3-6-2012

High Reliability Organization Theory As An Input To Manage Operational Risk In Project Management

John Werner
University of Pennsylvania, johnwerner381@hotmail.com

Submitted to the Program of Organizational Dynamics in the Graduate Division of the School of Arts and Sciences in Partial Fulfillment of the Requirements for the Degree of Master of Science in Organizational Dynamics at the University of Pennsylvania
Advisor: Keith Hornbacher

High Reliability Organization Theory As An Input To Manage Operational Risk In Project Management

Abstract
This paper demonstrates how adoption of High Reliability Organization Theory (HROT) delivers value to mainstream organizations. It presents the terminology that encompasses High Reliability Organizations (HROs) and how researchers define the characteristics and core principles of such organizations. These organizations have been well studied by professionals from numerous disciplines allowing us to understand what makes an HRO successful. This paper will add to this by exploring how HROT may be applied to mainstream organizations and elaborates on the importance of mindfulness specifically as it relates to sensitivity to operations. The findings are synthesized into an actual project that successfully leveraged HROT principles to improve reliability and address operational risk. The paper concludes that there are considerable opportunities to exploit HROT in project, program, and process management to achieve high reliability and value in a non-HRO.

Comments
Submitted to the Program of Organizational Dynamics in the Graduate Division of the School of Arts and Sciences in Partial Fulfillment of the Requirements for the Degree of Master of Science in Organizational Dynamics at the University of Pennsylvania

Advisor: Keith Hornbacher

HIGH RELIABILITY ORGANIZATION THEORY AS AN INPUT TO MANAGE OPERATIONAL RISK IN PROJECT MANAGEMENT

by

John Werner

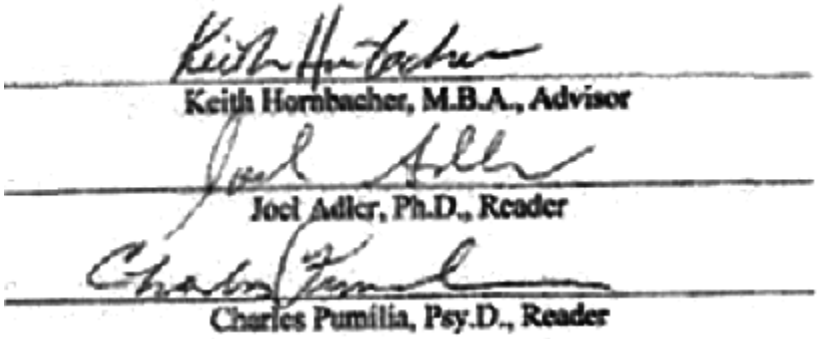
Submitted to the Program of Organizational Dynamics
in the Graduate Division of the School of Arts and Sciences
in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Organizational Dynamics at the
University of Pennsylvania

Philadelphia, Pennsylvania

2012

HIGH RELIABILITY ORGANIZATION THEORY AS AN INPUT TO MANAGE OPERATIONAL RISK IN PROJECT MANAGEMENT

Approved by:



ABSTRACT

This paper demonstrates how adoption of High Reliability Organization Theory (HROT) delivers value to mainstream organizations. It presents the terminology that encompasses High Reliability Organizations (HROs) and how researchers define the characteristics and core principles of such organizations. These organizations have been well studied by professionals from numerous disciplines allowing us to understand what makes an HRO successful. This paper will add to this by exploring how HROT may be applied to mainstream organizations and elaborates on the importance of mindfulness specifically as it relates to sensitivity to operations. The findings are synthesized into an actual project that successfully leveraged HROT principles to improve reliability and address operational risk. The paper concludes that there are considerable opportunities to exploit HROT in project, program, and process management to achieve high reliability and value in a non-HRO.

ACKNOWLEDGEMENTS

Appreciation is extended to all the professors and fellow students within the Penn Arts and Science Organizational Dynamics program who have nourished my thirst for knowledge and professional development. I experienced an intrinsically satisfying learning and life experience. I am departing with a vastly greater skills set and acquired knowledge then when I first enrolled in the program. Tremendous gratitude is extended to Keith Hornbacher, MBA, who guided me through my first semester and this capstone paper. He continuously challenged my thinking and furnished the necessary motivation to embrace the academic rigor this program has to offer. Appreciation is extended to Dr. Martin F. Stankard, who beyond offering both frank and refreshing perspectives, left me with memorable breakfast and lunch discussions. Special thanks are in order for Dr. Joel Adler, who introduced me to Organizational Dynamics. Special recognition is extended to my external Reader Dr. Charles Pumilia for his excellent guidance and support.

Appreciation is recognized to the following professors whose dedication to the program has delivered exponential benefits in my professional and personal life: Dr Richard Bayney, Dr. Anthony Tomazinis, Dr. Ana Maria Reyes, Dr. Larry Hirschhorn, Dr. William Wilkinsky, Dr. Jean Marc Choukroun, and Dr. Richard Heaslip.

Lastly, I would like to thank my family for their sacrifices during this period to make this achievement a reality.

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

Personal background

It is said that history repeats itself, but we most often don't recognize it happening until after it unfolds again. In a personal reflection on the irreversibility of life and death, Viktor E. Frankl, in his book the *Meaning of Life*, shares his personal imperative "Live as if you were living for the second time and have acted wrongly the first time as you are about to act now".[1] The essence of this quote is behavior guided by a sense of mindfulness. Its context is deepened once we understand its author is a miraculous survivor of German Nazi concentration and extermination camps. We all face our own degree of tragedy in life, personal and public, where even though the scale may be at the opposite extremes of what Viktor Frankl faced, we can learn from the wisdom of those who have survived travesties to find what resources they tapped in order to fuel resilient motivation and inspirations in our own lives. Similarly, this paper will investigate how a knowledge area developed through diagnosis of the worst accidents may help us address the challenges in our own organizations.

One must ask, is it necessary to bring an elephant into the room when your issues compare to a mouse in scale. When thinking back to my boyhood cartoons, the little mouse had the candid ability to create havoc by startling the larger creatures. Managing for these little creatures is an analogy for the underlying theme within High Reliability Organization Theory (HROT). The basic premise behind HROT is that organizations

need to be attentive to weak signals, and once identified, to address them with a strong response. Often, this is counter intuitive to how we normally behave.

The strength of High Reliability research is also a source of weakness. Its strength is the contribution by leading researchers from various disciplines, either collaborating or working independently to analyze and diagnose tragic or near tragic events to determine their underlying causes. Through this research, knowledge is gained that may be used to prevent a similar recurrence. Examples of such studies include the Three Mile Island accident, Challenger launch disaster, Bhopal gas tragedy, airline accidents, and the operational performance aboard an aircraft carrier. Its weakness is that the studies are conducted utilizing a relatively narrow cohort study that challenges its credibility in normal operations. Another limiting factor is that by design it's a retrospective diagnosis, offering little in terms on how to put a High Reliability Organization in place. In order to take advantage of HROT, one needs to incorporate these findings into an application framework to gain value. This may be in formalized project management such as The Project Management Institute's project guidelines, Program Management, Six Sigma, and other Quality and process improvement methodologies.

Are not these frameworks adequate? Why would you introduce additional theory to complicate the project? The justification is that many projects fall short or fail to deliver against their original expectations.

Project results

When comparing my professional experience with the success of projects defined in the Standish Group Report (2010), my experience is similar to the findings in the Literature Review. According to Erling S. Andersen's study in the Project Management Journal, (2010), "The most well-known quantitative studies of project success are the Standish Group Reports." [2] While the report is specific to Information Technology (IT) projects, it's generally viewed as a reasonable benchmark across other areas. Their research results are summarized in Table 1.

Table 1. Project Success Rates

Project Result	2000	2006	2008
Succeeded: (%) (delivered on time, on budget, with required features and functions)	28	35	32
Failed: (%) (cancelled prior to completion or delivered and never used)	23	19	24
Challenged: (%) (late, over budget, and/or with less than the required features and functions)	49	46	44

There has been an increase in the percent of "Succeeded" outcomes between 2000 and 2008 and a decline in the "Challenged" percentage. Despite these positive indicators, the findings still reflect almost one in four projects "Failed" with less than one third of projects "Succeeded". Given projects are susceptible to economic conditions; the declining economy during 2006 to 2008 may explain the increase in cancelled projects and the drop in those that "Succeeded". While this table furnishes valuable information, the limited amount of data and the date range makes it difficult to perform statistical

trend analysis. An important output of Erling S. Andersen's research is that it identifies improvement opportunity through improved decision processes, better management and leadership, and closer cooperation with the stakeholders.[3] The Literature Review suggests these attributes are found in High Reliability Organizations (HROs) and will be covered in Chapter 3.

Purpose of this capstone

The purpose of this Capstone is to determine if incorporating High Reliability Organization Theory (HROT) – specifically mindfulness of the unexpected through sensitivity to operations- into project and operational risk management may improve the success in fulfilling the project's goals. The impetus of this paper is to discover an alternative body of knowledge that may be used to address operational risks, within a project directive, that supports the program's strategic goals and objectives.

The methodology taken was to conduct extensive research on HROs and the discipline areas that contribute to the various facets of HROT. The paper will utilize an actual process improvement and Information Technology (IT) project to demonstrate HROT and the related findings of the research. This will be presented in Chapter 4. Based on the findings of the research, this capstone will draw a recommendation and conclusion.

Chapter 1 provides personal background and description of upcoming chapters utilizing analogy to emphasize the value of learning from an emerging research area and applying it into mainstream projects.

Chapter 2 furnishes the literature review of this subject area. This study will incorporate research from various professional areas, with most of it derived from clinical field study of disasters or near disasters. The availability of diversified disciplines brings a breadth of knowledge and perspectives into a single domain area. The strength and weakness of the applicable disciplines as they apply to this paper will also be presented.

Chapter 3 explores how the study of High Reliability Organizations (HROs) evolved into High Reliability Organizational Theory (HROT) and its usefulness in managing operational risks and achieving project deliverables. HROs are defined with explaining how expectations impact our sense of Mindfulness against five success factors. The characteristics of Sensitivity to Operations are demonstrated through use of the Swiss Cheese Model. The counter intuitive concept of making a strong response to a weak signal is explained as well as how tight coupling impacts implementation.

Chapter 4 uses a recently implemented project to evaluate the viability of HROT in a mainstream organization. The project delivered a streamlined paperless dispatch process integrating risk management and High Reliability Organization principles.

Chapter 5 summarizes the findings. Recommended further research and application will also be presented.

CHAPTER 2

LITERATURE REVIEW

Inter-discipline theory

Research comes together from various disciplines to contribute to HROT establishing it as a formidable model. The initial research may be traced back to the High Reliability Organizations Project at the University of California at Berkeley. This research followed the publication of Perrow's *Normal Accidents* in 1984 by two or three years. The pioneers include Todd La Porte, a Professor of Political Science, Gene Rocklin, originally a scholar in Physics, and Karlene Roberts, a Professor of Organization Behavior.[4] The emerging research can be found from such diverse areas such as Management, Sociology, Political Science, Anthropology, and Psychology. Each discipline furnishes a different lens of interpretation and insight fostering a greater breadth of understanding. Table 2 summarizes some of the leading research into this domain.

