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THESIS

OPTIMIZING THE MOBILIZATION OF WIRELESS COMMUNICATIONS SYSTEMS FOR DISASTER RESPONSE EFFORTS

by

Malcolm Mejia

September 2015

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Hastily formed network (HFN) deployment teams provide critical services to disaster areas. The coordination and control systems they deploy save lives and valuable property. It is critical that HFN deployment teams work quickly and effectively so that the widest range of services can be distributed throughout the widest geographical area. The Military Wireless Communications Research Group and the Hastily Formed Networks Group at the Naval Postgraduate School recently supported the California Department of Forestry and Fire Protection response to a wildfire in Mendocino County, California, successfully deploying a portable coordination and control system, including both wired and wireless capabilities, in support of fire management. During the deployment, there was a lack of inventory control and a very limited ability to share instructions for configuring equipment. If not corrected, these problems can reoccur, potentially affecting the team's ability to deploy effectively. This research describes options for developing process improvement strategies based on organizational design as a framework for systematic process evaluation and improvement. Observing, documenting, and improving processes allow the team to improve and become more effective with every deployment.

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ABSTRACT

Hastily formed network (HFN) deployment teams provide critical services to disaster areas. The coordination and control systems they deploy save lives and valuable property. It is critical that HFN deployment teams work quickly and effectively so that the widest range of services can be distributed throughout the widest geographical area. The Military Wireless Communications Research Group and the Hastily Formed Networks Group at the Naval Postgraduate School recently supported the California Department of Forestry and Fire Protection response to a wildfire in Mendocino County, California, successfully deploying a portable coordination and control system, including both wired and wireless capabilities, in support of fire management. During the deployment, there was a lack of inventory control and a very limited ability to share instructions for configuring equipment. If not corrected, these problems can reoccur, potentially affecting the team's ability to deploy effectively. This research describes options for developing process improvement strategies based on organizational design as a framework for systematic process evaluation and improvement. Observing, documenting, and improving processes allow the team to improve and become more effective with every deployment.

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TABLE OF CONTENTS

I. INTRODUCTION 1
A. BACKGROUND 1
B. PURPOSE STATEMENT 2
C. RESEARCH QUESTIONS 2
D. RESEARCH METHODS 2
E. SCOPE AND LIMITATIONS 3
F. THESIS ORGANIZATION 4

II. HASTILY FORMED NETWORKS AND DEPLOYMENTS 5
A. INTRODUCTION 5
B. HASTILY FORMED NETWORKS 6
1. Theoretical Overview 6
2. Disasters 7
3. Coordination and Control Systems 8
4. Hastily Formed Network Capabilities and Limitations 10
C. NAVAL POSTGRADUATE SCHOOL HFN DEPLOYMENTS 11

III. ORGANIZATIONAL DESIGN, STRATEGY AND STRUCTURE MODELS 17
A. ORGANIZATIONAL GOALS 18
B. STRATEGIES 20
C. ORGANIZATIONAL STRUCTURE 22
1. Three Key Components of Organizational Structure 23
2. Organizational Structure Models 23
a. The Traditional Organizational Structure 24
b. The Product Organizational Model 25
c. The Matrix Organizational Structure 26
d. The Project Management Organizational Model 27
3. Organizational Structure Review 28
D. TASK DESIGN 28
1. Task Design Types 29
2. Task Design Review 32
E. COORDINATION AND CONTROL SYSTEMS 33
F. INFORMATION SYSTEMS 36
G. DEVELOPING EFFECTIVE STANDARD OPERATING PROCEDURES 39
H. PEOPLE AND LEADERSHIP 40
I. REVIEW 41

IV. STRATEGY FOR PROCESS EVALUATION AND IMPLEMENTATION OF IMPROVED PROCESSES 43
A. DETERMINE GOALS 43
B. SELECT STRATEGIES 44
C. DETERMINE STRUCTURAL NEEDS 46
1. Process Improvement Team 46

2. Management Team 47
3. Department Head Team 47
4. Technician Team 48
5. Three Key Components/Deployment 48
6. Selecting a Structure 49
D. SELECT TASK DESIGN 50
E. SELECT COORDINATION AND CONTROL SYSTEMS 51
F. SELECT INFORMATION SYSTEMS 52
G. GAIN SUPPORT FROM EMPLOYEES 54
H. REVIEW 54
V. CONCLUSION 59
A. CONCLUSIONS 59
B. FUTURE STUDY..60
LIST OF REFERENCES 63
INITIAL DISTRIBUTION LIST 67

LIST OF FIGURES

Figure 1. Plans and Patterns (from Mintzberg, 2007) 22
Figure 2. Traditional Organizational Structure (after Springer & Ebary Inc., 2001)......24
Figure 3. Product Organizational Structure (from Springer, 2001) 26
Figure 4. Matrix Organizational Structure (from Springer, 2001) 27
Figure 5. Project Management Organizational Structure (from Springer, 2001)............28
Figure 6. Task Design Space Graph (from Burton et al., 2006).....................................30
Figure 7. Taxonomy of Coordination and Control Systems (from Burton et al., 2006) 35
Figure 8. Four Information Types (from Burton et al., 2006)..38

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LIST OF TABLES

Table 1. Seven-Step Process Improvement Strategy (after Burton et al., 2006) 55

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LIST OF ACRONYMS AND ABBREVIATIONS

BGAN	broadband global area network
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
FLAK	flyaway kit
FNMOC	Fleet Numerical Oceanography and Meteorological Command
HA/DR	humanitarian assistance and disaster relief
HFN	hastily formed network
HMOC	Hancock Medical Center
ICP	incident command post
LAN	local area network
NAVO	Naval Oceanography Center
NPS	Naval Postgraduate School
VOIP	voice over IP
VSAT	very small aperture terminal
WAN	wide area network

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I. INTRODUCTION

A lightning strike ignited the North Pass Fire on August 8, 2012, on Mendocino Pass Road, 10 miles northeast of Covelo in Williams Valley, Mendocino County, California. The fire burned 41,983 acres and significantly impacted “commercial timber resources, hunters and recreationalists” (Incident Information System, 2012). Numerous community members were forced to evacuate their homes (Wakoski, 2012).

Members of the Naval Postgraduate School’s (NPS) Hastily Formed Network (HFN) team and the CALFIRE Communications Task Force departed Monterey, California at 1900 on Thursday, August 23, 2012. The teams arrived at the incident command post (ICP) at 0130 on August 24. By 0500, a very small aperture terminal (VSAT) satellite reach-back capability, along with a Wi-Fi cloud, was established. The NPS team initially provided services for 15 first responders, 10 at the ICP and five at the fire. The team expanded services to the helipad base through the configuration of a WiMAX wireless bridge connection later that day. The team successfully provided voice, video, data, email, web, and Skype services to the ICP, the fire home camp, and the helipad base.

