cognitive Fit Theory

Within OneIT, the persuasive context and relevant data will be presented using two key formats presented by Vessey (1991): graphical and tabular representations. Vessey proposes that in order to reduce complexity in the task environment, the solution must support the methods or processes required to complete the task. This cognitive fit leads to "increased problem-solving efficiency and effectiveness" (Vessey 1991). Thus the use of graphical and tabular representations will need to be properly matched to the task, or in this case the desired behavior change (Vessey 1991).

Vessey (1991) proposes the following about cognitive fit:

> "…when a mismatch occurs between problem representation and task, similar processes cannot be used to both act on the problem representation and solve the problem, and problem solvers will therefore no longer be guided in their choice of problem-solving processes…performance will be worse than if the problem solver had been supplied a representation emphasizing the type of information that best supported task solution."
>
> "In effect, cognitive fit encourages the use of consistent (and therefore optimal) problem-solving processes in the solution of a specific task, resulting in performance advantages."

Vessey (1991) goes on to state that while decision makers, in this case leadership and application delivery teams, could use either graphical or tabular representations to make a decisions, there exist efficiency and

performance advantages when one is used over the other in certain scenarios.

Graphs are considered "spatial representations [that] facilitate viewing the information contained therein at a glance without addressing the elements separately or analytically" (Vessey 1991). In Vessey's (1991) analysis of Umanath et al., Vessey notes that spatial relationships lend themselves toward "tasks [that] require making associations or perceiving relationships in the data." Vessey (1991) quotes Jarvenpaa and Dickson (1988) as stating that graphics are preferred over tables for these elementary tasks: "(1) summarizing data, (2) showing trends and relationships over time, (3) comparing data points and relationships for variables, (4) detecting deviations or differences in data."

Based on these findings, the use of *graphical representation* would be preferred over tabular representation for the following OneIT functions:

- Presenting dashboard views of how teams and individuals are progressing towards goals, and how the IT organization is trending towards its goals
- Comparing individual progress to that of other teams and against the IT organization as a whole
- Simulating the effect of one behavior change over another and how the effects of different behavior changes compare to each other
- Displaying variations in progress towards goals vs. baselines, targets, or comparative team performance
- Summarizing metrics that represent the relationship between behavior changes made and the actual effect on metrics

Tables are considered "symbolic representations [that] facilitate extracting specific data values" (Vessey 1991). Tables lend themselves best to tasks that "[require] a specific amount as the response" where that specific amount is best extracted from discrete values (Vessey 1991). Based on these findings, *tabular representation* would be preferred over graphical representation for the following OneIT functions:

- Providing detailed numbers to present hard metrics for use in funding proposals and leadership presentations
- Providing detailed numbers to explain trends, and positive or negative effects resulting from persuasive events and the resulting behavioral changes

- Extracting cost and benefit numbers to be used in financial calculations (e.g., capital expenditures taken or required, ROI, IRR, etc.)

Theory of Goal Setting

The Locke et al. (2002) theory of goal setting is "based on Ryan's (1970) premise that conscious goals affect action" and that "a goal is the object or aim of an action…usually within a specified time limit." Goal setting theory was created as part of their effort "to predict, explain, and influence performance on organization or work-related tasks" (Locke et al. 2002).

Figure 1 is a graphical model of the goal-setting theory and high-performance cycle as presented by Locke et al. (2002).