Table 2. High Reliability Organization Discipline Areas (adapted from van Stralen, 2012. *High Reliability Organizing web site*) [5]

Advocate	van Stralen	Bea	Weick	Roberts	Perrow	Mercer
Discipline	Neuro-psychology	Civil Engineering	Social Psychology	Organiz-ational Psychology	Sociology	Naval Aviation, Nuclear Propulsion
Level of Analysis/ Function	Individual	Environment	Social	Organization (Structure)	Society	Operations
Principle	Threat, Team, Formation	Uncertainty and Threat, Working Environment	Cognitive Dissonance with Action	Commun-ication	Complex Organizations	Command Philosophy
Method	Reasoning	Design and Interaction	Interactions between people and environment	Organiz-ational Behavior	Interactions between people and technology	Command and Leadership
Goal or Purpose	Responsive-ness, Protection	Hazard Recognition	Collective Mindfulness and Enactment	Identify High Reliability	Decisions regarding Technology	Strength, Agility, Resilience
Result	Performance under Uncertainty	Interactive, Real-Time Risk Assessment and Management	High Reliability Organization	High Reliability Organization	Normal Accidents	High Reliability Operations/ Organizing

Neuropsychology

The findings in neuropsychology research studying the cognitive activity of the different areas of the brain of HRO individuals have revealed that their behavior is commensurate with one another. Determining what part of the brain's hemisphere is being used allows for a neurological assessment to understand both reasoning and behavior. Neuropsychology, according to the National Academy of

Neuropsychology, is a professional field of study of psychology with applied science of brain-behavior relationships.[6]

According to research advanced by van Stralen (2012),

> "The individual functions through neuroanatomy, reasoning, and attitudes. The prefrontal cortex, producing the brain's executive functions, makes binary decisions (right/wrong), abstract thought including the future, and planning. Here, perception goes to thought goes to action. The amygdala, a more primitive region sometimes called the reptilian brain, is the survival brain where perception goes to action without thought. This is where fight-flight-freeze resides. But the High Reliability person works in the cingulate cortex where the amygdala is modulated, error is identified, and adaptive decisions are made to find what works". [7]

Charles Pumilia (personal communication) notes that the amygdala is where fear is processed in the brain. The frontal lobes usually mediate the fear impulses, but this is not always a precise process – especially when stress, danger signals and other threats are evident. The frontal lobes are also called in to mediate against anger, rage, jealousy and competition. This is where human error, the subjective process that takes over and begins to affect how people think, react and how they interpret what is going on around them. This is where leadership and execution of process can easily break down.[8]

Van Stralen (2012) argues,

> The High Reliability individual uses inductive reasoning, increasing the strength of evidence to increase the strength of the conclusion. As these strengths vary, evidence is added or dropped and conclusions change in an active dynamic during engagement. Deductive reasoning, where facts (100% known) guarantee the hypothesis, is a luxury not available to the individual until long after events resolve and data can be evaluated.[9]

Understanding the cognitive makeup of individuals, helps construct teams who complement each other on how they think and behave. Theoretically this

will improve the teams' situational awareness and decision making. Use of similar psychological tests such as DISC, (an acronym for Dominance, Influence, Steadiness, Compliance), or Myers-Briggs may yield benefit to organizations.

Sociology: Normal Accidents

As a leading advocate within this discipline, Charles Perrow through his book *Normal Accidents* (1984) and his later research on the Three Mile Island nuclear power plant accident offers a sociological perspective. His coinage of the term normal accidents was further developed into Normal Accident Theory which delves into how people interact with complex technological systems to create whole or unitary systems. His work examines interactive complexity and coupling of components within complex organizations. The complexity and coupling, whether by design or happenstance, determine the system's susceptibility to accidents and make accidents not only inevitable but normal.[10] Roberts (1990) notes that,

> Generally, Perrow focuses on what he calls complexity and tight coupling. By complex interactions, Perrow means interactions of unfamiliar sequences, and either not visible or not immediately comprehensible." Complexity's elements are the potential for unexpected sequence of activities, complex technologies, subsystems called upon to serve multiple (and incompatible) functions, proximity, indirect information sources, and baffling interactions.[11]

> Accidents then derive not so much from human cognition and behaviors or by engineered designs but from dynamic human-machine interactions. While these accidents may be predicted and the risk accepted or identified in hindsight from missed data they may also result from information that is undiscoverable until events unfold. In effect, the surprise reflects not what is cognitively missed but what is cognitively absent.[12]

Counter argument

HROs research is based on a narrow cohort that may jeopardize the credibility of the study. The research is developed from high profile accidents, medical trauma centers, or processes that if they failed- the result would be catastrophic harm. These may not be applicable to mainstream projects and programs. For example, there may be little similarity in how nuclear plants, aircraft carriers, and forest fire fighters are organized, perform their recruitment and hiring, fund their budgets, and train their staff. These are only a few of the multitude of differentiating variables between HROs and most organizations. This questions the applicability of HROT into mainstream projects.

Post mortem clinical studies are also subject to 'hindsight bias', by starting at an outcome and reverse mapping to pre-existing latent conditions, that may have been altered since the event transpired. The existing research is so heavily retrospectively skewed that it challenges the notion of prospective application. This study revealed that all processes need to be evaluated independently as no cook book type methodology is available.

Another restraining factor is that it may be easily construed that HRO s theory is inversely correlated and tightly coupled to efficiency. The level of due diligence conducted in a HRO are exponentially higher than what may be viable for most mainstream organizations to implement into their processes. Exasperated by the economic duress over the last few years, existing organizations are running lean and are extremely productivity oriented. Most main stream organizations and their projects must prioritize what they can do, accepting the fact that the smaller less important things may never get done.

CHAPTER 3

HIGH RELIABILITY ORGANIZATIONS AS AN EMERGING THEORY

Based on the literature review, even though there is a tremendous learning opportunity from studying HROs, these outputs are not directly recognized in the leading body of knowledge publications in project management, business analysis, and business process management. This chapter integrates this emerging area into the project management context so the reader and the project community can better understand how they are associated to each other and the value proposition in bringing the two together.

Iron triangle

Linear based project management is bounded by what is referred to as the Iron Triangle. Time, Scope, and Budget represent each side of a triangle. Quality is generally represented as the inner dimension. These are interdependent variables, for changes occurring in one impacts at least one of the others. Increasing scope extends time and or increases cost, for a change in one impacts at least one other. Using a software development example, change management may create havoc on a project plan and schedule. Introducing a late business requirement such as developing new functionality (scope expansion) that was not configured into the original plan, may require additional assets to work on it, resulting in higher cost, or more time. There are countless scenarios that require managing tradeoffs among these and other constraints. The Project Management Institute (PMI®) in its, *A Guide to the Project Management Body of*

Knowledge (*PMBOK® Guide-4th Edition)* (2008) establishes that other primary project constraints include, but are not limited to, resources and risks.[13]

Innovative approaches may alter the relationships, but the elements remain as constraints to various degrees. For example, the growing popularity of Agile methodology results in short fuse development and implementation within short interval cycle times. The Institutional Institute of Business Analysis (2011) explains,

> Agile is a term used to describe a number of iterative development methodologies that have developed over time. Common traits amongst agile methodologies include frequent product releases, high levels of real-time collaboration with the project team and with customers, reduced time intensive documentation, and regular assessments of value and risk to allow for change.[14]

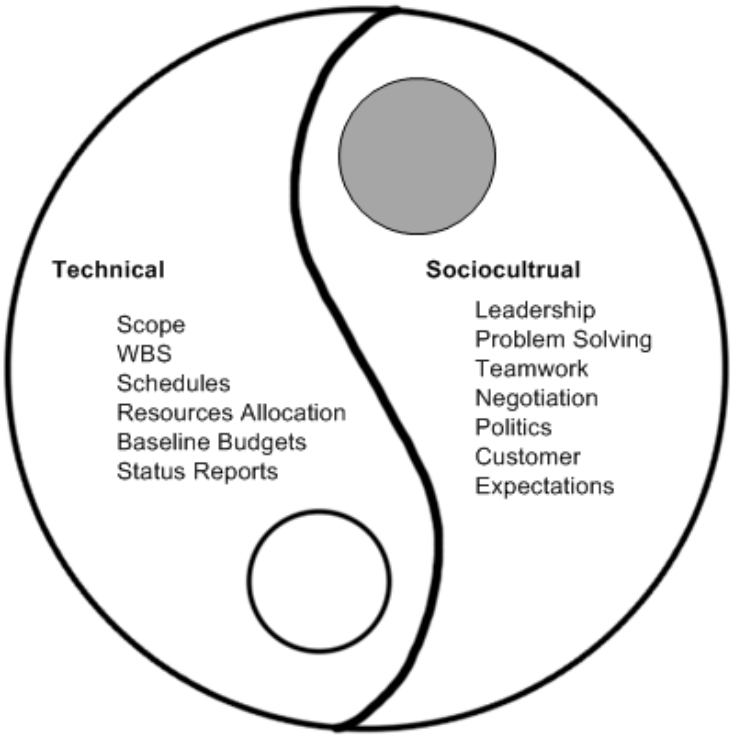
The Agile development phases are time boxed to fixed time parameters that emphasize delivering value to the customer in short time period release sprints so they deliver benefits to the customer as early as possible.

Regardless of the methodology deployed or implementation of a project or program framework, all organizations operate under constraints where they need to understand and manage tradeoffs. Once the team manages through these difficult situations, for the project to reach its strategic program's goals, these decisions need to ensure both continuity and sustainability post implementation to realize long-term benefit. Presented later in this chapter, the section on process coupling will identify pairing characteristics among key elements to better understand important inter-relationships and assist in the evaluation of specific tradeoffs. Paradoxically by introducing HROT it may jeopardize the Iron Triangle components by increasing time, scope, and budget without necessarily adding perceived value. Under General Accounting Practices, cost savings for events or issues avoided or effectively mitigated

are not normally recognized. Unless special calculations are performed, an organization may not have the visibility and means to judge the true value, resulting in an unfavorable perception.

There are two dimensions within the project management process: technical and socio-cultural. The technical side consists of the formal, disciplined, purely logical parts of the process.[15] The technical side represents the mechanics of planning, scheduling, and control. It is reliant on information systems to manage scope, cost, time, and the quality progress as identified above in the Iron Triangle of project management. It may also be referred to as the 'science' side of process management, as it integrates all the information in a quantitative form for management and decision making.

Figure 1. The Technical and Socio-Cultural Dimensions of the Project Management process (adapted from Gray and Larson. 2002. *Project Management-The Complete Guide for Every Manager*)[16]



The socio-cultural dimension addresses development of the social system to combine the talents of a divergent set of professionals working to complete the project. Gray and Larson (2002) report, "Project managers must shape a project culture that stimulates teamwork and high levels of personal motivation as well as a capacity to quickly identify and resolve problems that threaten project work."[17] This dimension is represented as the art of project management. Balanced attention to both aspects is required and equally critical.

Figure 1 is presented in a Yin Yang symbol demonstrating that these variables are both interconnecting and interdependent. They have the ability to build off and reinforce each other or operate as polar opposites causing conflict and disruption. This capstone postulates that HROT offers value in improving project, program, and portfolio performance by positively bridging these two dimensions together.

An organization's capability to integrate these components may be impacted by its maturity. Gray and Larson (2002) note that Carnegie Mellon University's Capability Maturity Model (CMM) was developed in December 1984 to initially address the well recognized need for improved software in the U.S. Department of Defense. Originally, the CMM serves as a guide for organizations on implementing best practices of managing software development projects.[18] Through iterative progression, CMMs expanded into improving processes within an organization. The university report argues, "They contain the essential elements of effective processes for one or more disciplines and described an evolutionary improvement path from ad hoc, immature process to discipline mature processes with improved quality and effectiveness."[19] The CMM models have iteratively progressed to what is now referred to as CMM Integration (CMMI). Its latest version is

CMMI v1.3 published in 2010. CMMI's current version delineates five stages of maturity. They advance sequentially through five sequential levels: Initial, Managed, Defined, Quantitatively Managed, and Optimizing [20]

Per Gray and Lawson (2002), "Our best guest estimate is that most companies are in the throes of moving from level two to level three and that less than 10 percent of those firms that actively practice project management are at level four or five."[21] Prospective adoption of HRO's sense of Mindfulness and its sub components, as presented later in this chapter, may be an excellent enabler as well as an accelerator to raise the maturity level within an organization.

Alternatively, the Project Management Institute (PMI) has developed their Organizational Project Maturity Model (OPM3)-Second Edition (2008) that seeks to improve an organization's competencies and outcomes through development of Best Practices. Specifically,

> The Organizational Project Management Maturity Model (OPM3®) is a framework that provides an organization-wide view of portfolio management, program management, and project management to support achieving Best Practices within each of these domains. This holistic perspective is a powerful tool enabling successful execution of organizational strategies, portfolios, programs, and projects, especially when these transcend functional and hierarchal boundaries. Moreover, OPM3 Global Best Practices, applied to the execution of strategy, can drive superior and sustainable results.[22]

PMI in the OPM3®-Second Edition guide breaks their Best Practices down into two major categories. The first is Process Improvement through four stages: Standardize, Measure, Control, and Improve (SMCI); the second category is Organizational Enablers (OE). Maturity is attained through sequential development of SMCI within each of its

elements. The Improvement stage is dependent on Control, Control on Measure, and Measure on Standardize.

PMI's second Best Practices category is 'Organizational Enablers' (OE). These are the structural, cultural, technological, and human-resource practices that can be leveraged to support and sustain the implementation of Best Practices in projects, programs, and portfolios.[23] PMI recognizes the value of supporting training, methodologies, tools, and techniques that are not explicitly defined in the PMI published standards with considering them within the domain of organizational project management.[24] Examples of pre-defined Organizational Enablers include: Competency Management, Sponsorship, Individual Performance Appraisal, Process Success Criteria and Organizational Project Management Practices, Processes, and Techniques. Based on the literature review, HROT is a natural fit as a Best Practice Organizational Enabler.

