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Abstract

Information Systems (IS) development has produced some undesirable results, from project mismanagement to production of unusable systems. Relevant research suggests that this is not new in the field of IS. The state of affairs in system development is not entirely dark and gloomy though. Roberts and Bea (2001) suggest that some organizations have been very successful in their implementation of complex systems. High Reliability Organizations (HRO's) not only display an outstanding record of success in the development and implementation of technology, they accomplish this in an environment where mistakes often invite disastrous results.

When a disaster occurs, such as the Challenger disaster, investigations ensue, and findings are made public. More importantly, the way the organization operates changes dramatically. IS project management failures present a less magnified version of comparable symptoms found in HRO disasters. The main difference is that it is often not made public, no one is officially blamed, and therefore, no sincere effort is made to improve how IS projects are managed.

Enterprise Resource Planning (ERP) system development involves a complex merging of technical systems "know how" along with a profound understanding of industry best practices. Failures in ERP system development projects can be catastrophic for the organizations that fail to manage them properly, even if it doesn't make front-page news.

A conceptual framework is proposed and a research design outlined to facilitate a study of the factors that determine success and failure among HRO and ERP system projects with a view to identifying those factors that may contribute to a higher success rate amongst ERP system implementations.

Introduction

Information Systems (IS) development has produced some undesirable results, from project mismanagement to production of unusable systems. Relevant research suggests that this is not new in the field of IS. Laudon and Laudon (1998) have suggested that 51% of all IS projects consume of 2 to 3 times the financial resources than originally budgeted and possibly up to 3 times the time resources than estimated at the beginning of the project. Ewusi-Mensah (1997) reported similar statistics by suggesting that approximately one third of all IS projects are abandoned before they are completed and that over 50% of projects that reach completion cost almost twice their original budget. Further, Laudon and Laudon (1996) have also suggested that 75% of completed projects are considered to be operating failures that provide no benefit to the organization.

Research conducted by the Standish Group (1994) identified three types of IS project outcomes, namely: successful, challenged, and impaired. From this research they concluded that over 83% of IS projects had significant difficulties with regard to schedule or budget projections (challenged), or were outright failures due to termination or abandonment (impaired).

Current research suggests that system development for the IT/IS industry continues to be characterized by extensive failures, and that project management is in a state of chaos (Yeo, 2002). Consequentially, systemic approaches to IS project management have been developed in order to facilitate effective IS project management. For example, Yeo proposed a "soft systemic" triple-S framework consisting of a process component, dealing with discourse processes and change management; a context component, addressing the "why" of change, culture, leadership, and organizational issues; and a content component, dealing with technical and business process issues (Yeo, 2002). Models such as these have been claimed to improve the likelihood of success. However, from the Standish Group's study concerned with identifying the critical success factors of IS projects and involving sixty IT professionals, Martin Cobb, Treasury Board of Canada Secretariat, Ottawa, Canada was quoted as saying:

> "We know why projects fail, we know how to prevent their failure-- so why do they still fail?" (The Standish Group, 1996, p.2).

Thus it appears that understanding the problem and developing a "solution" still falls short of ensuring success as system development projects, even in their simplest forms, are likely to fail. Yet, in spite of the bleak picture painted by IS researchers, organizations all over the world continue to design, develop, install, and upgrade their information systems. Apparently, the pursuit of the perceived benefits outweighs the inherent risks.

Information systems are developed to run part, or all, of their operations. Further, ERP systems are designed to integrate all of the functional areas of an organization, in a vastly complex "system of systems". ERP systems provide a comprehensive method of integrating an organization among its own functionality as well as with other organizations. Certainly, the risks are significant, since a complex system is inherently more prone to failure than a simple one. Therefore, an over-budget, behind-schedule development process could drain the organization of critical financial resources, possibly with fatal consequences.