A. BACKGROUND

The disaster area is a chaotic space in which there is often a lack of infrastructure needed to provide the affected community with lifesaving resources. It is essential that services are distributed effectively, so that the widest range of resources can be dispersed throughout the largest geographic space within the disaster area. Through the successful deployment of services to North Pass Fire early responders, two areas of needed improvement were identified. The first was a need for inventory management and the second was a need to share instructions for configuring equipment. Though these needs represent specific areas of possible improvement, they also represent a larger problem. When the HFN team was at home camp preparing for deployment, during deployment, and upon the team’s return to the home camp, there was an absence of discussion about how to define an effective deployment, how to report and define problem processes, and what actions could be taken to improve problem processes. If effectiveness is not defined and there are not strategies in place for documenting and improving processes, problems that occur during one deployment are likely to reoccur during the next.

B. PURPOSE STATEMENT

The goals of this thesis are to (1) analyze organizational design as a theoretical framework for understanding how organizations are broken down into functional components and how these components interact (2) create strategies for evaluating processes within the hastily formed network deployment team's organizational design (3) create strategies for developing improved processes (4) Create strategies for the implementation of improved process.

C. RESEARCH QUESTIONS

For successful development of strategies for evaluating and improving processes, our research is motivated by this foregoing discussion and guided by the following questions.

1. How can the organizational design model be applied to improve HFN practices?
   - How can organizational design allow processes to be evaluated to help determine where change is needed within the organization?
   - How can organizational processes be successfully implementing in order to improve HFN team processes?
2. What strategies can improve the planning and deployment of coordination and control systems within a disaster area?
   - How can we include team members in these strategies so that they are motivated to embrace the changes indicated by the process improvement strategies?

D. RESEARCH METHODS

Our first step was to review scholarly articles, government documents, after action reports, student theses, and electronic documents on (a) disasters, (b) hastily formed networks, and (c) organizational design.

- **Disasters**—Literature was reviewed so that the disaster space could be described and human conditions made apparent.
- **Hastily Formed Networks**—Literature was reviewed so that (1) HFN and the HFN conversation space could be described conceptually (2) the overall architecture defined (3) the FLAKs and needed components described, and (4) current advancements surveyed.
- **Organizational Design—**Organizational design provides a conceptual model that provides structure and guidance to this thesis. It is based on previous research that has been tested and validated within the intellectual community. It breaks an organization down into understandable functional components and describes their interdependencies. This framework is used to evaluate methods of introducing change within the framework provided by organizational design theory. Organizational design was reviewed to understand the organizational design components and to determine what the organizational design of the HFN would need to look like to support process evaluation and improvement and to determine how change could be implemented and managed within the HFN deployment team.

The second step was to describe the workflow of the process improvement team, and to define the hierarchy of the team to describe how authority, knowledge and resources are shared between groups.

The Third step was to develop and describe business practices that can enhance the performance of the HFN team by developing a strategy for creating teams that work through a cyclical strategic planning, evaluation and improvement process.

This thesis addressed streamlining deployment planning and response time. A qualitative, assessment methodology was used to review reports written by technicians who had recently participated in a deployment.

E. SCOPE AND LIMITATIONS

This thesis provides a review of organizational design. It applies organizational design theory and models to analyze process improvement and implementation of improved processes within the HFN context. It demonstrates a method for determining which organizational design component types best support the HFN deployment team's ability to evaluate and improve processes, and implement process improvements. Due to constraints of time and the scope of literature reviewed, this thesis does not provide step-by-step SOPs for improving processes. It also does not describe in detail the technologies used to support the process improvement strategies, and does not go into detail about employee incentives.

F. THESIS ORGANIZATION

This thesis is organized into five chapters. Chapter II introduces hastily formed networks, and provides a practical background. It also reviews disasters, as well as the uses, capabilities, and limitations of Fly Away Kits (FLAKs). It also discusses NPS HFN deployments. These deployments include the 2004 Indian Ocean Tsunami, Hurricane Katrina in 2005, the 2010 Haitian earthquake, and the August 18, 2012 North Pass Fire. It also discusses areas of the HFN deployment team's response improvement based on lessons learned explicitly from the 2012 North Pass Fire.

Chapter III is a literature review that focuses on organizational design, to include goals, strategy, structure, processes and people, and, coordination and control.

Chapter IV presents strategies for process evaluation and improvement, and the creation of strategic planning meetings, including a strategic planning meeting, a problem solving meeting, an after-action reporting meeting and a process improvement meeting. It also describes the structure of the process improvement team and describes the channels of authority, knowledge sharing and coordination and control.

Chapter V concludes with a summary of the thesis introduces ideas for future work, and presents final remarks.

II. HASTILY FORMED NETWORKS AND DEPLOYMENTS

This chapter provides a theoretical and technical background for HFNs and describes the environments in which they are deployed. It provides the background needed to analyze the current body of organizational design as a basis for developing strategies for improving processes. It describes the types of processes that are completed during deployment. This is done to point out the complexity of the interdependent processes completed during deployment and demonstrates why an understanding of organizational design is needed to develop strategies for process improvement. It also provides examples of the Naval Postgraduate School's (NPS) past deployments including a critical, more in-depth look at the successes and areas of improvement observed during the 2012 North Pass Fire which was attended by this author.

A. INTRODUCTION

The HFN deployment team works within two environments. The first is at the home station where planning and preparation are conducted. This environment is stable, and well-known. There is time for thought-out planning. There are also resources available, which means that if equipment is broken or missing it can be repaired or replaced. The second environment is the disaster area, which is unstable, and unknown. In this environment time and resources are limited. The affected community is in need of immediate assistance. The ability to set up and organize quickly is critical to ensure the safety of the human population and valuable property. Technicians from multiple organizations and agencies need to be able to deploy networks in environments where there is a lack of resources and little time for planning.

When deployed, the HFN team configures networks that coordinate and control large collaborative disaster relief efforts. Any number of government agencies and non-governmental organizations work collaboratively to provide services to communities whose infrastructure has been made unusable. These include health, fire, safety, and communications services. The HFN team's goal is to support the coordination and control of the disaster area. This includes configuring a communications network and managing network access and resources.

B. HASTILY FORMED NETWORKS

This section provides a theoretical background for HFNs, describes the disaster areas in which they are deployed, and provides a technical description of the equipment used during deployments. It provides an understanding of the HFN's purpose, the complexity of deployment, and the technologies involved in the deployment effort.

1. Theoretical Overview

Peter Denning coined the term "hastily formed network" (or HFN) at NPS. It was developed as a framework to understand critical information needed to explore disasters, the effects they have on communities, and the elements that need to be brought together to provide important, timely services effectively to the disaster area (Denning, 2006). Denning describes the HFN as having five elements: "(1) a network of people established rapidly, (2) from different communities, (3) working together in a shared conversation space, (4) in which they plan, commit to, and execute actions to (5) fulfill a large, urgent mission" (2006, p. 16). These five elements describe the qualities of the framework that can support what Denning calls the "conversation space." He describes the conversation space as having three elements: "(1) a medium of communication among (2) a set of players (3) who have agreed on a set of interaction rules" (2006, p. 17). The conversation space allows for communication and the coordination of efforts in an environment that is chaotic, lacking resources and infrastructure, and is managed by multiple agencies. Although the concepts he describes are theoretical, they outline the qualities of the technical solutions that comprise the HFN.