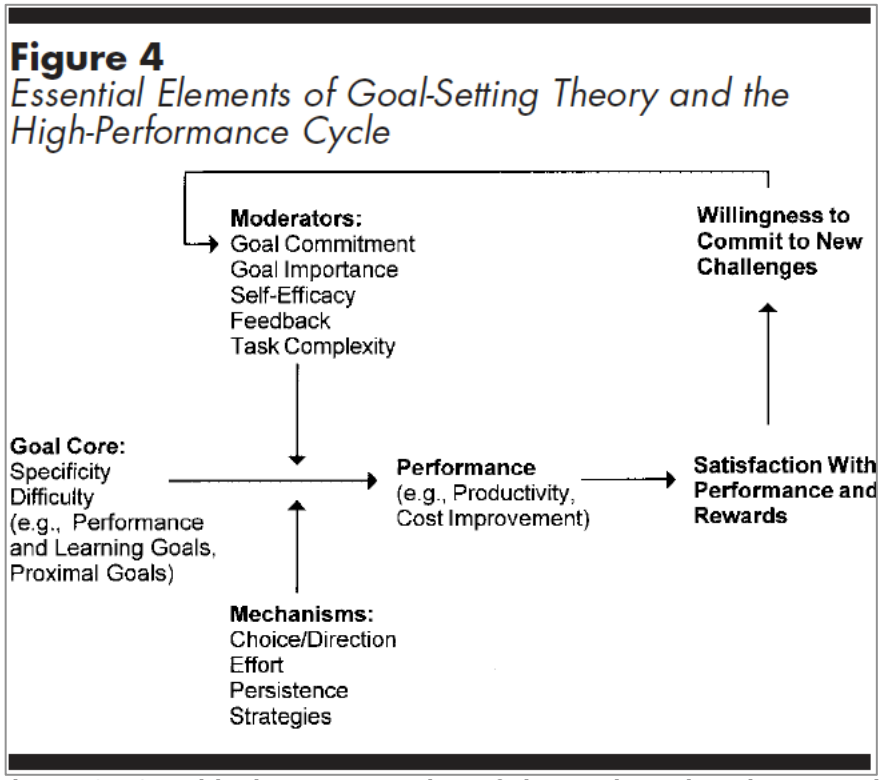

Figure 2: Graphical representation of the goal-setting theory and high-performance cycle as presented in the Locke et al. (2002) paper

Based on their review of previous literature, Locke et al. (2002) state that "the goal–performance relationship is strongest when people are committed to their goals" and that "commitment is most important and relevant when goals are difficult… because goals that are difficult for people require high effort and are associated with lower chances of

success than easy goals." We discuss here several constructs of Locke et al.'s theory of goal setting that are especially relevant for OneIT.

First, is the construct of *goal importance* that focuses on "[convincing] people that goal attainment is important," and proposes "making a public commitment to the goal enhances commitment, presumably because it makes one's actions a matter of integrity in one's own eyes and in those of others" (Locke et al. 2002). Locke also proposes an alternative to imposed goals which is "to allow subordinates to participate in setting them" based on the theory that "this would make goals more important to the person because one would, at least in part, own the goals." OneIT would reinforce the construct of goal importance by providing teams and individuals with the ability to simulate cause-effect scenarios, analyze spatial (graphical) and discrete (tabular) data, and set their own goals that can either stand-alone or link to organizational goals.

Second, is the construct of *self-efficacy*, which "enhances goal commitment" (Locke et al. 2002). In their review of previous literature from Bandura (1997) and White et al. (2000), Locke et al. (2002) goes on to state that "leaders can raise the self-efficacy of their subordinates (a) by ensuring adequate training to increase mastery that provides success experiences, (b) by role modeling or finding models with whom the person can identify, and (c) through persuasive communication that expresses confidence that the person can attain the goal." OneIT would enable leadership to increase self-efficacy by commenting on success stories, communicating regularly about OneIT related activities and highlights, and providing other "inspiring messages" and "cognitive stimulation" (Locke et al. 2002).

Third, is the construct of *feedback* that says "for goals to be effective, people need summary feedback that reveals progress in relation to their goals" because "if they do not know how they are doing, it is difficult or impossible for them to adjust the level or direction of their effort or to adjust their performance strategies to match what the goal requires" (Locke et al. 2002). OneIT would accomplish this by providing functionality for graphical dashboards; system and user generated comments; mentoring and coaching; and peer as well as leadership feedback to support the need for feedback as an integral part of effective goal setting and accomplishment (Locke et al. 2002).

Last is the construct of *task complexity*, which proposes that as task complexity increases, "goal effects are dependent on the ability to discover appropriate task strategies," and "because people use a

greater variety of strategies on tasks that are complex than on tasks that are easy, measures of task strategy often correlate more highly with performance than do measures of goal difficulty" (Locke et al. 2002). Locke et al. (2002) also goes on to state "proximal feedback regarding errors can yield information for people about whether their picture of reality is aligned with what is required to attain their goal." OneIT would enable users to set goals, manage their task strategy, and also utilized the communal framework to research whether others have formulated effective task strategies to accomplish similar goals. The system would also enable an automated as well as human-moderated feedback loop to ensure that goals match what can realistically be accomplished.

Locke et al. (2002) list a set of factors that can lead to goal failure:

- "not matching the goal to the performance measure,
- "not providing feedback,
- "not getting goal commitment,
- "not measuring the person's personal (self-set) goals,
- "not conveying task knowledge,
- "setting a performance goal when a specific high-learning goal is required,
- "not setting proximal goals when the environment is characterized by uncertainty, or
- "not including a sufficient range of goal difficulty levels (see Locke & Latham, 1990, chapter 2)."

These potential failures would need to be mediated using a combination of organization processes (e.g., coaching, mentoring, goal review), and functionality within OneIT (e.g., simulation, trend comparison, social networking).