The above withstanding, Roberts and Bea (2001) suggest that some organizations have been very successful in their implementation of complex systems (e.g., those controlling nuclear power stations and chemical processes.). These organizations, by the very nature of what they do require a high degree of reliability from their systems, procedures, and people.

High Reliability Organizations (HRO's) are entities that operate in an environment where the tolerances for error are extremely slim. Roberts (1990) identifies it means to be an HRO by asking the question, "How often could this organization have failed with dramatic consequences?". She then suggests that if failure could have occurred many thousands of times, the organization is highly reliable. Roberts further concludes "performance reliability rivals productivity as a dominant goal" (Roberts, 1990; p.102). The National Aeronautics and Space Administration (NASA) and the United States military often push the limits of technology with relatively few significant failures.

NASA and the US military operate in a different culture with different imperatives that dictate that a system failure, especially one that results in a loss of life, is to be avoided at all costs. HRO's are not immune to catastrophic system failures though. The Challenger Disaster, crashes of the US Marine Corps Osprey aircraft, and more recently, the USS Greeneville collision with a Japanese fishing trawler, are examples of catastrophic system failures.

While a system failure for an industrial information system can be as minor as a temporary inconvenience or as severe as a threat to the existence of an organization, a system failure for an HRO is a often a publicly visible man-made disaster.

The objective of this paper is to present a conceptual framework that will be used to inform research into this important area of IS/IT system implementation. A research design is also developed which will be used to facilitate the investigation for future research in order to determine what the commercial system development sector could learn, if anything, from the historical successes of HRO's.

Background

Flowers (1996) defines an information system as, "a wide combination of computer hardware, communication technology and software designed to handle information related to one or more business processes". Yeo suggests that an information system coordinates various functional areas of an organization, from administrative operations, such as payroll, inventory, and personnel, to strategic management processes for industries such as banking travel and insurance (Yeo, 2002).

What is information and what purpose do information systems serve? Bell and Wood-Harper (1998) define information as "structured data that has a contextual meaning" that provides the user of the information with knowledge necessary to make effective decisions. Avison and Fitzgerald (1995) suggest that the processes of selecting, sorting, and summarizing data in a particular context denote the information's usefulness to the recipient. Bell and Wood-Harper (1998) conclude that information systems are supposed to "inform" their users or clients. Checkland and Scholes (1990) suggest that information systems exist in order to support people taking action in the real world.

While there is ample literature to illustrate what information is, what information systems are "supposed to" do, and how to develop these systems, there is substantial evidence that suggests that IS development projects are plagued by difficulties and outright failures.

Types of IS Failure

As noted before, the Standish Group suggests that an overwhelming number (83.8%) of IS projects experience outcomes that are categorized as difficult or failed. Three categories of IS project outcomes were identified, and a sampling of IS projects were classified in each category.

The first, and most desirable, "successful" (16.2%), are projects completed on time, within budget, with all original operational requirements operating as specified. The second type of outcome, "challenged" (52.7%), although completed and operational, encountered budget and/or schedule overruns, and may have a reduced set of the original features specified. Finally, The Standish Group describes a type three IS project outcome, "impaired" (31.1%), which are projects that are abandoned or canceled during development (The Standish Group, 1994). Accordingly, only 16.2% of IS projects are considered to be successful, where as much as 83.8% encounter some form of significant difficulty.

Lyytinen and Hirschheim (1987) have identified four major types of failures for information systems:

- Correspondence failure
- Process failure
- Interaction failure
- Expectation failure (Lyytinen and Hirschheim, 1987).

Correspondence failure occurs when system design objectives are not met. It is assumed that system requirements are specified clearly enough at the beginning of the project so that they can be measured quantifiably upon delivery of the system.

Characteristics of a process failure are when a system is not developed within the allocated time and budget constraints. Lyytinen and Hirschheim cite two possibilities for a process failure. First is that the system is hopelessly unworkable, and further effort will not produce a useful system. Secondly, and more commonly, a process failure can occur when the project experiences runaway spending of time and money resources that eventually negate the organizational benefits of the system. This phenomenon is attributable to symptoms of poor project management performance.