HFNs provide mobile communications solutions to disaster areas at which the local communications services are not functional. They help to prevent the loss of life and property. To understand the purpose and the need for HFNs, it is first necessary to look at the disasters area in which they are deployed.

2. Disasters

Disasters are both natural and manmade and are inevitable global phenomena. They are powerful and destructive, with the potential to damage property and take human lives. Disasters can be acts of nature, such as the 2005 Hurricane Katrina, the 2010 Haiti earthquake, and the 2013 Typhoon Haiyan/Yolanda. They can also be manmade, such as the 9/11 terrorist attack and the 2010 Deepwater Horizon oil spill (Antillon, 2012; Hwee, Calvin, Singh, & McKenzie, 2007; Lancaster, 2005). The International Federation of Red Cross and Red Crescent Societies define a disaster as "a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources" (International Federation of Red Cross and Red Crescent Societies, 2014). Survivors are often left without the ability to obtain goods, such as food and water as well as critical services, such as medical care, public safety, and communications capabilities. They are left in immediate need for assistance from first responders.

First responders provide disaster victims with "fire, explosives, hazmat, law enforcement, search and rescue, communications and emergency medical services" (Department of Homeland Security, 2014). First responders are represented by international and federal government organizations; non-government organization (NGOs), such as international, state and local volunteer organizations; local and state governments and resources, such as the National Guard; and neighboring communities (FEMA, 2014). The organization of the collaborative response between numerous agencies and organizations are dependent upon the ability to communicate.

During a disaster, resources are limited; time and energy needs to be put into the areas that most benefit survivors. Without telecommunications, first responders cannot gather, share, and organize data so that it can be analyzed to generate actionable intelligence and situation awareness. Situational awareness is needed so that action plans can be created and executed for the organized deployment of goods and services. It is important to deploy communications as quickly as possible. Response packages, such as HFN FLAKs, can be developed to rapidly deploy to provide temporary important communications capabilities. Such capabilities exist on a macro-scale within military organizations such as the U.S Transportation Command's Joint Enabling Capabilities Command's Joint Communications Support Element (Joint Enabling Capabilities Command (JECC). However, rapidly deployable response packages for state and local organization are generally less capable if even available.

3. Coordination and Control Systems

HFN deployment team configures coordination and control systems that are transported in FLAKS and can be rapidly deployed to remote disaster areas. They include the equipment used to make up the conversation space, as described by Denning, to be deployed by the HFN team. Once configured, the Coordination and Control system components comprise the physical architecture of the HFN (Denning, 2006). The architecture allows for the critical communications needed to support the conversation space used by first responders in remote disaster areas. They are lightweight and self-sustainable networks that can be transported to disaster areas throughout the globe. Once the coordination and control system is deployed, it provides for the establishment of three major network types: wide area networks (WAN), communications satellite ground stations, local area networks (LAN), and the last mile solutions necessary to interconnect the LANs (Antillon, 2012; Lancaster, 2005).

Wide Area Networks (WANs)

WANs cover a large geographic area and provide functionality associated with the physical, data-link, and network layers of the OSI model. WAN services are provided by data carriers and telephone companies, such as Comcast and ATT. WAN technologies provide regional and global point-to-point and mobile application services. WAN components are not packed in the FLAK. The WAN represents developed areas that have a networked architecture, as well as the developed infrastructure that already exists. The home offices of the first responders will be attached and integrated into WANs (Knox Clarke, 2013).

Communication Satellites and Satellite Ground Stations

WANs can be interconnected by communications satellites. Communications satellites maintain an orbit above the earth. Satellite networks also provide access for widely dispersed LANs. They can also communicate with other satellites. Their ability to amplify and redirect data transmissions allows geographical boundaries to be circumvented. The network of orbiting satellites allows for data communications to be transmitted to any location on the Earth through the ground station/broadband global area network (BGAN) and the VSAT network (Antillon, 2012; Barreto, 2011; Lancaster, 2005).

BGAN provides two-way telephony and limited data transfer between satellites and ground stations located in remote locations. Three I-4 geosynchronous Inmarsat satellites provide the service. VSAT is a satellite ground station that transmits to satellites in a geosynchronous orbit. Both technologies provide remote terminals communications and data solutions that can connect them to the greater World Wide Web (Barreto, 2011; INMARSAT, 2013; Lancaster, 2005; VSAT-Systems, n.d.).

Local Area Network and Virtual LANs

The LAN includes computers and the equipment that comprise the network in a limited geographical area. It is through LANs that the responders gain access to global digital resources. Most LANS include IEEE 802.3 (Ethernet) and IEEE 802.11 (Wi-Fi) technologies. The backbone of the wired LAN consists of routers and switches, as well as the interconnecting physical media, such as twisted-pair cables and fiber optic links. The routers allow for the forwarding of data throughout the network and the switches create entry points for wired computers. The switches may be configured to support virtual LANs (VLAN). VLAN's allow the network's address domain to be divided into several logical domains and allow for network management, broadcast control, and more granular access control to promote quality of service provisioning and network security (Antillon, 2012; Barreto, 2011; Lancaster, 2005).

Last Mile

The last mile connection allows for data to be shared between the various LANs within geographically contiguous remote locations. Due to the lack of local network infrastructure, most last mile solutions rely on directional IEEE 802.11 Wi-Fi, and 802.16 Wi-Max, or similar proprietary solutions. David D. Lancaster states that "Solutions for last-mile connectivity should be flexible and easily moved or changed. For this reason, most last-mile connections are wireless" (Lancaster, 2005, p. 20).

4. Hastily Formed Network Capabilities and Limitations

This section describes some of the HFN capabilities and points out the value of HFN deployments. It also describes its limitations as a way of emphasizing the importance of the need to maximize performance capabilities through process improvement.

Satellite communications can provide Internet "speeds ranging from 128 kbps to 20–30 mbps" that allow the disaster response team members at the remote LAN location access back to their home station WAN and LAN connections (Nelson, Steckler, & Stamberger, 2011, P. 4). Wi-Fi Mesh or IEEE 802.3 can provide local connectivity for laptops, handheld devices, Voice over IP (VoIP) phones, and remote sensors. This connection can then be provided over the 802.16 WiMAX over a distance of up to 50 miles to provide communications to very remote locations (Nelson, Steckler, & Stamberger, 2011). The benefits of the HFN are that they provide rapid communications solutions for disaster areas where no other form of communications may exist.

The limited amount of equipment and resources shipped in a FLAK and the lack of redundant connections from the local LAN to the greater World Wide Web are two examples of major limitations of HFNs. The HFN deployment team must travel lightly, which limits the amount of equipment that can be shipped. Once deployed little opportunity exists to procure needed equipment. Any missing or broken inventory can disable components of the network. The lack of redundant reach-back connection and the inability to obtain equipment during deployment also represent possible points of failure. If the network lacks redundancy, then any failure in the network may have grave consequences. For example, equipment not inventoried correctly might result in the power supply for the satellite connection not being deployed. This might result in team members not being able to communicate to the outside world. Potential lifesaving efforts could fail due to a lack of power to the satellite connection. The HFN deployment team must be as effective as possible or it will not be able to support the local communities to its full potential. The limitation that is explored by this thesis is a lack of understanding how to improve deployment. This limitation is addressed by developing strategies for identifying, recording and improving HFN deployment processes.