According to Hillson (2004), "the goal for the risk-aware organization is to be able to modify its risk attitude appropriately given the changing environment in which it operates. This requires a flexible corporate risk culture that is neither always anxiously risk-averse nor unflinchingly risk-seeking, but can be described as "risk mature." [25] Frameworks enable an organization to assess themselves against benchmarks to determine their strengths and weaknesses. They also furnish a structured guideline or road map toward achieving higher competency and effectiveness. One such model is the Risk Maturity Model (RMM). As described by Hilson (2004),

> RMM was developed to meet the needs of organizations wishing to compare their management of risk with best practice or against competitors using an accepted benchmark for organizational risk capability. Development of the RMM drew on established concepts from existing models such as the Capability Maturity Model (CMM) from Carnegie-Mellon Software Engineering Institute and the European

> Foundation for Quality Management (EFQM) Business Excellence Model. The RMM describes four levels of increasing risk management capability, termed *Naïve, Novice, Normalized*, and *Natural*. The aim is to provide a structured route to excellence in risk management, with recognizable strategies along the way that organizations can use to benchmark themselves against. Each RMM level is further defined in terms of four attributes, namely *culture, process, experience,* and *application*. These allow an organization to assess its current approach to risk management against agreed criteria, set realistic targets for improvement, and measure process toward enhanced risk capability.[26]

Development of HROT as an input into an applicable framework must warrant its effort against the project's Iron Triangle of Time, Cost, Scope and Quality. Risk management must be backed by strong organizational commitment within a supportive culture. Hillson (2004) states: "Culture can be defined as the total of the shared beliefs, values, and knowledge of a group of people with a common purpose. It therefore has both an individual and a corporate component. For risk management to be effective, the culture must be supportive. This means that the risk attitudes of individuals must be understood and managed, and the organization's overall approach to risk must be mature." [27] Prior to elaborating further on this proposition, a baseline understanding of Program and Project Risk as they are associated to HRO's will now be compared.

Definition of risk

The triadic framework presented in Figure 2 identifies Program risk at the apex of the triangle. Program risk maturity is dependent on the project risk management processes, which is shown as the center or core of the triangle. The foundation or lower level of the triangle represents the operational risks inherent to the processes developed within each project. Operational risks are attributed to the tactical decisions and transactions that are continuously or routinely performed. Based on literature review, HROs are successful at picking up weak signals and apply strong responses to them.

This enables the problem to be addressed while it is still controllable and manageable. Effectively leveraging HROT at the earliest detection or origination point of the signals delivers the best bang for the buck. This enables the organization to construct and execute an action plan, either through escalated monitoring of the situation or implementing a prompt strong risk response. Chapter 4's Astro Project study established pre-defined trigger points and criteria based on various scenarios to serve as a decision aid for escalation and response management.

Figure 2. Triadic View of Program, Project, and Operational Risk

The literature review on CMMI states that there is variability in the amount of time it take organizations to move from one maturity level to the next using CMM. Level 1 to 2 takes 19 months, level 2 to 3 takes 20 months, level 3 to 4 takes 25 months, and level 4 to 5 takes 13 months. The entire journey if consistently pursued would take six and a half years.[28] Adoption of HROT at the operational level advances the organization's risk competency resulting in a high quality input into the project risk

management plan. This further elevates into the program's knowledge and awareness enabling greater organizational maturity. Previously identified as a best practice organizational enabler, HROT may also be construed as a risk maturity accelerator.

In the United Kingdom's Office of Government Commerce (OGC), *Managing Successful Programmes* (2007) guide, risk is defined as "An uncertain event or set of events which, should it occur, will have an effect on the achievement of objectives; a risk is measured by a combination of the probability of a perceived threat or opportunity occurring and magnitude of its impact on objectives."[29] The guideline's risk management process consists of four steps: Identify, Assess, Plan, and Implement. Within its principles it promotes establishing early-warning indicators based on predefined criteria to proactively trigger corrective action. Beyond this, there is little discernible evidence that compliance to the framework adequately prepares an organization for the unexpected. It is heavily geared toward prioritization, roles, and responsibilities.

Similarly, The Project Management Institute in its, *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide-4th Edition)* (2008) defines risk as "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives."[30] Its principles are comprised of six Project Risk Management processes:

- Plan Risk Management
- Identify Risks
- Perform Qualitative Risk Analysis
- Perform Quantitative Risk Analysis
- Plan Risk Responses
- Monitor and Control Risks [31]

Cross-referencing this to the Table 1 Project Success Rates in Chapter 1, the need for improvements within this area is validated by the actions of the Project Management Institute (PMI®). In 2009, PMI supplemented the use of tool, technique, or process identified in the PMBOK® Guide through publishing a dedicated guideline to risk project management. PMI followed with developing qualifications standards and establishing the Project Management Institute-Risk Management Professional (PMI-RMP) certification. While this is a major step forward in risk management, it has scope limitations as described in *Practice Standard for Project Risk Management* (2009).

> The *Practice Standard for Project Risk Management* covers risk management as it is applied to single projects only. Like the PMBOK® Guide-Fourth Edition, this practice standard does not cover risk in programs or portfolios of projects. [32]

Use of the aforementioned standard provides a narrow orientation of risk within a single project that limits the ability of an organization to both manage systemic risk and proactively identify unexpected risk. It also introduces confounding by simplifying the concerns to within a project or functional areas in isolation. Failure to systemically evaluate the full realm of the impact exposes the organization to sub-optimizing the holistic end to end process; or potentially exposing it to secondary risk materialized from an ill conceived initial risk response.

Development of practices that address both the technical and socio-cultural aspects - identified in Figure 2- with taking a process oriented approach offers an effective prescription for managing risk. One technique to accomplish this is to routinely evaluate how things are operating, extending beyond the hard milestone check list of

scheduled deliverables, and flush out the organizational dynamic issues that may thwart improvement, hinder risk management, or otherwise sub-optimize performance.

Project lessons learned

Lesson learned offer the potential to advance an organization's knowledge and awareness. Often this is under exploited in practice. The Project Management Institute (2008) defines a project as a "temporary endeavor undertaken to create a unique product, service or result. The temporary nature indicates a definitive start and end."[33] According to the statistics presented in Table 1, of projects reported, almost 1 in 4 projects terminated prematurely. Regardless of success or failure, lesson learned audits are frequently viewed as expendable exercises and if performed, have limited distribution and circulation of the findings. Lack of a lesson learned knowledge repository limits others from benefitting from experience, especially in viral and in distributed team settings, holding back the maturity potential of the organization.

One trap in project risk management is simply that it is associated to a single project. Once the project is launched and implemented, the risk register and the internalized concerns of the Subject Matter Experts (SMEs) or stakeholders goes into a closed book. Keith Hornbacher argues for an enterprise view of managing project risk and prefers using the phrase "cradle to cradle" rather than "cradle to grave" when describing a project. That is, projects are tactical steps toward achieving a larger strategic purpose. They are part of a whole-perhaps a program, portfolio, and the like.[34]

Due to pressures facing a typical project, Risks are generally prioritized toward Critical and Highs, or lists of the top 10. Potentially the cumulative impacts of the small and medium risks are equally significant or greater than any of the top risks. Risks that are identified but do not experience a known consequence, may become normalized resulting in a down grade of its risk assessment. This latent risk may be ignored resulting in an unexpected failure at a greater level of magnitude. As risks become artifacts of the project, and once the project ends, so does the visibility of previously identified risks. This would apply to both negative and positive risk which represents lost opportunity.

In Nassim Taleb's (2007) bestseller *The Black Swan*, he points out that "We learn from repetition-at the expense of events that have not happened before. Events that are non-repeatable are ignored before their occurrence, and overestimated after (for a while)."[35] The author offers to us that we need to maintain a heightened sense of awareness, in a similar form of mindfulness of the unexpected, to anticipate exposure to an unfavorable circumstance. Based on human nature, we are susceptible to the heuristic of a recent event, where it is over weighted for a short period of time before our attention is drawn away.

Managing for the unexpected also prepares an organization to take advantage of positive risk opportunities. Readiness puts the organization in a position to exploit an opportunity first by being mindful of its existence and second to be prepared to exploit the opportunity once it presents itself. In Chapter 4, the Astro Logistics project's initial focus was on delivering functionality, not recognizing the secondary capabilities gained through superior reporting and management of the business.

High reliability organizations

High Reliability Organizations are generally associated with organizations whom operate in highly hazardous environments that could cause catastrophic harm. In Karl E. Weick and Kathleen M. Sutcliffe's (2007) book, *Managing the Unexpected, Resilient Performance in an Age of Uncertainty*, their progressive research is based on:

> The examination of the way people and organizations organize for high performance in settings where the potential for error and disaster is overwhelming: nuclear aircraft carriers, air traffic control systems, aircraft operations systems, hostage negotiation teams, emergency medical treatment teams, nuclear power generation plants, continuous processing firms, and wild land firefighting crews." [36]

This knowledge area benefits from diversified professional disciplines conducting research based on their area of expertise. Often initiated only after a major or near miss disaster, the accumulated diagnostic studies from the various disciplines both deepens and expands the breadth of expertise, generating synergy among them, to formulate a comprehensive synopsis of what caused the major disaster. In the understanding of the contributing factors, precautionary response measures could be developed to avoid similar reoccurrence.

In supporting the value of retrospective analysis, Christian Stadler (2011) studied the commonalities among the oldest sustaining companies with some histories dating back centuries. In his book *Enduring Success, What we can learn from the history of outstanding companies*, he states:

> Companies that perform outstandingly well over time act cautiously on many levels. They know the future is uncertain and that they should never make assumptions that potentially threaten their existence. In other words, they need to ensure that their core business is resilient enough to hold up against unexpected disasters. [37]

High reliability classification

The use of "High" as a qualifier in the terminology of High Reliability Organization is consistently found in most research conducted on the topic. This field of study also is also known as High Reliability Organization Theory or HROT. This paper will prefer the use of High, versus "Absolute," "Extreme" or "Perfect" or any synonyms which could be used to categorize near defect free operating performance. The confines of existing research appears to be limited and oriented toward incidences capable of causing significant harm, such as within the parameters describe afore mention by Weick and Sutcliffe (2007).

This paper postulates that the use of High does not anchor performance as perfection. It allows extending latitude to scale, as within a tolerance of error, and scope where the boundaries are applicable to a larger population of organizations. This permits non HROs to benefit from the knowledge gained by both studying and understanding what makes HROs successful, and also applying it into their existing programs and organization. This is supported by researchers in the high reliability theory area who argue "by analysis of high reliability organizations we can construct, discover and correct unexpected events that are capable of

escalation into serious problems and establish what is necessary for both reliable performance and adaptive learning."[38] Weick and Sutcliffe offer "Although HROs seem unlike any other organization, that appearance is deceptive. They resemble other organizations in their input processes, their adoption of precautionary beliefs, and their susceptibility to surprises. Where they differ is in their commitment to mindfulness as a means to manage inputs, precautions, and surprises. Even though HROs may be unique in their pursuit of mindfulness, there is nothing unique about how they pursue it. Processes by which HROs pursue mindfulness are processes that can be adopted by anyone." [39]

Karelene H. Roberts (1990), one of the earlier published researchers and contributors on this subject, published an article titled "*Managing High Reliability Organizations*" in the *California Management Review* and describes HROs as:

> Within the set of hazardous organizations, some organizations have operated nearly error free for very long periods of time. These organizations are "high reliability" organizations (HROs). To identify these organizations one must ask the question, "How often could this organization have failed with dramatic consequences?" If the answer to the question is many thousands of times the organization is highly reliable. In such organizations, performance reliability reveals productivity as a dominant goal.[40]

There is considerable recent research derived from the medical domain. David Gaba (2005), in *Improving Patient Safety by implementing strategies of High Reliability Organization Theory,* addressed how High Reliability

Organization Theory (HROT) is applicable to perioperative health care, and has identified the following attributes when classifying HROs:

> Many of these industries share key features with health care that make them useful, if approximate models. In these endeavors:
>
> - Intrinsic hazards are always present
> - Continuous operations 24 hours a day, seven days a week are the norm
> - There is extensive decentralization
> - Operations involve complex and dynamic work with complex materials
> - Multiple personnel from different backgrounds work together in complex units and teams.[41]

The contention of this paper is that many of these items are relative in context and are applicable across a multitude of industries and disciplines. In comparison to both scale and impact, a company bankrupted or that otherwise ceases to exist, creates undo trauma to its employees, their families, and the extended local community.