The third type of failure, interaction failure, is characterized by a lack of acceptance for the system by the user community. While it is difficult to measure user attitudes and satisfaction, an outright revolt by the user community often is a sign of a poorly designed system.

The final type of failure is an expectation failure, where the system fails to deliver the return on investment that its stakeholders anticipated. It is the difference between the actual and the desired results that a system delivers to those who have a vested interest in it. In this case it is often difficult to identify where the shortcomings are, rather this type of failure is viewed in more holistic terms (Lyytinen and Hirschheim, 1987).

More recently, Flowers (1996) identified four situations that denote failure in system development. The first situation occurs when the system as a whole does not perform as expected and its overall capability does not live up to expectations. Secondly, a system can be a failure if it is so "user-hostile" that the user community resists using it or it is profoundly rejected. The third way a system can fail is when it consumes excessive amounts of time and monetary resources throughout its life cycle, thus reducing its benefit to the organization. Lastly, and more obviously, if a system is abandoned before it is completed, either due to improper project management, or the inability to overcome issues related to the excessive complexity of the system, it is considered a failure (Flowers, 1996).

Flowers develops this theory further by identifying a set of interactive critical failure factors (CFF's) that influence all system development projects as organizational, financial, technical, human, and political. These factors are interesting in that they are consistent with the conclusions proposed in other research (i.e., Lyytinen and Hirschheim, 1987; Presidential Commission, 1986; Vaughan, 1990), that the most influential causes for system development failure are socio-organizational, not technical. Flowers identifies specific organizational and managerial factors such as hostile company culture, political pressures, vested interests, and a lack of management commitment. Factors related to the project itself include pre-occupation with technology in project planning, underestimating the project complexity, design by committee, and lack of competence among project management and project team (Flowers, 1996).

Time has shown that, while information technology improvements have been introduced at a blistering pace, project management techniques, and the outcomes associated with them have not yielded corresponding improvements.

ERP Systems

Enterprise Resource Planning (ERP) systems are highly integrated, cross-functional systems that are designed to manage an entire organization or multiple organizations. In addition to an infrastructural holism, ERP system developers are addressing project management issues for these systems as well.

SAP develops ERP systems for a wide variety of customers, requiring a comprehensive knowledge of how the relevant industries operate. Using industry best practices SAP is able to develop systems for companies in industries such as, financial services, communications, manufacturing, distribution, and public services (SAP, 1999).

According to SAP, when an organization embarques on an ERP system development project, there are suggested project management procedures that the organization should "sign on to" in order to ensure a successful system implementation. SAP refers to these procedures as "Solution Maps" (SAP, 1999). Based on the requirements of the organization and the industry in which it exists, a series of integrated software modules are assembled to compile the system. The goal is to build a system that is tailored to the organization, yet complies with industry best practices.

Unfortunately, opportunities exist throughout this process where the organization can significantly reduce its chances of success. Of these, the most commonly overlooked area of change is in the way the organization manages its business, i.e. the human side (Wah, 2000).

HRO's conduct business in dangerous environments, often with significant public visibility and political pressure, and yet they develop and operate some of the most sophisticated technology with amazing success.

What Makes HRO's So Successful?

HRO's often operate in dangerous environments where the tolerances for error are extremely slim. Outer space and beneath the surfaces of the worlds oceans are environments that are inhospitable to human life. Any kind of exploration or operation of these domains by humans must be approached with caution. If funding for these activities is provided by government sources, there is an added level of public scrutiny. The National Aeronautics and Space Administration (NASA) and the United States military have developed their operational capability in these environments with relatively few significant failures.