C. NAVAL POSTGRADUATE SCHOOL HFN DEPLOYMENTS

This section provides a background for the development of the NPS HFN group and describes how the group has supported past relief efforts. It briefly describes the 2004 Indian Ocean Tsunami, 2005 Hurricane Katrina and the 2010 Haitian Earthquake deployment. It describes the 2012 North Pass Fire in more detail and describes the scope of the tasks completed and the technologies used during the deployment. It also describes the successful aspects of the deployment and points out areas for improvement.

The HFN group was founded in 2005 by Brian Steckler (Antillon, 2012). Steckler added to the state of the art and to the body of literature by developing a HFN 9-piece puzzle that describes "the tools, configurations and human skills necessary to set up an effective and efficient, on-location, communications network in response to emergency situations" (Steckler, 2013). Since its creation, the HFN team has supported many disaster relief efforts. This researcher deployed with the HFN group in support of the 2012 North Pass Fire response. During this deployment, the HFN group successfully provided critical communication services to the Incident Command Post (ICP) in Covelo, California. The deployment also provided this researcher with insights on ways to improve deployment efforts. This section provides some history of the past activities of the HFN group and discusses the North Pass Fire as a case study describing the successful services provided to the disaster area while also providing some insight into elements of the deployment that can be improved.

(1) 2004 Indian Ocean Tsunami

On January 4, 2005, NPS faculty, along with contractors working in a coalition field experiment program, decided that helping the global community would help to further research and development goals. They landed in Takuopa, Thailand, in support of the Indian Ocean tsunami relief efforts. The team provided assistance to the Wat Yang Yao morgue and grave registration center. It also provided broadband wireless service to a nearby survivor camp providing support to displaced victims, NGOs, volunteers, media, and others (Lancaster, 2005). The team supported the effort by contracting a local satellite provider to provide critical reach-back services and limited last-mile support, as well as establishing wireless mesh infrastructure using radio nodes from the Rajant Corporation. They further extended connections through an 802.11b wireless LAN. According to Lancaster, "This provided WiFi Internet connections to many users without them having to be near a satellite connection. Within two hours of operating time the network had fifty to sixty users" (Lancaster, 2005, p. 11). Later, additional HFN team members were deployed to provide longer-term support.

(2) 2005 Hurricane Katrina

On September 3, 2005, the NPS HFN group was invited to join the Fleet Numerical Oceanography and Meteorological Center (FNMOC) and the Naval Oceanography Center (NAVO) deployment into the Gulf Coast just a few days after the hurricane struck the coast. The NPS HFN team contributed NPS faculty and students along with the NPS Nemesis Mobile Research Facility, to the Stennis Space Station in Mississippi to provide NAVO with SATCOM broadband wireless services. When they arrived, they found that NAVO did not need their services and they redeployed to support the Hancock County Mississippi Emergency Operations Center (EOC). The NPS team helped restore communications for the Hancock Medical Center (HMOC) (Bradford, 2006; Steckler, Bradford, & Urrea, 2005). Bradford states that the NPS team supported "local government offices, police and fire stations, temporary emergency service locations, and relief shelters in the disaster stricken areas of Bay St. Louis and Waveland, MS" (Bradford, 2006, p. 2).

> The NPS-led team of industry and DOD entities successfully integrated key wireless technologies (802.11, 802.16, SATCOM, Voice Over Internet Protocol) in a disaster zone bringing the first Internet connectivity and dial-tone telephony to the entire region. First responders, many local hurricane victims, relief agencies, city/county government, and hundreds of volunteers were able to communicate with the outside world for the first time as a result of the Hastily Formed Network. (Bradford, 2006, p. 4)

(3) 2010 Haitian Earthquake

The NPS team supported relief efforts in Haiti for three months. It deployed to the USNS Comfort hospital ship but when it found that its services were not needed, it moved to support the Port-au-Prince port facility and other NGOs. The communications services provided helped to facilitate medical evacuation (Nelson, Steckler, & Stamberger, 2011). The NPS team was also able to communicate with the USNS Comfort and the U.S. Embassy for medical evacuations. Information and Communication Technology assessments were conducted, frequency assignments were completed, and documentation was created so that NGOs in the area could better support the collaborative relief efforts. Also included were NGOs, "various militaries," and the United Nations (Nelson et al., 2011). The article, "The Evolution of Hastily Formed Networks for Disaster Response" reports the following:

> The HFNs deployed in Haiti were distinct from prior disaster deployments because of the high volume and type of data carried over the communication networks. Haiti was the first all-encompassing test of a predominantly data driven response, due to the fact that much of the usual terrestrial telecommunications infrastructure did not exist and responders had no other option than to use IP-based communications as the core of the response. Most previous disasters were driven more by legacy communications such as telephones and radios. (Nelson, Steckler, & Stamberger, 2011, p. 6)

(4) August 18, 2012 North Pass Fire

This researcher participated in the deployment of HFN support of the North Pass Fire relief effort in 2012. The North Pass Fire was ignited after lightning struck the forested area along Mendocino Pass Road, 10 miles northeast of Covelo in Williams Valley, Mendocino County, California. The fire burned 41,983 acres and significantly impacted "commercial timber resources, hunters and recreationalists" (Incident

Information System, 2012) and forced some community members to evacuate their homes.

Members of the NPS Team and the Cal FIRE Communications Task Force, led by Brian Steckler, departed Monterey, California at 1900 Thursday, August 23, 2012. The teams arrived at the ICP at 0130. By 0500, VSAT capability, along with a Wi-Fi cloud, was established. Services were initially provided for 15 first responders, 10 at the ICP and five at the fire camp. Later that day, services would be provided to the helipad base through the configuration of a WIMAX connection (Steckler, 2012). The team successfully provided voice, video, data, email, web, and Skype services to the ICP, the fire base camp, and the helipad base. By the end of the next day the ICP had VSAT and BGAN access via wireless LAN coverage, and the mess officer in the supply area had WIMAX based point-to-point connection to ICP (Steckler, 2012). On August 26, over 50 Internet users at the ICP and the helipad base were being supported through a WIMAX link, and 10 users received connectivity through BGAN at the fire camp. These services were maintained and improved on August 27 when a 24/7 helpdesk was created and Wi-Fi Mesh was extended at the fire camp and the ICP (Steckler, 2012). This researcher left on the August 28, 2012 with all deployed services running (Steckler, 2012). The overall deployment was successful. However, some areas for improvement were identified including the need for inventory control and the sharing of instructions for configuring equipment.

The components that the NPS team brought had not recently been tested, inventoried, and packaged for rapid deployment. We did not know the locations of some of the equipment prior to packing at the NPS home campus. We would have benefited from testing, grouping and maintaining a packaged inventory beforehand. Preparation allows for quicker deployment and easier tracking of equipment in the field. Managers cannot communicate the actual capabilities of the team without a clear view of the inventory. An example of this is that during the deployment the ability to set up an internet café at the fire camp was advertised; however, we were unable to locate the needed laptops. The firefighters at the home camp were appreciative of the services we provided but were disappointed that we could not set up the internet café. We were also dependent on a second deployment team to deliver components that were missing from their initial inventory. Evaluating inventory processes and assigning the responsibility of maintaining inventory to a team member could help to mitigate these types of problems in the future.