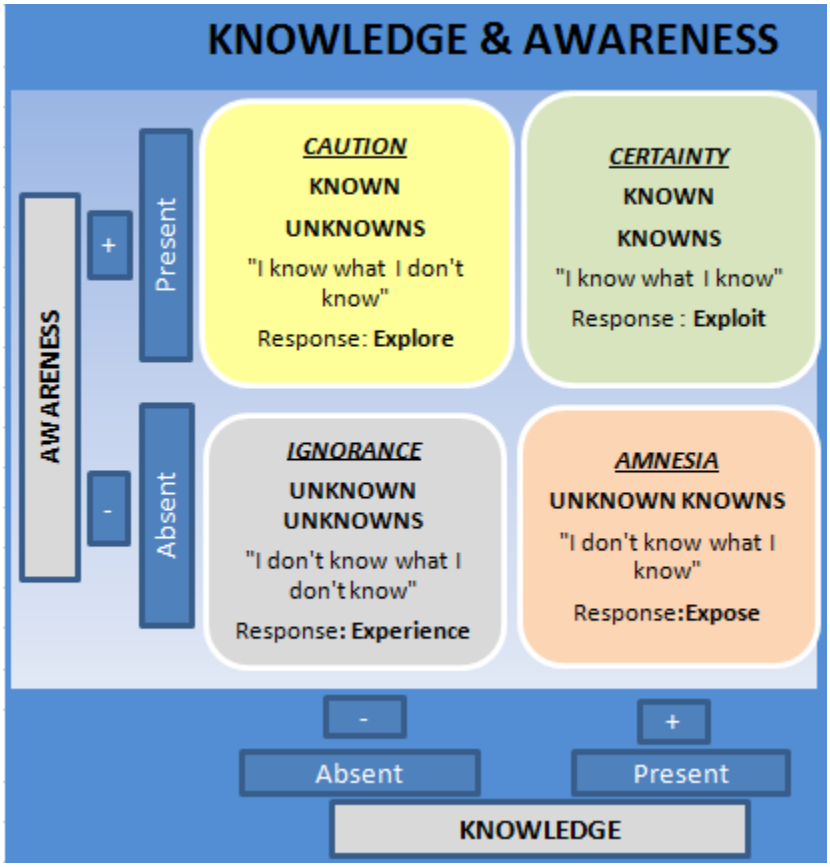
Risk and uncertainty

In David Hillson's (2004) book *Effective Opportunity Management for Projects, Exploiting Positive Risk*, the author differentiates the term uncertainty from risk. Where risk is referred to as aleatoric, whose root Latin word *alea* means dice. Here, risk "strictly refers to an unknown event drawn from a known set of possible outcomes."[42] He couples Risk, which is a measureable uncertainty, to Awareness. Uncertainty is said to be Epistemic, with the Greek root word *episteme* which means knowledge. Hillson

defines uncertainty as “an unknown event from an unknown set of possible outcomes”, which is due to a lack of knowledge about possible outcomes, their nature and associated probabilities.[43] Hillson uses the following couplet to explain the relationship between risk and uncertainty, and distinguishes between *aleatoric* and *epistemic* as: Risk is measureable uncertainty; Uncertainty is unmeasurable risk.[44] Hornbacher notes that uncertainty is an unknown event from an unknown set of possible outcomes, where sources are many, relates to “knowability” of what might happen in the future, with uncertainty being a fuzzy concept which needs focus to be practical. [45]

Figure 3 presents the relationship between awareness and knowledge in a four block matrix. The model is similar to the JoHari Window concept that provides a perspective on personal awareness and blindness. Starting in the top right quadrant, ‘Certainty’ is your Known Knowns, where you know what you know; both awareness and knowledge are present. Presence of both awareness and knowledge should be exploited to maximize your strengths and make full use of known facts to take well-founded decisions and actions.[46]

Figure 3. Knowledge and Awareness Matrix (Adapted from Hillson, 2004)



The bottom right, in this situation you have the presence of knowledge, but you lack awareness or have a blind spot regarding the knowledge actually possessed. This quadrant is labeled 'Amnesia'. Exposure unlocks the knowledge delivering advantage to the situation and the organization. Exposure eliminates wasted opportunity that could otherwise been addressed with the existing resources, enabling better decision making and managing for the unexpected. This will be a target area covered in the Chapter 4 project study, where software development is supported by newly developed processes to convert signals into awareness, facilitating the ability to effectively deal with risk.

The upper left is the Caution quadrant. Here you have the presence of awareness, and recognize you lack specific information or experience in dealing with something.

You don't have all the pieces, and recognize up-front they are missing or deficient in some form. The appropriate response should be 'explore'. Realizing a shortfall gives you the opportunity to remedy the situation to satisfy the gap. This is the only quadrant where risk in the sense defined above resides, whereas Risk is measurable uncertainty, allowing for quantitative analysis to be conducted on the range of possible outcomes.

Pure 'ignorance' exists with the absence of awareness and knowledge. This is also referred to as an 'unknown unknown". This is correctible through experience, competency development, training, and team composition and design. PMI's PMBOK® Guide-Fourth Edition offers guidance on this, stating "the specific unknown risks cannot be managed proactively, which suggests that the project team should create a contingency plan."[47] The existing dominant frameworks in project and program management do not explicitly recognize the distinct dual meaning of risk as described by Hillson above, nor develop the concept of awareness and knowledge in their guidelines. Elaborating on this further, the OGC's Managing Successful Programmes (MSP) states "Successful programme management has at its core the need to both manage and tolerate uncertainty, complexity and ambiguity. Risk management and issue resolution are the vehicles for achieving this."[48] While the guideline establishes the need to develop a support structure and a supportive culture to realize the benefits of risk management, there is little evidence supporting the need to diagnose the program, project, or process aptitude for awareness and knowledge. Failure may result in a short coming to prepare for the unexpected and formulate the appropriate response. In effect this jeopardizes the program allowing it to operate in a state of ignorance as categorized in Figure 3.

Introducing High Reliability Organization Theory (HROT) into the organization's processes and culture accelerates awareness and knowledge –enabling an organization to effectively manage against the unexpected. In Roberts and Bea's (2001) article *Must accidents happen? Lessons from high-reliability organizations*, "Research on HROs shows that they are better finding out what they don't know than are organizations that have higher accident frequencies."[49] Based on this finding, HRO's operate at a high state of awareness by recognizing what they don't know. This drives them to remedy the gap, either by bringing in expertise, training, learning or gaining experience that enables them to perform with high reliability. Since most organizations will operate in and out of the Caution and Amnesia quadrants, this conceptual framework promotes the need for continuous improvement to evaluate and develop the critical skill sets, knowledge, and competencies required by the organization to remain competitive, sustain itself, if not thrive in its business environment.

Mindfulness

Expectations create a reference baseline for both interpretation and judgment. This frame of reference may cause bias as we look to reinforce what we anticipate will happen or how people will behave. Expectations are built into nearly every component of our life. In organization they are found in one's roles and responsibilities, routines, deliverables and strategies. Bias may cause erroneous diagnosis of the situation causing misdirected responses, or discounting aberrations resulting in failure to initiate a response. Weick and Sutcliffe (2007) describe Lee Clarke's findings in *The Disqualification Heuristic: When Do Organizations Misperceive Risk?* "the basic idea is that people disqualify

disconfirming information, highlight confirming information, and neglect information that contradicts a conviction, all in the interest of reducing uncertainty and increasing their sense of control."[50]

In Daniel Kahneman's (2011) *Thinking, Fast and Slow*, he describes how one formulates a model of your personal world that represents what is normal in it. Kahneman notes,

> The model is constructed through associations that link ideas of circumstances, events, actions, and outcomes that co-occur with some regularity, either at the same time or within a relatively short interval. As these links are formed and strengthened, the pattern of associated ideas come to represent the structure of events in your life, and it determines your interpretation of the present as well as your expectations of the future.[51]

These heuristics aid in our ability to make rapid interpretations of situations, but also form a bias that may distort our sense of reality.

Complex and dynamic processes may conceal confounding factors resulting in what may seem as benign signals that may exponentially worsen as they remain undetected. These threats may cause tremendous stress and harm in the system when they surface at a later time making it much more difficult and costly to control. Synder and Stukas (1999) identify that this expectation bias problem is accentuated under pressure. Where pressure increases, people are

more likely to search for confirming information and to ignore information that is inconsistent with their expectations. [52]

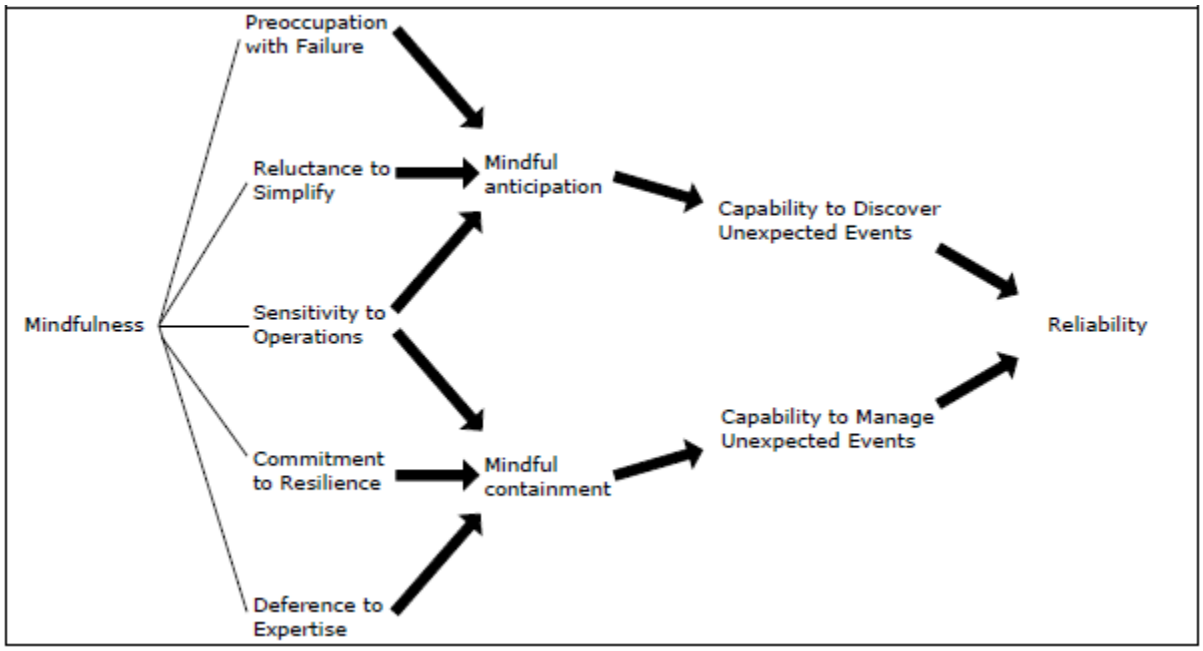
Such situations create blind spots (Unknown Unknowns) that are only manageable by being tuned in to the details. This heightened sense of awareness recognizes that expectations distort perception and operate in the moment, both seeking and engaging unexpected signals. This is referred to as operating in state of Mindfulness. Weick and Sutcliffe (2007) formally define mindfulness "a rich awareness of discriminatory detail", with viewing mindfulness as being about the quality of attention, with a focus on comprehension of emerging threats and on factors that interfere with such comprehension.[53]

Weick and Sutcliffe (2007) developed five principles that need to be indoctrinated into the organization to achieve High Reliability. These include the ability to notice small failures (the principle of preoccupation with failure), and their distinctiveness must be retained rather than lost in a category (reluctance to simplify). People need to remain aware of ongoing operations if they want to notice nuances that could be symptoms of failure (sensitivity to operations). Attention is also crucial for locating pathways to recovery (commitment to resilience) and the knowledge of how to implement those pathways (deference to expertise). [54]

Weick and Sutcliffe's (2005) five principles enable HROs to achieve reliability and effectively deal with the unexpected. The first three deal with anticipation: Preoccupation with Failure, Reluctance to Simplify, and Sensitivity

to Operations. The last two deal with containment and include commitment to resilience, and deference to expertise.[55] Collectively through a heightened sense of mindfulness within each area, they prepare an organization to work with the unexpected and to achieve reliability. The below figure graphically demonstrates the relationship.