NASA and the US military operate under a high standard of performance where a system failure, especially one that results in a loss of life, is not tolerated. Therefore, HRO's need to be continuously aware of the consequences of a system failure. This applies not only to the operation of the system, but to the development processes that created it, often the genesis of catastrophe. Roberts and Bea propose that HRO's are characterized by several key factors that enhance reliability in the organization:

- "HRO's aggressively seek to know what they don't know.
- HRO's design their reward and incentive systems to recognize the costs of failures as well as benefits of reliability.
- HRO's consistently communicate the big picture of what the organization seeks to do, and try to get everyone to communicate with each other about how they fit in the big picture."(Roberts and Bea, 2001)

When HRO's Experience Disasters

Though a rare occurrence, HRO's are not immune to system failures, including those that involve the loss of human lives. The Challenger Disaster, crashes of the US Marine Corps Osprey aircraft, and more recently, the USS Greeneville collision with a Japanese fishing trawler are examples of catastrophic system failures.

While a system failure for an industrial information system can be as minor as a temporary inconvenience or as severe as to threaten the existence of an organization, a system failure for an HRO is a often a publicly visible man-made disaster. These disasters, and the contributing factors that lead up to them have similar principles at work.

Man-Made Disaster Model

Turner (1978) developed a "Man-made Disaster Model" to illustrate the chain of events that lead to disaster. Turner suggests that the root causes of industrial catastrophe are managerial and administrative in origin (Turner, 1978). Pidgeon and O'Leary (2000) suggest that disasters in large-scale technological systems are "neither chance events, nor 'Acts of God'". They further suggest that disasters are not entirely technical in nature, but rather arise out of the human and organizational interaction procedures designed to manage complex and ill-structured risk problems (Pidgeon and O'Leary, 2000). At the heart of the man-made disasters model, a disaster is not solely defined in terms of physical events but more commonly in sociological terms.

Turner proposes that there are discrepancies between assumptions about the way the world operates and the actual state of affairs (Turner, 1978). He further suggests that vulnerability to disaster is increased when these assumptions are allowed to exist over an extended period of time, the "disaster incubation period". The potential risk of any single assumption may be negligible, however, over time, and in coordination with other factors within an organizational framework, the risks increase dramatically.

The following are three examples of man made disasters; the crashes of the Osprey aircraft, the Challenger Disaster, and the USS Greeneville collision with a Japanese fishing trawler.

US Marine Corps Osprey Aircraft

In recent years the US Marine Corps has experienced problems with its V-22 Osprey aircraft, which is capable of taking off like a helicopter and flying like a turbo-prop airplane (Ladkin, 2001).

The Marine Corps has experienced two Class A mishaps with Osprey aircraft, one in April 2000 and another in December 2000. The US military defines a Class A mishap is an incident where there is loss of life and the aircraft is completely destroyed, or damages exceed one million dollars (US Army, 2002). In the wake of the Osprey crashes, the Pentagon launched an investigation focused on eliminating future failures of these aircraft.

The US Air Force Special Operations Command began to rethink its commitment to the Osprey program when an anonymous V-22 mechanic claimed that the squadron commander at the V-22 training squadron, VMMT-204, Lieutenant Colonel O. Fred Leberman, ordered the tampering of maintenance records in order to improve the image of the troublesome aircraft (Wall, 2001). The V-22 Osprey program was subsequently grounded.

Certainly, Turner's man-made disaster model is consistent with the events surrounding the problematic history of the Osprey. An organization that has a vested interest in acquiring and keeping equipment it deems necessary to conduct its operations, and yet, does not want its public image to be tarnished by operational disasters, fails on both counts. Further, there is evidence that minor safety issues, hidden from authorities, have provided the extended incubation period conducive to a disaster.

Challenger Disaster

On January 28, 1986, approximately seventy-three seconds into its flight the space shuttle Challenger exploded, killing all seven astronauts on board, including civilian Christa McAuliffe. The apparent technical cause of the explosion was a failed O-ring, which seals each joint where major sections of the solid rocket booster are connected. The cold temperatures in conjunction with a faulty design were cited as two major technical factors in the accident (Federation of American Scientists, 1997).