During our deployment to the North Pass Fire, we were required to configure BGAN-satellite land terminals and WiMAX antennas. Several team members at the location could independently configure the equipment. The issue we had was that only the lead technician knew the network IP addressing scheme and equipment interfaces. Instead of dividing the workload between team members, a group of technicians ended up following the lead technician to each location as he configured the gear. A process that could have taken the group two hours ended up taking closer to six. Proper prior training and knowledge sharing is helpful in mitigating these types of bottlenecks. Individuals can be asked to document their processes and the steps required complete them. This takes the implicit knowledge that is in the head on the team member and allows it to be turned into tacit knowledge that can be stored in a searchable database and accessed by other team members. These documents can be used for cross-training and as references for technicians in the field. Cross-training will allow for group members to teach each other how to complete important tasks, and the subsequent documentation could be used to assist them when in the field and configuring equipment they may not have much experience with. This would allow team members to work concurrently to configure equipment, saving time and expanding the knowledge base of team members.

The importance of being able to setup mobile communications solutions in disaster areas through the deployment of a HFN also emphasizes the need for HFNs to be deployed rapidly and efficiently. The importance of these literally lifesaving capabilities cannot be overstated and should not be overlooked. This chapter provided a theoretical background of HFN, described HFN and the equipment used during deployment in technical detail, gave examples of HFN deployments, and analyzed the 2012 North Pass Fire communications-capability response by taking a critical look at its successes and needs for improvement so that methods could be explored to make deployment more effective. The next chapter discusses organizational design in terms of how it is affected by change. Models taken from the current body of literature or organization design are explored and used as foundations for the integration of new or improved processes.

III. ORGANIZATIONAL DESIGN, STRATEGY AND STRUCTURE MODELS

This chapter discusses organizational design and the components considered when implementing plans for process evaluation and improvement. Scholarly research and articles written by specialists who share their understanding of organizational design can be used to help managers understand the components that need to be addressed when introducing change in an organization. The book *Organizational Design: A Step by Step Approach* by Burton, DeSanctis, and Obel is used to define organizational design components and is supported by the works of several other authors. They define and list the organizational design components as being goals, strategy, structure, task design, coordination and control (including SOPs), information systems, and people and leadership.

The definitions of organizational goals and organizational structure are supported by writings from Richard L. Daft, Alfred D.Chandler, Chrystal Doucette and Henry Mintzberg. Mintzberg's works also support the definition of strategy along with works by Joan Sloan and Mitchell L. Springer. David Grusenmeyer's work helps describe SOP development. SOP development is not an organizational design component but it supports *task design* and *coordination and control*. The definitions of people and leadership are supported by Katherine Kane. Introduction

The implementation of plans for process evaluation and improvement represents internal situational changes in the organizational strategies and processes that exist within the organizational design of the HFN deployment team. Change can be stimulated by both internal situations or by the external environment. Examples of external environmental influences are changes in global economics, changes in stakeholders' desired outcomes, and changes in technology. An example of changes stimulated by internal situations is the discovery of ways of improving performance through the evaluation of processes, such as the plans for improving inventory and sharing instructions for configuring equipment as discussed within this thesis.

The challenge of implementing organizational change is that mechanisms for change have to be integrated into each of the organizational design component before it can be successfully implemented. The components of organizational design are interwoven and each must be developed so that they support the efforts of the others. If change is introduced in one organizational design area but is not integrated into the others it will not receive the consistent support needed for successful implementation.

The implementation of plans for evaluating and improving processes must be driven by a need to reach specific organizational goals and sub-goals. Strategies then need to be put into place for integrating the plans into the organizational design. These strategies ensure that design components can support efforts to reach specific organizational goals. Structure defines how the organization as a whole is divided into groups and subgroups that have specific responsibilities. It also defines how these groups and subgroups share resources and communicate the authority needed by team members. Task design works similarly to structure but instead of breaking organizational groups into subgroups it breaks large tasks down into smaller tasks and coordinates interdependent processes that must traverse the different organizational groups and subgroups. Coordination systems and information systems define how these tasks are tracked and evaluated and how computer systems are leveraged to support the organization and computation of data needed by analysts for decision-making and analysis of organizational processes. With respect to this thesis, the organization's design components allow a clear picture of how the HFN members need to act and interact to implement the plan for evaluating and improving processes.

A. ORGANIZATIONAL GOALS

For this thesis we will look at goals in terms of Richard L. Daft's description of mission goals (or "official" goals) and operational goals (Daft, 2004). Richard M. Burton, Geraldine DeSanctis and Borge Obel define goals as either goals of effectiveness or goals of efficiency (Burton, DeSanctis, & Obel, 2006).

(1) Mission Goals

Mission goals are conceptual and are described by Daft as goals that communicate the organization's vision, values, and beliefs (Daft, 2004). They are written down in a policy manual or annual report and used to legitimize the organization. Daft states that this legitimacy is required to gain a commitment from "employees, customers, competitors, suppliers, investors and the local community" (Daft, 2004, p. 55).

Daft describes operational goals as measurable outcomes and suggests they differ from mission goals. Mission goals are stated goals, while operational goals are the specific outcomes of operating procedures. Operational goals are defined by organizational strategies and the structures that support them. Daft describes operational goals as "overall performance, resources, market, employee development, innovation and change and productivity" (Daft, 2004, p. 55).

(2) Effectiveness and Efficiency

Burton, DeSanctis, and Obel describe goals in terms of effectiveness and efficiency. Goals of effectiveness describe the organization's outputs which include products, services, and revenues. Goals of efficiency are goals that focus on inputs and are more concerned with conservation of resources and management of costs (Burton et al., 2006). This thesis focuses on goals of effectiveness.

(3) Goals Review

The goals that are discussed in this section represent the organizational vision that provides the general direction and mission, defines organizational outcomes, and describes the improvement of organizational outcomes. The defining of these goals helps upper management to segment goals by type. When looking for ways to improve organizational performance it allows for the specific goal types to be analyzed in an attempt to determine where the investment of time and resources can best benefit the organization.

B. STRATEGIES

Once upper management has determined its organizational goals, strategies for producing desired outcomes are developed. According to Alfred D. Chandler strategy is "the adoption of a course of action and the allocation of resources necessary for carrying out these goals" (1990, p. 13). Strategies help define how groups and processes are broken down into sub-groups and sub-processes. They also define work flow and map out the sequence of steps that organization groups must take to reach organizational goals.

The implementation of strategic thinking helps organizations develop competitive strategies that can give them an advantage over competitors. It is critical to an organization's ability to develop plans for achieving organizational goals but is not inherent in organizational design. This section explores methods of nurturing strategic thought and creating and recognizing strategies through Julia Sloan's concept of formal and informal learning (2013), and Mintzberg's (2007) concepts of strategic plans and patterns. Together they illustrate the creative process of strategic design and demonstrate methods used by upper management for cultivating strategic thinking and recognizing where strategies can be found.