Figure 4. A Mindful Infrastructure for High Reliability *(*adapted from Weick et al., 1999, Willem, Eede, Bartel, 2007).[56]



Sensitivity to operations

HRO mindfulness through sensitivity to operations is achieved through high situation awareness coupled with superior decision making capability; while operating in an environment with a great deal of uncertainty and incomplete information. By understanding what makes an HRO successful, an organization has the potential to advance toward the 'Certainty' quadrant as presented in Figure 5. The convergence of

HRO Theory with Project Risk Management principles demonstrates the synergistic opportunity to strengthen emerging best practices and theory in both domain areas.

The downside of HROT is that through its emphasis on addressing weak signals with strong responses there may be instances where it is overkill. This may cause responses to activity that does not warrant attention, and worse yet, may be counter-productive by distracting one from addressing the issues that deserve greater attention. The accumulation of weak signals may cause an over-saturation of actionable items immobilizing the organization. If not administered properly, this could paralyze an organization, in effect causing secondary risk that is greater than not addressing them in the first place. Six Sigma uses the terminology *common cause variation,* to describe naturally occurring variation, for environmental factors beyond our control. High Reliability Organization Theory's orientation is to make strong responses to weak signals. Here, common cause variation may not be discernible from special cause variation, which is correctible through process improvement tools and techniques, thereby resulting in wasted time, resources, and opportunity.

Research to date on HROT offers little in the way of how to implement the finding of their research that curtails its value. This capstone study indicates that this limitation may be offset by integrating HROT into mainstream frameworks, such as an Organizational Enabler in the OPM3 context. HROT elevates an organization's process and risk maturity growth through mindfulness attention to its five principle areas. This process is thus facilitated by disseminating knowledge and developing cultural awareness on the importance of mindfulness.

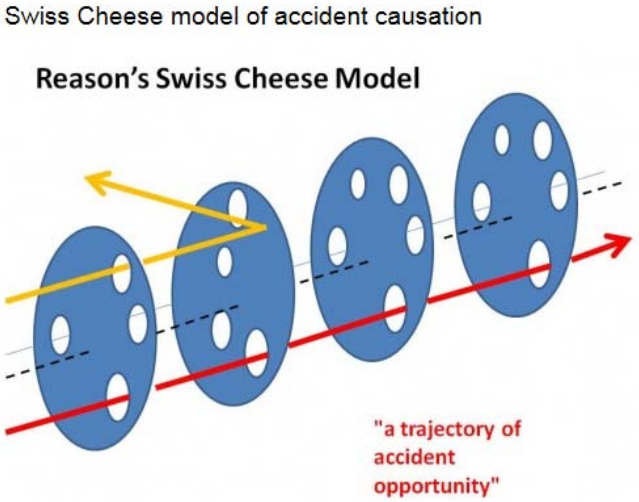
Swiss cheese model

James Reason, a sociologist from the University of California, Berkeley, and an early contributor on HROs, developed a conceptual model to identify how an accident can penetrate multiple barriers. By analogy in Chapter 4's Astro Logistics project, some of the traditional definitions of the elements are modified to reflect the characteristics of the study. Each slice represents a defense barrier. The triggers are the risk signals against the process inputs, which are the tender orders from customers. Where each sequential slice of cheese (shown as a disc in Figure 5) is a functional silo, the space between each slice represents the hand offs between the various groups involved in the process. Traditionally, the holes represent the sub-optimal functioning within each area. Extensions are made to include various signals, functional disruptions, and quality related concerns that may give way to problems in down steam production and service handling. Seemingly inconsequential signals in one process area, may either yield insight to another area or add value at a latter point of time. The project study develops the capability to capture these weak signals as Risk attributes against the order, fostering systemic visibility for determination and dynamic risk escalation handling. Service failures occur when hazards penetrate the holes within the layers of the process, piercing multiple defense barriers to cause service failure.

Use of this model provides a means to conceptualize the complexity of the process, and supports identifying the vulnerability of the organization. The diagram demonstrates the value of each area being vigilant to the signals from within their immediate operating environment, and creating a heightened sense of

awareness of these concerns. By being mindful of the sensitivity to operations, the organization can address early on signals with the appropriate response. An escalation Responsibility, Accountable, Consulted, and Informed (RACI) matrix was developed in the Astro Logistics project to provide guidance for escalation communication management. It was customized to incorporate severity against trigger points on when to take specific actions or formulate a team based response.

Figure 5. Swiss Cheese Model (adopted from James Reason HF model)[57]



Another favorable attribute of this model is that it visualizes the gap between the functional areas. This is similar to a Value Stream Map or other various process maps that utilize swim lanes to identify specific roles or functional areas. Process management recognizes that the greatest risks to a process are in the handoffs or between the interfaces among the functional groups. These are traditionally illustrated as delineated lines known as functional swim lanes in a process flow chart. During these exchanges, communication issues, incongruent priorities per area, cultural issues and other

contributing variables introduce risk into the reliability of the service or product being delivered. Rummler and Brache's (2010) work in *White Space Revisited*, point out that the greatest opportunities for improved performance often turn up at the hand offs between silos also known as interfaces. Each interface creates opportunities for important silo priorities to disrupt and delay processing work flowing through the silo on its way to some distant customer.[58]

Christopher Martin and Donald Waters (2007), in the book *Global Logistics, New Directions in Supply Chain Management*, state.

> One of the most significant changes in recent years has been in the way in which we think of organization structures. Conventionally, organizations have been 'vertical' in their design. In other words, businesses have organized around functions such as production, marketing, sales and distribution. Each function has had clearly identified tasks and within these functional "silos" or "stovepipes" (as they have been called) there is a recognized hierarchy up which employees might hope to progress. The problem with this approach is that it is both inwardly focused and concentrates primarily on the use of resources rather than upon the creation of outputs. The outputs of any business can only be measured in terms of customer satisfaction achieved at a profit. Paradoxically, these outputs can only be realized through coordination and cooperation horizontally across the organization. These horizontal linkages mirror the materials and information flow that link the customer with the business and its suppliers. They are in fact the core processes of the business.[59]

Processes that are tightly aligned to the input and outputs of the customer facilitate tighter communication and promote amplification of the weak signals. This enables well directed and prompt response handling. Referring back to the Swiss Cheese Model, processes designed with strong horizontal linkages strengthen the defensive barriers among the functional handoffs. This improves its ability to manage the unexpected throughout its end to end process.

Process analysis

While not specifically found in existing research on HROs, this Astro Logistics project study described in Chapter 4, utilized various process diagnostics tools including As Is, To Be, and Value Stream Mapping and codified the tasks into a modified Work Breakdown Structure (WBS). A WBS decomposes processes into sub-processes, and breaks them down further into tasks at their lowest measurable level. In the Astro Logistics project, modification was necessary to meet the customized needs of the client. Examples of the registered items included: upper/lower thresholds, how quality is measured, determining if the process works every time it is called upon, evaluating the root cause when it does fail, and assessing what needs to be measured to know if the system is operating properly. Use of the WBS is described in both Chapter 4 and Appendix C: Process Analysis.

Weak signal response

HRO researchers are proponents of assertive action and effort against weak signals. This is counter intuitive to how most people would behave. Normally one would respond to a strong signal with a strong response, and with a weak signal garnering a weak response. Research by Weick and Sutcliffe identified, "HROs take deliberate steps to create more complete and nuanced pictures of what they face and *who they are* as they face it. Knowing that the world they face is complex, unstable, unknowable, and unpredictable, HROs position themselves to see as much as possible." [60] Weick and Sutcliffe (2007)

reference the work of psychologist James Reason on “latent failures”. These are defined as “loopholes in the system’s defenses, barriers and safeguards whose potential existed for some time prior to the onset of the accident sequence though usually without any obvious bad effect.”[61] These loop-holes consist of imperfections in the elements found in Figure 1: The Technical and Socio-Cultural Dimensions of the Project Management Process. These elements included both the science and art side components of a project. On the technical side, these may include project scope, WBS, Schedules, Resource Allocation, Baseline Budgets, and Status Reports. On the Socio-cultural side, these may include Leadership, Problem Solving, Teamwork, Negotiation, Politics, and Customer Expectations. These socio-cultural factors are the most inconsistent factors because they are people-based, and therefore harder to control their confounding effects, compared to the technical processes. Roberts and Bea (2001) have identified three basic things HRO organizations do to enhance their reliability and offer helpful lessons to any organization seeking to increase its reliability:

- HROs aggressively seek to know what they don’t know.
- HROs design their reward and incentive systems to recognize costs of failures as well as benefits of reliability
- HRO’s constantly 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.[62]

Robert and Bea’s (2001) research identified that HROs spend disproportionately more money than other organizations training people to recognize and respond to anomalies. Training includes both failure simulation

and accident analysis. Simulation addresses anticipation of potential situations, and the latter builds an organization memory of what happened and why. Such training helps people recognize how to decouple highly coupled systems quickly to minimize the harm caused by the initial accident to the total system. [63]

Roberts and Bea (2001) identify that HROs are able to balance producing short-run profits and the expense of long-term safety. Their findings indicate that if reliability and safety are critical, it has to be measured, incentivized and rewarded or it won't happen." [64] Their position is that companies oriented only on financial performance run the risk of failure. Some of the approaches they cite to address these issues are the following three items:

1. Use interviews, focus groups, and employee surveys
2. Develop creative accounting techniques to account fully for the cost of having accidents and assign value to avoiding them
3. Develop and reward measures of safety and include them as part of employee evaluation to balance the financial measures. [65]

Communicating the big picture within an HRO enables its members to know how their behavior and action ties into the purpose of the organization. It includes the importance of staying in touch with everyone if and when they see something wrong. Key components include:

- Top management tells stories about employees who saved the company major dollars, embarrassment, or injury;
- All managers are encouraged and rewarded to communicate openly with each other, especially in situations that seem odd, unusual, or problematic;
- Incident Command Systems are created as a standing procedure with well-know decision rules about when they are engaged. [66]

In order to accomplish integration of HROT into project management, the process, tools, and technical applications need to be aligned and capable of converting weak signals into a form designed for early detection and prompt response handling. Development of this capability engages the problems while they are manageable and controllable. This will be exemplified in the project study.

Process coupling

Adoption of any new theory, process, or procedure needs to add value to an organization. Investment in time, resources, and capital must be substantiated by evidence that tangible results are achievable. This may be in the form of Risk Reward Benefit, Payback Financial Analysis, Return on Investment and from a multitude of various benefit realization measurements.

In a continuous service operation, it is necessary to be sensitive to operations to pick up signals influencing the ability to deliver a quality product. HROs both evaluate their failures and pay attention to their near misses. For example, air traffic controllers must report near accidents. The justification is that there are valuable lessons learned that can be used to openly discuss existing protocol to strengthen the process defenses in order to prevent re-occurrences and learn how to handle similar situations in the future.

A major weakness in adopting HROT in one's organization's processes is the perception that one does not have the available resources, the time, or the technological capabilities to incorporate these process variables. Organizations operating under Lean Six Sigma principles may also find this challenging. Lean processes have the goal to

banish *Muda*, which is the Japanese term for waste and to minimize non-value steps. Waste may be made visible by mapping out the process steps and identifying the ones for which the customer is not willing to pay. In this context, taking the time and effort to put strong responses into weak signals may result in change resistance.

In Rummler, Ramias, Wilkins's (2011) book *Rediscovering Value Leading the 3-D Enterprise to Sustainable Success*, the authors define a process as "a construct for organizing value-adding work to achieve a business-valued milestone so it:

Can be *performed* effectively and efficiently

Can be *managed* effectively

Offers the potential for a *competitive advantage*. [67]

The aforementioned criteria furnish an excellent triad for coupling comparison when assessing HROT. Existing research limits itself through evaluating the tight coupling among HRO's and efficiency. Efficiency as a single element is ill suited to properly assess coupling, as a highly efficient project does not necessarily mean it's effective. In turn, a highly effective project may be so inefficient that it's not viable to implement. The Astro Logistics project shows how people, processes and technology can be integrated together to balance these competing variables into a project.

CHAPTER 4

ASTRO LOGISTICS PROJECT

Astro Logistics, a pseudo name for the actual company, provides transportation brokerage service in the United States market. While it has been operating profitably for over 11 years, it has been struggling since November 2010 with both internal and external challenges to its favorable growth. Presently there are approximately ninety employees domiciled in a centralized location in the metro New Jersey/New York area. As a transportation brokerage company, it operates as a middle man between shipper and motor carrier. It does not own any truck assets. Its success is dependent on finding trucks and having them pickup and deliver shipments on time. The transportation sector is an intensely service oriented environment. Astro's customer base is very demanding with little tolerance for sub-standard performance.