The Presidential Commission appointed by Ronald Reagan and the Congressional Committee on Science and Technology investigated the cause of the disaster. They determined that, though there were technical causes for the disaster, NASA was also to blame. NASA had known about problems with O-rings of this type dating as far back as 1977 (Presidential Commission, 1986). Thus, there is evidence of a prolonged incubation period, consistent with Turner's man-made disaster model that might have been a major contributor to the catastrophe in 1986.

Vaughan (1990) concluded that, in addition to the administrative breakdowns that lead to the Challenger disaster, the regulatory system that had been established to ensure safety in the shuttle program had actually developed information voids, hiding critical safety data from authorities (Vaughan, 1990). NASA, had implemented its own "watch-dog" safety committees, thus, regulating itself on safety issues, a system that is considered to be "fundamentally suspect" (Shapiro, 1987).

USS Greeneville Collision

On February 9, 2001, the reliability of US Navy submarine systems, and their operators, was called into question. The collision of the USS Greeneville and a Japanese fishing trawler, the Ehime Maru, resulted in the deaths of nine Japanese civilians, causing an international incident, straining diplomatic relations between Japan and the United States.

Investigations into the causes of the accident discovered that a number of errors in judgment and breaches in protocol occurred just before the collision. Evidence was presented that showed that civilian guests took turns maneuvering the vessel (Congress Daily, 2001). Sonar operators failed to acknowledge and communicate to superior officers that the fishing trawler was only 4000 yards away and closing (Time 2001). Also, the inquiry concluded that the crew neglected to oversee the flow of information in the control room (Time, 2001). Testimony of the Greeneville's Commander, Scott Waddle, indicates that the civilian visitors' presence in the control room could have affected the concentration of the crew (Time, 2001).

Each of these factors, in isolation, might not seem significant enough to cause such a catastrophe. Yet, in concert with each other they were enough to cause the 360-foot long, 6500-ton submarine to collide with the 190-foot trawler and cause enough damage to have it sink in less than ten minutes (US News and World Report, 2001).

The irony of this incident is that it is not a case of an inept commander, or a lackluster crew. It is quite the contrary, a highly trained, experienced commander who had the unwavering loyalty of his very capable crew (Time, 2001).

Sometimes HRO's Aren't as HR as They Should Be, But...

Since the nature of operations in High Reliability Organizations such as the military or NASA has the potential to portray these organizations in an unpopular light, reliability of their systems is a high priority. Disasters are often met with public outrage, and calls for them to disband their operations. Their highly visible position in society mandates that they perform to the highest standard of accuracy and safety. It is the nature of the business.

Even though some horrific disasters have been examined here, these organizations have a commendable history for safety. NASA has lost ten lives in two incidents in over forty years of intense technological research, development, test and evaluation. When Apollo 13 threatened to claim the lives of its crew, NASA's Mission Control crew managed to return the crippled spacecraft to earth safely.

The US Marine Corps, while training thousands of recruits each year, have few incidents that result in loss of life. Since 1990, the US Marine Corps has logged 4.8 million flight hours and experienced 201 fatalities, including the entire duration of the Gulf War (US Marine Corps, 2002). By these statistics the Marine Corps experienced one fatality for every 24000 flight hours (the equivalent of having a single aircraft fly, in a high risk environment, for almost three years continuously for each fatality).

The US Navy has come a long way since its first submarine, the Hunley. The Hunley lost her entire crew twice in sinkings near Charleston, South Carolina in the 1860's. Today the US Navy has not lost a single crewman since the 1960's for its submarine fleet (SUBNET, 2002).

In fact, mile for mile the US Navy's Submarine Fleet is safer than travel by automobile, aircraft, or train in the US. In addition, the US Navy's Submarine fleet is in constant deployment in hostile environments, all over the world, relying on some of the most sophisticated military technology in existence.