(1) Learning to Think Strategically

Julia Sloan (2013) introduces the concepts of formal and informal learning in her book *Learning to Think Strategically*. She explains that formal learning is structured. She uses classroom learning as an example of a formal learning environment. She describes informal learning as creative and spontaneous, which occurs during everyday life, and argues that successful strategies are most often found in informal learning.

According to Sloan "strategic thinking is nonlinear and a-rational and does not occur within a prescribed time and place" (2013, p. 34). Informal learning is conducted during everyday life, such as at a bar, in the grocery store, at the company picnic. Sloan also states, "Informal learning is regarded as learning that is predominantly unstructured, unplanned, experiential, non-institutional, and non-routine" (2013, p. 34). The importance of her definition is that it explains the development of strategy as a continuous, creative process that requires "creative thinking, long term thinking, critical reflection, dialogue, challenge or testing" (Sloan, 2013, p. 41). This implies that thought needs to be put into strategic thinking and that strategists need to be able to use information and ideas that come to them though all aspect of their lives. She implies that informal thinking is more beneficial than formal thinking.

(2) Plans and Patterns

Henry Mintzberg describes strategy as both a plan and a pattern. He states that two types or organizational strategies exist. The traditional definition is that they are forward thinking plans designed to meet organizational goals (Mintzberg, 2007). The second definition is that strategy is a pattern that can be recorded historically and analyzed after the event (Mintzberg, 2007). These are depicted in Figure 2. The discovery of patterns is a by-product of the organizational goal of effectiveness with the analysis of completed processes being a part of the cyclical process of evaluation and improvement that was mentioned earlier in this section.

The importance of recognizing patterns as a strategy is powerful because it can help the organization to see that undefined actions are taking place that have either a negative or positive effect on the organization. The ability to recognize these patterns allows for negative patterns to be corrected and positive patterns to be documented and added to strategies in the form of future plans.

(3) Strategy Review

Mintzberg's concepts of formal plans and patterns and Sloan's concepts of formal and informal strategic thinking work together to explain the cyclical nature of strategic planning (2007). Plans are developed using formal strategic learning patterns to organize and detail how processes are thought to be best executed. Patterns and informal strategic thinking allow for creative solutions to be added to the formal plan and for successful processes to be recognized, documented, and added to formal plan. Organizational strategy, like organization design, must be flexible so that it can incorporate new ideas that come from informal processes and to analyze them so that they can added to formalized plans. The images in Figure 1 visually illustrate these concepts.

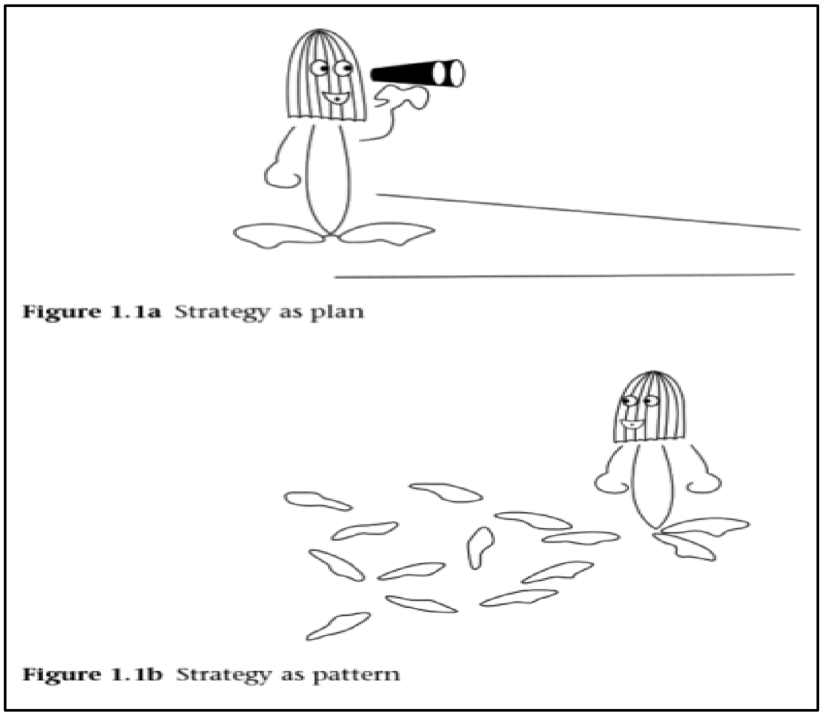

Figure 1. Plans and Patterns (from Mintzberg, 2007)

C. ORGANIZATIONAL STRUCTURE

Organizational structure is defined by organizational goals and strategies that support desired outcomes. Springer describes it as a way to departmentalize and decentralize authority, responsibility, and accountability (Springer, 2001). Organizational structures map out groups and sub-groups and define lines of responsibility. They also define how organizational resources, authority and responsibilities are communicated and distributed to support organizational groups. This section will introduce Daft's three key components of structure that describe the functionality of organizational structure. It will also explore popular organizational structures through written descriptions and representative charts provided by Springer and Ebary. Together they enhance management's ability to understand the relationship between structure and performance and help them to predict what structures best support the functionality of its chosen strategies and task design.

1. Three Key Components of Organizational Structure

Daft provides a description of key elements of organizational structure through his "three key components" (Daft, 2006). These components define the functional needs that are met by structure. The first two define how the organization is organized and which members have authority. The third defines how the organization functions.

The first component consists of lines and levels of authority within the organization. Daft states that "Organizational structure designates formal reporting relationships, including the number of levels in the hierarchy and the span of control of the managers and supervisors" (2006, p. 86). The establishment of lines of authority implies that authority is hierarchal and a flow of responsibility and accountability exists and is reflected through formal reports. The first component answers the questions of who reports to whom and how progress is monitored and describes how management supports the efforts of individuals performing tasks.

The second component consists of knowledge sharing between groups within the organization. Although organizations are divided into groups, it is necessary to ensure that organizational division does not prevent knowledge from being able to traverse the organization. Organizational members need to have access to the knowledge base as a whole rather than just what is produced in their group or department.

The third component consists of "the design of systems to ensure effective communication, coordination, and integration of efforts across departments" (Daft, 2004, p. 86). Systems that enable such communications are essential to the organization's operations. Control across the organizational structure is necessary to ensure the organization works within its physical structure and authoritative hierarchy. It also includes task design, people and leadership, coordination and control including standard operating procedures and information systems.

2. Organizational Structure Models

This section describes and points out the advantages of the *traditional*, *product*, *matrix*, and *program* organizational structures as defined by Springer, Ebary, and Doucette, 2001. The descriptions are supported with graphs that provide a visualization of each type of structure. The understanding of these structures provides management with some background as to how structures function. The charts are visual representations that can be studied and referenced by management when determining what structure best meets the needs of the organization.

a. The Traditional Organizational Structure

The traditional organizational structure, shown in Figure 2, is hierarchical and defines groups by their specific function. Each group is led by a functional manager accountable for defined group responsibilities. The functional manager assigns responsibilities and allocates resources in terms of both current and future needs. It is a predominately vertical structure in which the employees have well defined roles and know where to report (Doucette, 2014).