Additional Theories for Consideration

Time has not permitted for a thorough analysis of all relevant IS theories for this proposal, however, we list here additional theories for further review that have potential to inform the structure of the research project, and the design and evaluation of the IT artifact.

Theory
Knowledge based theory of the firm

Theory
Delone and McLean IS success model
Organizational information processing theory
Information processing theory
Diffusion of innovations theory
Game theory
Change theory
Communication theory
Decision theory
Markus' IT power relationship
Organizational learning theory
Theory of sensemaking

Evaluation Criteria for OneIT

Hevner et al. (2004) state, "The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods." Hevner et al. (2004) also point out the following about evaluation metrics:

> "The business environment establishes the requirements upon which the evaluation of the artifact is based. This environment includes the technical infrastructure which itself is incrementally built by the implementation of new IT artifacts. Thus, evaluation includes the integration of the artifact within the technical infrastructure of the business environment."

An initial summary of these metrics is listed in the section below entitled *Quantitative and Qualitative Metrics to be Evaluated*.

Four of the five design evaluation methods will be used to determine how effectively OneIT has achieved metrics targets relevant to the business. We have omitted Experimental since the goal is to implement a working system in production and study its use in the real-world context with live data. The design evaluation methods and their descriptions are listed in Table 7: Design Evaluation Methods.

Design Evaluation Methods	
1. Observational	Case Study: Study artifact in depth in

Design Evaluation Methods	
	business environment
	Field Study: Monitor use of artifact in multiple projects
2. Analytical	Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical IS architecture
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
	Simulation: Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

Table 7: Design Evaluation Methods

Quantitative and Qualitative Metrics to be Evaluated

- What were the actions taken by teams when deciding how to prioritize and allocate time and resources used on business IS activities?
- What proactive strategic decisions by leadership and/or the application delivery teams were made as a result of better access to data?
- Based on surveys, where did leadership and project teams feel they made decisions differently because of OneIT:

    - More funding in areas that hadn't received funding before?
    - Less funding in areas previously thought to be high value?
    - Funding of new ideas teams had not, or could not have, considered without this data?
- Based on surveys, to what extent did OneIT provide users with visibility into business IS that they did not have before?
- Did the system's suggestions based on metrics result in activities to improve the suggested areas?
- How did improvements perform in relation to increases or decreases in cost, design utilization, business IS performance, TCO, customer satisfaction, etc.?
- Did utilization and implementation of design increase?
    - How many more new design interfaces were deployed to production vs. previously?
    - How many more strategic (affects many business groups) vs. operational (affects a single business group) designs did they work on?
    - How were designers able to leverage metrics to inform their sanctioned design projects, and greenfield projects for exploring new ideas?
- What are customers saying about the enhanced design of their business IS?
    - Based on before and after surveys, how well did the design improvements add additional utility, usability, and/or performance?
    - Did customer's assessment of IT improve and what are the factors that gave IT more credibility, higher satisfaction, and/or higher net promoter scores?
- Did users find OneIT to be useful and how so? If not, what are the areas for further improvement?
- Would users recommend OneIT to a colleague?

Discussion

This proposal has focused on the design principles, persuasive technology principles, and design theories that would inform the instantiation of OneIT as design artifact. We have presented a provisional analysis of the personas and goals and have shown how persuasive events could be customized to address the user mental model and desired persuasion intent. We have discussed characteristic OneIT must have in order to present a holistic view of the IS portfolio and persuade users to increase strategic use of design to achieve

organizational goals for IT. An initial set of qualitative and quantitative metrics to be evaluated has also been presented.

The OneIT artifact and documentation of findings have the potential to deliver a second IT artifact which is a model for IS portfolio management in organizations where leaders are challenged to drive beneficial behaviors and demonstrate the value of IT, and where delivery teams are challenged to deliver measurable value and customer satisfaction.

As such, we are seeking leadership support and funding of a two-year research project. Year one will focus on analysis of the problem domain and implementation of OneIT. Year two will focus on implementing enhancements, conducting evaluations, and documenting the research findings. In order to carry out the research, a project team with the following skill sets will be required: design; project management; business analysis; software architecture; rich internet application development; usability, quality assurance, and performance testing; data management and infrastructure; and domain expertise for all relevant systems.

Conclusion

In this paper we have presented a proposal for a OneIT system that would provide a holistic view of TCO for the business IS portfolio, and leverage persuasive technology to drive behavioral changes leading to increased utilization of design. OneIT represents the IT artifact as instantiation. Evaluation would be performed on the IT artifact to determine how well it has improved qualitative and quantitative metrics important to the IT organization. Finally, we have presented a high-level analysis regarding the support and resources that would be required to carry out the research project.

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