Learning from Their Mistakes

The HRO's mentioned here have demonstrated an ability to learn from their mistakes, usually by public mandate. A common thread to each of the three disasters is that there is a high degree of accountability by participants and government officials if an accident occurs. Also, an intense investigation, at times ending the careers of individuals involved, and a resulting change in the way business is conducted followed each of these three disasters. These changes are reflected, not just in terms of technical enhancements to existing systems, but identifying and rectifying shortcomings in how individuals participate in these organizations. The most frequent and impactful changes were in how these operations are managed.

While not all organizations need to be as careful as NASA when conducting their business, private industry could learn from the techniques applied by HRO's. Today, system developers are producing more complex systems, demanding much more from project managers than in the past. ERP systems have had a transforming affect on the organizations that have "successfully" implemented them. However, commercial system development projects in general, are still prone to failure.

Why Compare HRO and ERP systems?

ERP systems have been at the forefront of system development in recent years because of their cross-functional design. These systems are capable of integrating the functional areas of an organization as well as those of other organizations. Timely and accurate information for functional areas such as Accounting, Purchasing, Finance, and Human Resources can be critical to maintaining a competitive advantage, market share, or simply the survival of an organization.

The examples of HRO systems examined in this paper have similarities in their functional design. They are highly integrated, cross-functional systems that are used to control all aspects of the vessel, vehicle or aircraft. Functional areas of these systems include critical tasks such as life support, vehicle positioning and attitude, and propulsion. Also, each of these vehicles operates in an environment that is hostile for supporting human life. If the oxygen production system of a submarine has a "General Protection Fault" at a thousand feet below the surface of the ocean, or the instrumentation of an aircraft provides false information in poor visibility, or an O-ring fails on a solid rocket booster of the space shuttle, ...people die!

Changing Business Practices

ERP systems usually require an organization to modify or completely overhaul the way they do business. The degree to which this occurs can have an impact on how effectively the system operates. Organizations that resist operational change are likely to invite system development and operational problems in the future.

The environment of IS project management is complex, with a broad range of interacting variables. The proliferation of ERP systems requires a study into the factors that influence the success of these complex projects in order to identify areas for potential failure.

From these observations, several questions arise. Some of these may have intuitive answers, and others will require further empirical study.

> "How is it that High Reliability Organizations avoid the frequency and magnitude of system failures that plague the commercial industry? What do they do differently in developing their systems?"
>
> "What symptoms of HRO disasters (e.g., those suggested in Turner's man-made disaster model), exist in commercial system development that contribute to commercial failures?"
>
> "When an HRO experiences a catastrophic failure, what aspects of HRO organizational culture contribute to the its ability to learn from its mistakes and prevent future disasters?"

One approach to studying HRO's versus commercial ERP system development is to identify success factors that thrive in HRO environments, but are weak or nonexistent in commercial environments. To accomplish this, four aspects of system development should be examined in each type of organization:

- Technical
- Procedural
- Managerial
- Organizational Culture

Roberts and Bea (2001) have suggested that HRO's place a high priority on avoiding disasters. Not all of the effective countermeasures used to increase reliability are prohibitively expensive. Some preventive measures involve improved communication between management and workers. Others provide the empowerment of the workers to make decisions in order to avoid a disaster. When an employee understands how he/she fits into the big picture of the organization it helps to increase reliability (Roberts and Bea, 2001).

By observing HRO system developers, the presence of factors that have been shown to prevent disaster can be identified. In addition, in those organizations that have experienced a disaster, investigations into the causes have indicated a set of contributing issues that evolved unchecked until a catastrophe occurred (i.e., the Challenger disaster). From this information a series of disaster prevention components can be assembled to formulate a framework for other organizations to follow.

Once the governing dynamics of HRO system development are identified, the system development practices of commercial ERP systems can be observed. By identifying similarities in symptoms of commercial system failures with those of HRO failures, parallel models of behavior can be developed to avoid future disasters.