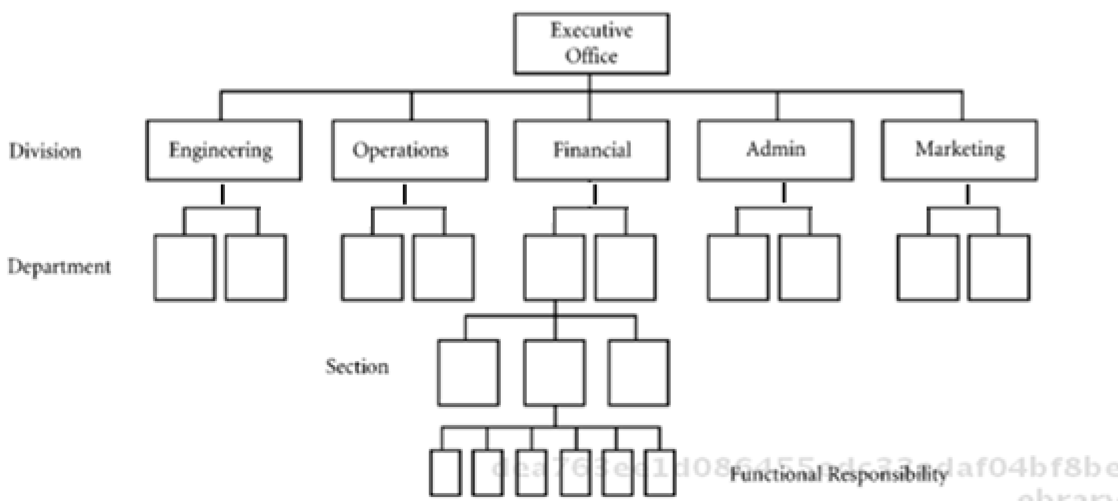

Figure 2. Traditional Organizational Structure
(after Springer & Ebary Inc., 2001)

The traditional organizational structure provides a clear promotion path and holds the manager responsible for ensuring that all employees are given the same advancement opportunities. The manager has the flexibility to assign individuals with greater capabilities tasks that allow them to demonstrate their full potential. The disadvantage is that the organization as a whole lacks a central project authority or focal point for customer relations. Project planning or reporting is also lacking. The lack of horizontal communications does not expose employees to other groups and creates a functional view of the organization by limiting the group's view of how it fits into the greater organization as a whole (Springer, 2001).

This structure defines lines of authority within groups. The limitation to this organizational model is a lack of sharing organizational knowledge. Although employees may be encouraged to gain implicit knowledge that would allow them to be competitive within their functional group, methods are not available for taking that implicit knowledge and making it explicit so that it can be shared with the rest of the organization.

b. The Product Organizational Model

The product organizational structure, as depicted in Figure 3, is organized around a specific product or product line (Springer, 2001). It gives the project manager control over all the resources needed for a specific project. This project authority and command over resources allows for good customer interface and the ability to react rapidly to changing customer needs (Springer, 2001).

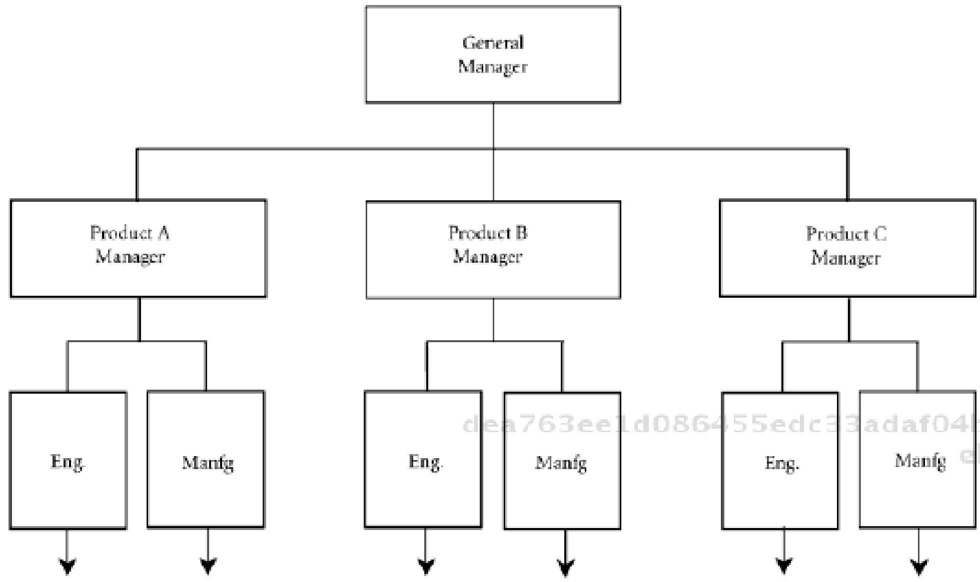

Figure 3. Product Organizational Structure (from Springer, 2001)

The shortfall to the Product Organizational Structure is that organizational groups do not share resources or organizational knowledge. This means that product groups may duplicate efforts and that they cannot combine resources to develop strong functional technology. There is also downtime for employees in between projects which might not exist if the product groups were not isolated from the rest of the organization (Springer, 2001).

c. *The Matrix Organizational Structure*

The matrix organizational structure, depicted in Figure 4, is a hybrid that combines traditional and product structures so that human resources can be better utilized during downtime that is encountered in the product structure. In this model, managers maintain functional responsibilities but share human resources. This requires that managers are able to communicate with each other. If employees finish their assigned tasks for one manager, they can work for another (Springer, 2001).

The disadvantage to this structure is that managers must compete for resources and employees may not put forth a good effort for managers who do not have direct influence over their work reviews (Springer, 2001).

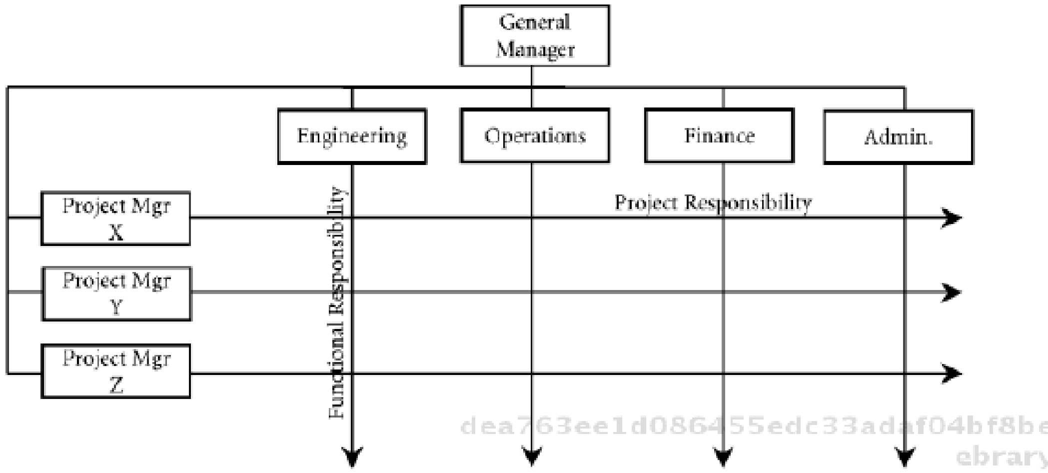

Figure 4. Matrix Organizational Structure (from Springer, 2001)

d. The Project Management Organizational Model

The project management organizational structure, shown in Figure 5, builds on the matrix structure through the assignment of a point of authority (director) who has responsibility and accountability for all projects (Springer, 2001). Directors who sit higher in the organizational hierarchy have a clearer view of the resources available because they can see within all of the groups rather than having the limited view that a manager would have of his or her specific group. In the Project Management organizational structure, directors work with numerous managers to maintain coordination and ensure consistency in the work. The downside is that competition occurs between directors and managers and they might not work well together (Springer, 2001).