Astro Logistics' growth aspirations were constrained by its ability to scale up its volume while sustaining if not improving its quality service level to its customers. Diagnostic study of its end to end process identified the dependency on the shipment paperwork as a limiting factor. Shipment paperwork was first generated when the shipment tender order was presented; it continued throughout its support processes across three separate departments and concluded once the load was delivered. It served as a source document, accumulating additional pages, such as emails and screen printouts, to be used as an all encompassing reference document concerning the shipment. The limiting factors include the

physical aspect that the paper could be in only one spot at any one time, often getting misplaced in the paper shuffle. Frustration often occurred when a customer or carrier inquired about the status of a shipment, and the responder had difficulties hunting down the paperwork on someone's desk to get an update.

Sensitivity to operations

A priority with top management was to eliminate being blind sided by the shipper calling in about a problem they were not aware of; usually a shipment was not delivered. High profile shipments, such as high value or production deliveries, fall into this category. For example, Astro is constantly under pressure to deliver glass bottles to breweries around the country. Many of these companies operate Lean or Just In Time (JIT) inventory practices. In these scenarios the bottles are delivered to the brewery for immediate use in the assembly line. Failure to deliver the bottles jeopardizes the production operation by potentially causing the plant to shut down, resulting in stiff fines and penalties.

Another important aspect, often emphasized by the organization's management, is that it's better to be in a position to make a call to a customer about a problem, than to unexpectedly receive a call from a customer regarding a problem the management knows nothing about. The company needed a solution that provided visibility and transparency across the organization.

HRO's operate with a high sensitivity to operations as was described in previous chapters. Integrating these principles into a comprehensive plan resulted in an end to end process definition. The tasks in the critical functional areas were

decomposed to a granular level within a work breakdown structure (WBS) template. Each "As Is" step was catalogued, assessed, and analyzed. While the "As Is" process was re-configured into a "To Be" process, risk assessment escalated from the task level to the organization and process level.

Originally the steps were documented on Post It's during working sessions with the Subject Matter Experts (SMEs). Once organized, they were developed into a Visio diagram, reviewed by the business clients, and registered into an Excel spreadsheet. The familiarity of Excel by the stakeholders made use of spreadsheets administratively easier during both elicitation and review sessions, and for distributing the outputs of such sessions to the group for their review. The organization in the project study also used the process analysis to assist in job design definition, project prioritization, risk management, and to baseline throughput velocity and performance.

Appendix C illustrates how each sub-process task is defined across an array of these performance variables. Presence of these pre-defined performance variables facilitated brain storming which stimulated thought provoking discussion of the stakeholders. It also channeled consideration of how the steps correspond to requirements within this and other downstream processes. This included identification of the associated risk, constraints, inputs, outputs, and various other operating parameters. In using Excel, it became relatively easy to aggregate sub-processes, under the hierarchy of their higher level processes, and to encapsulate the work flow into a comprehensive framework that supports systemic evaluation of the end to end process.

During this systemic evaluation, there needed to be a mechanism to filter weak but important signals from the noise. This was deemed necessary to support scalability, and promote increased velocity, throughput, and service performance, in terms of on time delivery and exception management.

The company internally developed a “Risk” dispatch status as both a searchable data element and visible icon to identify the orders deemed at jeopardy for late delivery. This functionality enabled the staff to register the signals from within its immediate operating environment and associated them to the orders deemed at risk. This supported the ability to have greater sensitivity to its operations.

Development of the Risk status supplemented the conventional use of qualifiers based on the characteristics of the cargo or trailer requirement, Hot Load (e.g. a production load), contract and insurance status, among others. These statuses were also developed into search criteria to filter on specific loads, prioritize work, and manage the shipment in the system. For example, now at his finger tips, a dispatch manager could search on all the loads the organization deemed to be at risk or in need of special attention. Visibility gave the dispatch manager the ability to verify that the appropriate responses were being taken. Greater visibility also increased the level of cross functional team problem solving and collaboration.

Application development

Development of the risk status enabled users to encapsulate their tacit knowledge and risk assessment based on their functional area. Combined with online search filters and reporting capabilities, it created a dynamic and interactive risk register broken down to the single shipment level, which supports HRO's need to be sensitive to operations. Given this was a novel approach without precedent in the organization, the risk designation criteria were intentionally not defined, leaving it to the collective organization to normalize how they wished to exploit this technology. Intentions were to avoid a situation that delegated away responsibility from the individual level and retained the initiative of the employee. During implementation training, each employee was oriented to the critical roles they each play and the shared responsibility they have in the successful delivery of every load. By each position taking ownership and contributing their risk awareness in the form of preparedness to the unexpected, in effect problems were prevented from occurring.

An extension of enabling the Risk Icon is the ability to add order notes which further enriches the quality of the aggregated risk assessments. For example, the customer service representatives are on the front end, processing the order when it comes in, and setting the pickup and delivery appointments. When dealing directly with the shippers and consignees, the communication exchange might reveal potential problems. An example may be a warehouse backed up. This may be a signal that changing an appointment there may encounter a problem if the carrier experienced a delay. A carrier held up at a shipper,

jeopardizes not only his on time delivery, but subsequent loads due to federally mandated hour of service regulation Sensitivity to operations is achieved by registering these weak signals as risk attributes in the system against the specific order. This facilitates proactive problem solving and resiliency that are also key aspects of HROs.

Harvey A. Levine (2005), in his book *Project Portfolio Management: A Practical Guide to Selecting Projects, Managing Portfolios, and Maximizing Benefits,* advises that dealing with projects with High Uncertainty, through their very nature is to exhibit increased uncertainty in the earlier phases. Levine states "the objective of the earlier phases is to define the later ones. As the project moves through the phases, the degree of uncertainty should diminish." [68] Similar to the Astro Logistics project, identifying the warning signals early on offers the organization the ability to assess their risk at key stages or milestones within the shipments activity. Risk response triggers are deployed based on pre-set criteria as defined in the RACI escalation matrix.

Supporting this approach, Roberts and Bea (2001) advise,

> While the importance of communication may seem self-evident to most managers, HROs truly emphasize it. They spend time and money developing and maintaining an effective communication capability that allows them to shape and share the big picture of what the organization should be looking for and worrying about as they do their jobs. [69]

Correspondingly, the brokerage group deals directly with motor carriers and continuously receives feedback from the carriers. This is a valuable conduit for external signals, as well as to be in a position to flag credibility issues with

particular carriers or other red herring issues that jeopardize performance on a given load.

Dispatch is the execution phase of the process, from carrier set up, to driver dispatch, tracking, and tracing of the moves. This group manages the shipments from pick up coordination to final delivery. Development of the system included search and sort functionality to prioritize the work, which also included ability to segregate and identify all the flagged Risk orders. Priority management and escalation handling permitted greater focus on issues which poised the greatest risk.

Performance

Approximately 3 months have elapsed since implementation. The most demanding accounts, many being the well known big box retailers, have experienced a10 percent or more increase in On Time Delivery (OTD). It is not uncommon to have subsequent week-to- week on time delivery performance scores at 100%. Prior to the implementation, operating at such levels was never accomplished. Phone metrics measured by the number of dropped calls improved by over 20 percentage points. Prior to implementation, Astro's dispatch department was operating near 70%. This equates to 30% of their inbound phone calls dropping off. Within 60 days the company was operating in the low nineties. Evidence of adopting HROT mindfully (recognition of sensitivity to operations) strongly suggests it drives success. In this case, it delivered the ability to turn a liability into a competitive advantage.

One of the concrete improvements in the new process includes development of the Risk icon and its supporting functionality. This delivers the ability to pick up the "noise" across the silos. These noises are equivalent to the weak signals of complexity that may reside as tactical knowledge within one domain, but not explicitly known or understood by the other functional areas. The cumulative effect of the other functional areas' expertise, especially as fresh signals occur, adds value to the assessment and the tactical response handling. Based on improved performance, customers have awarded Astro additional business supporting the sustainability of their business model.

Continuous process improvement

Karl E. Weick's and Kathleen M. Sutcliffe's (2007) research on High Reliable Organizations (HRO's), they identified that organizations must maintain continuing alertness to the unexpected in the face of pressure to take cognitive shortcuts. Shortcuts stem from prior success, simplifications, strategies, plans and use of hierarchy to pass responsibility upward. Brutal audits lie in the path of those same shortcuts. [70] The extra work spent up-front, as demonstrated in the Astro Logistics project, contributes to the building of core competency and achieving the company's goals.

Weick and Sutcliffe (2001) continued by saying HROs are distinguished from other types of organizations.

> They are attentive to the front line, where the real work gets done. The "big picture' in HROs is less strategic and situational than is true of most

> other organizations. When people have -developed situational awareness, they can make the continuous adjustments that prevent errors from accumulating and enlarging. Anomalies are notices while they are still tractable and can still be isolated. All this is made possible because HROs are aware of the close tie between sensitivity to operations and sensitivity to relationships. [71]

Escalation, control, and customer feedback

Further supporting the keen attention to operations, a customized Responsible, Accountable, Consulted, and Informed (RACI) matrix and communication escalation protocol was implemented. This cross reference matrix defined responsibility against actionable trigger points to escalate the situation or take specific action. This one page form was a means for the CEO to exercise his risk tolerance against typical operational scenarios and to leave no room for interpretation. These guidelines remove any ambiguities regarding responsibility and ownership. Development in itself delved into the sensitivity of operations, of who is accountable, responsible, and consulted prior making a decision or communicating to the customer. Historically many of these situations were handled in functional isolation. They now permeate horizontally across silos, vertically to management, and frequently cross departmental lines. This better leverages the expertise of the organization on a whole to better assess and effectively work through a problem. It also improves communication with the customer. For example, the Sales group has now become much more informed of operational issues. This enables them to proactively communicate to their

contacts and leverage their relationship to develop the most amicable solutions. Customer service is now better informed on carrier issues and challenges. This improves their effectiveness in dealing with shippers, consignees, customer load planners, transportation, and corporate management. This facilitates an understanding of the big picture, that was identified earlier as another quality of HROs.

The RACI escalation matrix was presented to select customers to solicit their feedback and to customize our escalation and communication protocols to satisfy their expectations. Favorable feedback was received. Appendix B: RACI illustrates an example.

CHAPTER 5

CONCLUSION

The purpose of this Capstone is to determine if incorporating High Reliability Theory (HROT) -mindfulness of the unexpected through sensitivity to operations into project and program management- may improve the success in fulfilling the organization's goals. The business case is predicated on the need for improvement. Approximately only one third of projects succeed, as documented in the 2008 Standish report on IT projects. Research also identified that less than 10% of companies are operating at CCM maturity level of 4 or 5. This gap means these organizations are not operating with fully managed and continuously improving processes. HROs are organizations that operate continuously and whose failure would cause serious harm. These organizations have been well studied by professionals from numerous disciplines. These studies offer excellent insight on what makes an HRO successful and may be applied to non HROs.

In Chapter 2, the Literature Review identified High Reliability Organizations as an emerging theory area. Currently HROT has little recognition in main stream project, process, or program frameworks. A critical argument against HROT research is that it is based on a narrow cohort study which operates under very different operating parameters from main stream organizations. HROT is viewed as tightly coupled with efficiency, and critics may claim it is not viable for mainstream organizations that must work under tighter resource and budgetary constraints than HROs.

Chapter 3 demonstrated that projects processes operate in two dimensions; Technical- which includes the hard science of project management, and the Socio-Cultural- which includes the "art" side of organizational dynamics. Operating under HROT's sense of Mindfulness and its five principles of Preoccupation with Failure, Reluctance to Simplify, Sensitivity to Operations, Commitment to Resilience, and Deference to Expertise delivers the proper orientation to bridge the two project process dimensions. Mindful anticipation and containment deliver the capability to manage for unexpected events and achieve high reliability. While each of the five principles is important, this capstone emphasized Sensitivity to Operations and illustrated its value in the Astro Logistics Project.

This capstone identifies the potential for HROT to be integrated into mainstream frameworks and deliver value. Based on the literature review and augmented by direct experience from the Astro Logistics Project, HROT appears to be a natural fit as an organizational enabler within the OPM3® framework. Implementing HROT as a contributing factor in OPM3® best practices would be likely to increase the organization's maturity and favorably impact the strategic inputs and outputs at the portfolio, program and project level. Chapter 3 also identified similar advantages in other well known frameworks such as the Capability Maturity Model and Risk Maturity Model where it is recognized as a maturity accelerator.