A Proposed Research Design for Empirical Study

In order to effectively study a topic as complex as system development, it will be difficult to accomplish this while relying on a single measurement tool. This research design will propose using a combination of methods that will approach the data from multiple perspectives, each designed to provide a specific insight into the topic, a triangulation of qualitative and quantitative methods.

Frankfort-Nachmias and Nachmias define triangulation as the "use of more than one form of data collection to test the same hypothesis within a unified research plan" (Frankfort-Nachmias and Nachmias 1996:599). The author further adds, "To minimize the degree of specificity of certain methods to particular bodies of knowledge, a researcher can use two or more methods of data collection to test hypotheses and measure variables; this is the essence of triangulation" (Frankfort-Nachmias and Nachmias 1996:206).

A summary of this research design is provided in Table 1.

Published Literature

This research began with a review of published literature in order to establish relevant issues and relationships that influence system development in general, as well as that of HRO and ERP systems. This process establishes a theoretical underpinning for the remainder of this research.

Interviews

The interview process will provide a method of extracting the experiences and observations of the participants involved in developing these systems. While interviews provide limited breadth, they allow a high degree of depth and detail into this area of research. This process will involve a small number of participants, approximately twenty interviewees. Interview data will be processed in order to identify the major issues that affect system development outcomes.

Table 1. Research Design Summary

Phase	Research Depth	Scope Breadth	Source of Data	Type of Analysis	Purpose of Analysis
1	Low	Very High	Published Literature	Literature Review	Exploratory: Identification of scope of system development failures, historical practices, relevant issues, and success factors.
2	High	Low	Interviews	Analysis across organizations	Theory formulation: Identification of relevant forces (technical, managerial, procedural and organizational culture) affecting system development project outcomes. Identify success strategy effectiveness. Identification of deviation points of system development planning that invite failure. Compare and contrast HRO and commercial ERP development environment.
3	Medium	High	Questionnaire Survey Data	Statistical Analysis	Confirmation: Validation of theoretical constructs over larger population.
4	Very High	Very Low	Practical Application	Evaluation of feedback	Test and Evaluation: Validate system development framework through application in practice.

Questionnaire Survey Data

Once the major issues affecting system development are identified, a survey instrument will provide a method of validating the existence and influence of these issues over a larger population of participants. This will provide a much broader context in which to observe this topic.

Practical Application

The results of this research will provide insight into the system development processes from the perspective of organizations that experience a high degree of success, as well as those who commonly experience failure. A framework will be developed that includes the factors that promote success for HRO's, and mitigates those factors that lead to failure.

Once a framework has been developed based on the successes of HRO system developers, it can be applied in a "real world" setting. It can then be evaluated by obtaining feedback from participants involved in the project in order to determine its degree of success. If successful, this framework could provide commercial system developers with a road map for successful system development projects.

Conclusion

HRO's can provide insight into effective system development for commercial organizations. Research has shown that system development for even simple systems is characterized by failure. Also, larger more complex systems, while broader in scope and providing more capability, bring with them significant risk of failure, as well as severe financial consequences associated with failure. The benefits to industry for having an effective framework for system development based on the experiences of HRO's might include but not be limited to:

- Understanding the origins of factors that lead to comprehensive system failure.

- Learn how theoretically harmless anomalies can develop into significant threats.
- Learn to identify and correct adverse symptoms early in the project rather than reacting to their future effects.
- Develop project management techniques that prevent the development of these project threats.
- Understanding the affects of organizational culture on individuals' motivations concerning his/her responsibilities to the organization.

With the proliferation of vastly complex ERP systems, organizations need to be aware that failing to follow effective system development practices can invoke mortal financial injury for even the most affluent corporations. The ERP development industry has strongly suggested that organizations be open to modifying the way they do business in order to align themselves with industry best practices. While there may be no established "best practices" concerning organizational culture, it may prove beneficial to evaluate cultural practices as well.

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