Chapter 4 validated the capstone's research by comparing it with an actual process and IT development project. The project describes how inclusion of HROT principles into a new paperless dispatch process yielded favorable results. The Astro Logistics project demonstrates how HRO theory can be integrated into

business process management, effectively integrate risk management into an operating plan, and foster a culture of risk awareness and mindfulness of the unexpected. Coupling both process and IT development proved critical to dynamically register the risk signals for collaboration across functional silos. Adoption of this systemic approach better equipped the organization with a tool to prioritize response efforts against the multitude of signals encountered throughout an orders life cycle. Ultimately this has proven to improve the reliability of the organization as substantiated through higher key performance scores.

While the HRO theory provides invaluable insight into the contributing factors of success or failure of HROs, there is very limited research available on how best to implement it. This business case demonstrates that HROT is very well suited to be incorporated into existing project management methods with a high degree of success.

Future research is recommended in three areas. The first is to correlate the association of Organization Maturity with HROs. Second, utilize economic modeling to present implementation merits from a financial perspective and third, evaluate the viability of converting the retrospective findings into a consolidated body of knowledge that may be used in a prospective framework.

Other potential future applications may include developing a High Reliability 'Partnership' model. This construct would emblaze the five success criteria of an HRO into guiding principles for the relationship. Adopting HROT into supply chain

collaboration benefits both parties and develops maximum synergy among the partnership enabling competitive advantage.

NOTES

[1] Frankl, Viktor E. (2006). *Man's Search for Meaning.* Beacon Press. Boston, MA: 150

[2] Anderson, Erling S. (2010). *Are We Getting Any Better? Comparing Project Management in the Years 2000 and 2008.* Project Management Journal. Wiley/PMI. August, 2010: V 41,4

[3] Anderson, Erling S. (2010). *Are We Getting Any Better? Comparing Project Management in the Years 2000 and 2008.* Project Management Journal. Wiley/PMI. August, 2010: V 41,4

[4] Bourrier, Mathilde. (2011). *The Legacy of the Theory of High Reliability Organizations: An Ethnographic Endeavor.* Sociograph N9/2011. Universite De Geneve. Departement de Sociologie: 6

5 High Reliability Organization Discipline Areas. Retrieved February 10, 2012 from http://high-reliability.org/pages/HRO-model-overview

[6] National Academy of Neuropsychology. Definition of a Clinical Neuropsychologist. The Clinical Neuropsychologist 1989. Vol. 3, No. 1: 22

[7] van Stralen, Daved. Retrieved March 1,2012 from http://high-reliability.org/pages/vanStralen

8 Pumilia, Charles. (2012). personal communication. March 10, 2012

[9] van Stralen, David. Retrieved March 1, 2012 from http://high-reliability.org/pages/vanStralen

[10] Perrow, C. (1981). *Normal accident at Three Mile Island.* Society 18(5):17-26

[11] Roberts, Karlene H. (1990). *California Management Review. Managing High Reliability Organizations.* Summer 1990. 32,4. ABI.INFORM Global: 101

[12] Roberts, Karlene H. (1990). *California Management Review, Managing High Reliability Organizations.* Summer 1990. 32,4. ABI.INFORM Global: 101

[13] Project Management Institute. (2008). *A Guide to Project Management Body of Knowledge (PMBOK® Guide)-Fourth Edition.* Newtown Square, PA: 6

[14] International Institute of Business Analysis. (2011). *The Agile Extension to the Business Analysis Body of Knowledge* (BABOK® Guide). Toronto, Ontario, Canada: 7

[15] Gray, Cliffort, Larson, Erik. (2002). *Project Management-The Complete Guide for Every Manager*. McGraw-Hill. New York, NY: 13

[16]Gray, Cliffort, Larson, Erik. (2002). *Project Management-The Complete Guide for Every Manager*. McGraw-Hill. New York, NY: 13

[17]Gray, Cliffort, Larson, Erik. (2002). *Project Management-The Complete Guide for Every Manager*. McGraw-Hill. New York, NY: 14

[18] Gray, Cliffort, Larson, Erik. (2002). *Project Management-The Complete Guide for Every Manager*. McGraw-Hill. New York, NY: 14

[19] Carnegie Mellon University. (2010). *Improving processes for providing better services.* CMMI-SVC, V1.3. CMU/SEI-2010-TR-034. ESC-TR-2010-034. Retrieved 17March2012 from http://www.www.sei.cmu.edu

[20] Carnegie Mellon University and Software Engineering Institute. *Capability Maturity Model- Integrated Systems/Software Engineering*. version 0.2b. September 1999

[21] Gray, Cliffort, Larson, Erik. (2002). *Project Management-The Complete Guide for Every Manager*. McGraw-Hill. New York, NY: 15

[22] Project Management Institute. (2008). *Organizational Project Management Maturity Model (OPM3®)-Second Edition.* Project Management Institute. Newtown Square, PA: 1

[23] Project Management Institute. (2008). *Organizational Project Management Maturity Model (OPM3®)-Second Edition.* Project Management Institute. Newtown Square, PA: 30

[24] Project Management Institute. (2008). *Organizational Project Management Maturity Model (OPM3®)-Second Edition.* Project Management Institute. Newtown Square, PA: 31

[25] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 258

[26] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 258-259

[27] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 239

[28] Carnegie Mellon University and Software Engineering Institute. *Capability Maturity Model- Integrated Systems/Software Engineering.* version 0.2b. September 1999: 15

[29] Office of Government Commerce. (2007). *Managing Successful Programmes.* TSO (The Stationery Office. United Kingdom. ISBN 978011331040: 248

[30] Project Management Institute. (2008). *A Guide to Project Management Body of Knowledge (PMBOK®Guide)-Fourth Edition.* Newtown Square, PA: 446

[31] Project Management Institute, (2008). *A Guide to Project Management Body of Knowledge (PMBOK®Guide)-Fourth Edition.* Newtown Square, PA: 273

[32] Project Management Institute. (2009). *Practice Standard for Project Risk Management,* Project Management Institute. Newtown Square, PA: 2

[33] Project Management Institute. (2008). *A Guide to Project Management Body of Knowledge (PMBOK®Guide)-Fourth Edition.* Newtown Square, PA: 5

[34] Hornbacher, Keith D. (2008). Managing Project Risk, Uncertainty and the Unexpected (Fall,2010) *Assessing and Managing Project Risks.* DYNM-605. 2008.

[35] Taleb, Nassim. (2007). *The Black Swan: the impact of the highly improbable*. Random House. USA: 78

[36] Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA: 11

[37] Stadler, Christian. (2011). *Enduring Success:what we can learn from the history of outstanding corporations.* Stanford University Press. Stanford, California: 72

[38] D'Avini, R.A.I (1994) *Hypercompetition.* New York Free Press. New York, NY

[39] Weick, Karl E., Sutcliffe, Kathleen M. (2001). *Managing the Unexpected, Assuring High Performance in an Age of Complexity.* 1st Edition. Jossey-Bass. San Francisco, CA: 23

[40] Roberts, Karlene H. (1990). *California Management Review, Managing High Reliability Organizations.* Summer 1990. 32,4. ABI.INFORM Global

[41] Gaba, David M. (2005*). Improving Patient Safety by implementing Strategies of High Reliability Organization Theory.* Vienna, Austria. May 2005

[42] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 6

[43] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 6

[44] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 6

[45] Hornbacher, Keith D. (2008). Managing Project Risk, Uncertainty and the Unexpected (Fall,2010). *Assessing and Managing Project Risks.* DYNM-605. 2008

[46] Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL: 7-8

[47] Project Management Institute. (2008). *A Guide to Project Management Body of Knowledge (PMBOK®Guide)-Fourth Edition.* Newtown Square, PA: 275

[48] Office of Government Commerce, (2007). *Managing Successful Programmes,* TSO (The Stationery Office. United Kingdom. ISBN 978011331040: 115

[49] Roberts, Karlen H, Bea, Robert. (2001).*Must accidents happen? Lessons from high-reliability organizations.* Academy of Management Executive. 2001. Vol. 15. No. 3:72

[50] Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA: 141

[51] Kahneman, Daniel. (2011). *Thinking, Fast and Slow*. Farrar, Straus and Giroux. New York: 73-74

[52] Snyder, Mark, Studkas, Arthur A. Jr. (1999). *Interpersonal Processes: The Interplay of Cognitive, Motivational, and Behavioral Activities in Social Interaction.* Annual Review of Psychology 50 pp: 273-303

[53] Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA: 39

[54] Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass, San Francisco, CA: 37-39

[55] Weick, Karl E., Sutcliffe, Kathleen M. (2001). *Managing the Unexpected, Assuring High Performance in an Age of Complexity.* 1st Edition. Jossey-Bass. San Francisco, CA: 16

[56] Muhren, Willem, Van Den Eede, G., Van de Walle, B. (2007*). Organizational Learning for the Incident Management Process: Lessons from High Reliability Organizations.* Tilburg University. The Netherlands. Vlekho Business School. Belgium

[57] Retrieved from http://www,skybrary.aero/index.php/James_Reason_Swiss_Cheese_Model (Nano) 6-January 2012, at 11:13

[58] Rummler, Geary A, Ramias, Alan J., Rummler, Richard. (2010). *White Space Revisited- Creating Value through Process.* Jossey-Bass. San Francisco, CA: 106

[59] Martin, Christopher; Waters, Donald, (2007). *Global Logistics, New Directions in Supply Chain Management.* 5th Edition. Kogan Page Limited. London, UK: 31

[60] Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA: 37-39.

[61]Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA: [Referencing the work of Maurino, Reason, Johnson, 1998]: 22

[62] Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations*, Academy of Management Executive, 2001. Vol. 15. No. 3:71

[63] Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations.* Academy of Management Executive. 2001. Vol. 15. No. 3:74

[64] Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations.* Academy of Management Executive. 2001. Vol. 15. No. 3:74

[65] Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations.* Academy of Management Executive. 2001.Vol.15. No. 3:75

[66] Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations.* Academy of Management Executive. 2001. Vol. 15. No. 3:76

[67] Rummler, Geary A, Ramias, Alan J., Wilkins, Cherie. (2011). *Rediscovering Value Leading the 3-D Enterprise to Sustainable Success.* Jossey-Bass. San Francisco, CA: 16

[68] Levine, Harvey A. (2005). *Project Portfolio Management: A Practical Guide to Selecting Projects, Managing Portfolios, and Maximizing Benefits.* Jossey-Bass, San Francisco, CA: 104

[69] Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations.* Academy of Management Executive. 2001. Vol. 15. No. 3: 72

[70] Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA: 37-39.

[71] Karl E., Sutcliffe, Kathleen M.(2001) *Managing the Unexpected, Assuring High Performance in an Age of Complexity.* 1st Edition. Jossey-Bass. San Francisco, CA: 13

REFERENCES

Anderson, Erling S. (2010). *Are We Getting Any Better? Comparing Project Management in the Years 2000 and 2008.* Project Management Journal. Wiley/PMI. August, 2010: V 41,4

Bourrier, Mathilde. (2011). *The Legacy of the Theory of High Reliability Organizations: An Ethnographic Endeavor.* Sociograph N9/2011. Universite De Geneve. Departement de Sociologie: 6

Carnegie Mellon University and Software Engineering Institute. *Capability Maturity Model-Integrated Systems/Software Engineering*. version 0.2b. September 1999

Carnegie Mellon University. (2010). *Improving processes for providing better services.* CMMI-SVC, V1.3. CMU/SEI-2010-TR-034. ESC-TR-2010-034. Retrieved 17March2012 from http://www.www.sei.cmu.edu

D'Avini, R.A.I (1994) *Hypercompetition.* New York Free Press. New York, NY

Frankl, Viktor E. (2006). *Man's Search for Meaning.* Beacon Press. Boston, MA: 150

Gaba, David M. (2005*). Improving Patient Safety by implementing Strategies of High Reliability Organization Theory.* Vienna, Austria. May 2005

Gray, Cliffort, Larson, Erik. (2002). *Project Management-The Complete Guide for Every Manager.* McGraw-Hill. New York, NY

Hillson, David. (2004). *Effective Opportunity Management for Projects Exploiting Positive Risk*. CRC Press. Boca Raton, FL

Hornbacher, Keith D. (2008). Managing Project Risk, Uncertainty and the Unexpected (Fall,2010). *Assessing and Managing Project Risks.* DYNM-605. 2008

International Institute of Business Analysis. (2011). *The Agile Extension to the Business Analysis Body of Knowledge* (BABOK® Guide). Toronto, Ontario, Canada

Kahneman, Daniel. (2011). *Thinking, Fast and Slow.* Farrar, Straus and Giroux. New York

Levine, Harvey A. (2005). *Project Portfolio Management: A Practical Guide to Selecting Projects, Managing Portfolios, and Maximizing Benefits.* Jossey-Bass, San Francisco, CA

Martin, Christopher; Waters, Donald, (2007). *Global Logistics, New Directions in Supply Chain Management.* 5th Edition. Kogan Page Limited. London, UK: 31

Muhren, Willem, Van Den Eede, G., Van de Walle, B. (2007*). Organizational Learning for the Incident Management Process: Lessons from High Reliability Organizations.* Tilburg University. The Netherlands. Vlekho Business School. Belgium

National Academy of Neuropsychology. Definition of a Clinical Neuropsychologist. The Clinical Neuropsychologist 1989. Vol. 3, No. 1: 22

Office of Government Commerce. (2007). *Managing Successful Programmes.* TSO (The Stationery Office. United Kingdom. ISBN 978011331040: 248

Perrow, C. (1981). *Normal accident at Three Mile Island.* Society 18(5):17-26

Project Management Institute. (2008). *A Guide to Project Management Body of Knowledge (PMBOK®Guide)-Fourth Edition.* Newtown Square, PA

Project Management Institute. (2008). *Organizational Project Management Maturity Model (OPM3®)-Second Edition.* Project Management Institute. Newtown Square, PA

Project Management Institute. (2009). *Practice Standard for Project Risk Management*, Project Management Institute. Newtown Square, PA

Roberts, Karlene H. (1990). *California Management Review. Managing High Reliability Organizations.* Summer 1990. 32,4. ABI.INFORM Global: 101

Roberts, Karlen H, Bea, Robert. (2001). *Must accidents happen? Lessons from high-reliability organizations*, Academy of Management Executive, 2001. Vol. 15. No. 3:71

Rummler, Geary A, Ramias, Alan J., Rummler, Richard. (2010). *White Space Revisited-Creating Value through Process.* Jossey-Bass. San Francisco, CA: 106

Rummler, Geary A, Ramias, Alan J., Wilkins, Cherie. (2011). *Rediscovering Value Leading the 3-D Enterprise to Sustainable Success.* Jossey-Bass. San Francisco, CA: 16

Snyder, Mark, Studkas, Arthur A. Jr. (1999). *Interpersonal Processes: The Interplay of Cognitive, Motivational, and Behavioral Activities in Social Interaction.* Annual Review of Psychology 50 pp: 273-303

Stadler, Christian. (2011). *Enduring Success:what we can learn from the history of outstanding corporations.* Stanford University Press. Stanford, California

Taleb, Nassim. (2007). *The Black Swan: the impact of the highly improbable*. Random House. USA

van Stralen, David. Retrieved March 1, 2012 from http://high-reliability.org/pages/vanStralen; HRO-model-overview

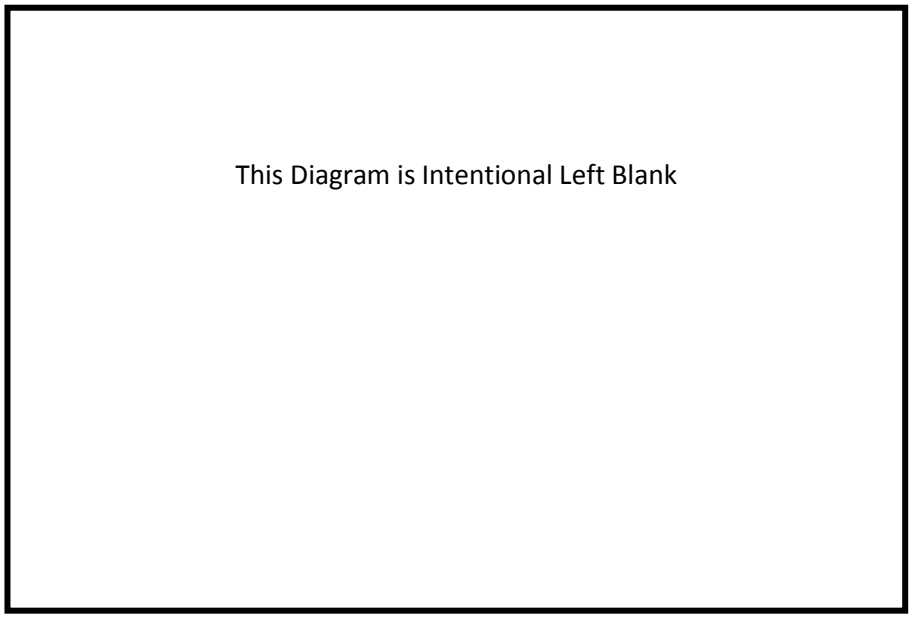
Weick, Karl E., Sutcliffe, Kathleen M. (2001). *Managing the Unexpected, Assuring High Performance in an Age of Complexity.* 1st Edition. Jossey-Bass. San Francisco, CA

Weick, Karl E., Sutcliffe, Kathleen M. (2007). *Managing the Unexpected, Resilient Performance in an Age of Uncertainty.* 2nd Edition. Jossey-Bass. San Francisco, CA

APPENDIX A

WEB PAGE

"Risk" was designated as a Dispatch Status making it available as a Search filter and viewable in both the Order screen as an Exclamation Mark and as a Caution symbol in the Dispatch Status (DS) column. Used in conjunction with notes, the signals could be monitored and a response triggered under the criteria defined in the escalation matrix.



APPENDIX B

RACI

This Responsible, Accountable, Consulted, Informed (RACI) matrix was developed to establish threshold guidelines for response handling and achieve clarity in roles and responsibilities. Management categorized the Escalation Level per each Issue and approved the Ownership. It was developed both as a bottom up and top down exercise to secure buy in and establish credibility in the criteria.

Escalation RACI

			OWNERSHIP							
seq#	Issue	Escalation Level	Carrier Mgmt/ Front De	Dispatch Lea	CSR	RM	NAN	Sale	Mgn	Pricing
2	Unassigned carrier: as of 3 hours prior Pickup Appointment or Shipper close FCFS.	L3			C	A	R		C	
3	Need to Change *Pickup* date/time - there's still time to make Delivery date /time (Initiated no later than 1 hour prior scheduled pickup time)	L1		I	A	C				
4	Need to Change *Pickup* date/time + *Delivery* date/time- but still will make MABD (Initiated no later than 1 hour prior scheduled pickup time)	L2		I	A	C		I	I	
5	Need to Change *Pickup* date/time + *Delivery* date/time- will NOT make MABD. (Initiated no later than 1 hour prior scheduled pickup time)	L3		I	A	C		I	I	
6	2nd Appointment Change (push outs)	L3			R	C		I	A	I
7	In Transit: ETA is (Greater than) > 60 minutes late at Receiver	L3		R	A	C		I	C	
8	In Transit: Dispatch reports No Communication from driver past 24 hours- Delivery appoint < Less than 6 hours	L3		A	C	C				
9	In climate weather reporting - identify Bad weather situations impacting deliveries	L3		A	C	I		I	C	
10	Carrier Agreement Problem identified: Not Assigned to a Shipment	L2	A	I	I	C			I	
11	Carrier Agreement Problem identified: Assigned to a Shipment	L3		C	I	C		I	I	
12	In Transit: mechanical issue reported / still too early to determine if will miss appointment	L2		A	C	I			I	
13	In Transit: mechanical issue reported, within 2 hours of p/up of Delivery Appointment or high probability will miss appointment	L3		R	A	I		I	C	
14	In-Transit: Load in Carrier's Yard	L3		A	C	I		C	I	
15	In-Transit: Delivery date dispute	L2		R	A	I		C	I	
16	In-Transit: Accident / Theft	L3		R	A	I		C	I	

	Escalation Levels:	Description	Customer Notification
L1	Routine Transaction	Communication via general staff	None / Limited to schedulers
L2	Warning/shipment in Jeopardy	Communication under direction of Manager	Discretionary
L3	Shipment High Probability of being late /Commercial risk to us	Communication under direction of Business Owner	As per established guideline defined by Customer and ship point

	Ownership	
R	Responsible	R reports to Accountable
A	Accountable	Person in Charge / Only 1
C	Consulted	Contribute to decision making
I	Informed	Kept abreast

APPENDIX C

PROCESS ANALYSIS

Enclosed is the process definition for Accounts Receivable and Payable process, which is downstream function of the order process. The full end to end analysis was conducted to identify the inter-relationships, complexity and risk in the decision making process. Beyond routine process definition, this modified Work Breakdown Structure (WBS) tool was also configured to support job design and tact time calculation.

(Partially Adopted from Rummler, Ramias, Rummler (2010) White Space Revisited, Figure 6.3 The VCH and Key Variables Requirement)

Seq.#	Sul	AP/A	task/activity	Paper Dependency Yes/No?	Task Owner	External Stakeholder	Task Duration	Upper Control limit (Highest input /output volume)	Lower Control limit (Lowest input /output volume)	What Customer Specifications or target value should each process step achieve to make customers happy?	Internal Benchmark / Target or Goal	How does one measure quality of outputs at every process step?
1	1.00	AR	Run Daily Delivered Report for EDI customer & Bill, 2 days after delivered	Printed Now/screen view is viable	Full staff/by account			1 x week	1 x week		bills ASAP when delivered- prior carrier ever submitting the freight bill	
2	2.10	AP	Open Mail- mailed in paper invoices	Yes		Carrier/ Factor companies	1 hour/Monday - 1 hour for rest of week	55% Monday	45% T-Friday	invoice to be paid in 30 days	Mail opened date of receipt	visual check of mail inbox
2	2.20	AR	Open Mail - receive customer checks	yes		customers	Monday's hvy - 3hours				Goal to get them all opened by COB of receipt date	Report : total receipt of day vs report on Bank receipt daily deposits

Does this process work every time it is called upon? What stresses cause it to break down? What is the worst case scenario?	What root causes generate the most common or severe process failures?	What data must be collected to measure and improve process reliability?	What decision criteria exists or escalation pathways to problem/resolution handling?	VOC Lean- Would Carrier Pay for it	How many FTE's available? (with skills/ training / competency to do this task?) breakout per dept.	What workforce skills and capabilities are needed to operate the process from initiation to completion? System,Training,Competencies,Ski	RISKS (Threats) Who or what could this process harm or un-intentionally damage? (Ethics, Regulatory (e.g. DOT HOS), Safety	Opportunity / Improvement Ideas
Lumper/accessorial charges - it's better original billing includes extra charges up-front to avoid extra work. Lean Logistics (pinnacle/nestle pizza) is not updated-then not	Dispatch is suppose to ask if any det/unloading fee's as part of their check call/deliver & supposed to put into check call-for Acctng to check & include in	Delivered Reprot but not invoiced generated to identify EDI bill to customers to keep current (run weekly)	Orders on the Report x days	No	Keypoint, Ultra procedures & understaind buisness	Keypoint, clerical skills,	Not billing, format is incorrect, rate, surcharge is incorrect- keypoint- autocalculation error- bad bill going out , reject, manually handling & delay of payment	If staff given 2 monitors, may eliminate need for paper
yes, mail arrives 13:00 14:00 +	Mail arrives late afternoon	pulse check on number of carrier phone calls		No	2	clerical	We invoice a day later negatively impacting our ability to punctually settle & preserve credit status/pymt record & not AR invoicing as quick as we could (cash flow)	Get mail earlier ... po box ? Will call $1300/year / in past, Saturday mail was picked up at post office- why can't we have mail delivered here to us on Saturday ? Mail box/slot? Building locked! 16MAR: SPOKE TO MAIL MAN- POST OFFICE DOES NOT HAVE A SORTER NOR DELIVERY MAN ON DUTY FOR THIS ROUTE (LEVERAGE PT) TO DEMAND A CONCESSION BY DEMANDING SERVICE THEY ARE OBLIDGED TO PROVIDE. WORK WITH BUILDING - ACCESS, MAIL BOX, OTHER or Allow the mail to be picked
customer includes pymts /amount we can not apply- or automatic reductions for claims (anchor) short pays, applying money (refunds/claims resolution) out of balance vs keypoint shipment records	customers taking credit for a problem that is not related to that shipment pymt on the check	reports variance: posting	can't apply money, decrepancies must be reported to mgr		2	basic accounting skills	miss applying money may cause reconciliation errors	Customer check quality- they don't provide our invoice #- but theirs. Ex. Nestle pizza, pinnacle, graham packaging, heinz