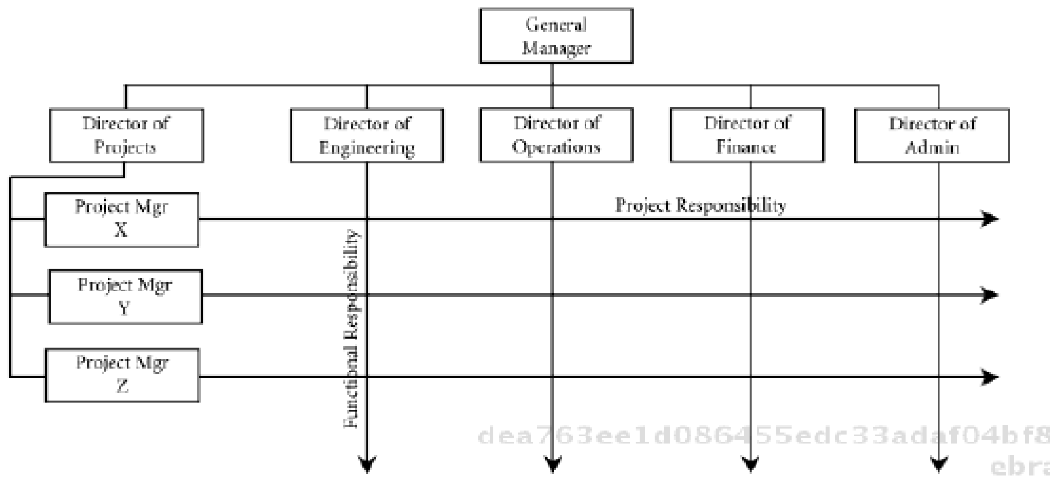

Figure 5. Project Management Organizational Structure (from Springer, 2001)

3. Organizational Structure Review

It is management's responsibility to analyze the three key components described by Daft so they can determine an organizational structure that best fits organizational needs. As described in the introduction of this chapter, organizational design is a cyclical process, so the determination of structure is not a one-time effort. Structure supports other organizational design components and as each design component is developed the organization will understand in more detail how it needs to work and what it needs in order to optimize performance. The structure defines how groups are broken down into sub groups and how these groups communicate responsibility and share resources. Another component that must be incorporated into the design of structure and that is to map out how tasks are completed through the development of task design. Once upper management has completed the task design processes they may realize that structure needs to be changed so that the groups can accommodate the needs of the work flow as defined by the chosen task design type.

D. TASK DESIGN

This section describes task design and the four task design types as defined by Burton, DeSanctis and Obel. Task design begins after a need for change has been identified, strategy for implementing the change has been planned, and a supporting organizational structure has been established. It defines processes for breaking high level tasks into smaller sub-tasks. Task design also describes how organizational groups interconnect and coordinate the completion of tasks to meet organizational goals. (Burton et al., 2006) Burton DeSanctis and Obel emphasize the fact that "task design determines the coordination requirements for the firm's work, and thus it is vital that there is a fit between task design and the other components of organizational design" (2006, p. 110). This reinforces the interconnectedness of organizational design components, where each group must be aligned to meet the needs of the others for the optimization of performance. Task design types are models for optimizing production and defining in detail how sub-processes are put together to complete larger tasks. The definitions explored in this section can be used to help management determine the model that best fits the organization.

1. Task Design Types

Task design, as defined by Burton, Obel, and Desanctis, is made up of four-task design types which are; *orderly, complicated, fragmented,* and *knotty* (2006). These design types provide guidelines for determining how high-level tasks are completed. As mentioned above, they describe how large tasks are broken down into subtasks. They also determine if tasks are completed by a single group or through the collaborative efforts of multiple groups. Determining the task design type allows organizational leaders to share a common idea of how tasks are completed and how responsibility and resources are shared throughout the organization. This shared idea helps to facilitate organizational alignment and allows for optimized performance.

Management determines which task design type best fits the organization by evaluating the levels of divisibility and repetitiveness of high level tasks (see Figure 6). Divisible tasks are tasks that can be broken into pieces that can be completed by independent groups. Repetitive tasks allow for specialization of specific tasks which makes production rapid and effective. Once the levels of divisibility and repeatability have been determined the matrix in Figure 6 can be used to determine the type of task design that is used by the organization.

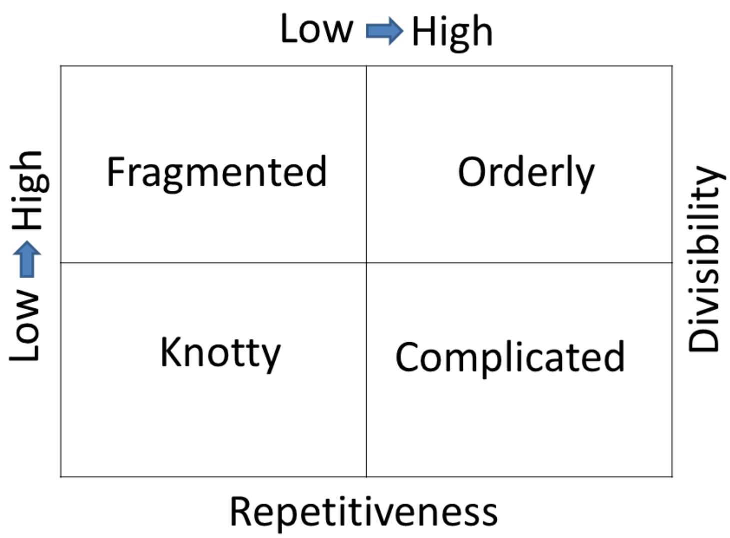

Figure 6. Task Design Space Graph (from Burton et al., 2006)

The Orderly Task Design

The *orderly* task design is highly divisible and highly repetitive. This means that tasks can be broken down into subtasks that can be completed by a single group and that the results are the same every time. It allows groups to work independently to complete standardized tasks rapidly and repeatedly. Groups report the completion of assigned tasks and problems to upper management. Management is responsible for assigning new tasks and creating solutions for reported problems. An example of an organization that would use the orderly task design is a web development company. Once the client has made a request to add or change a web page, management can assign the task to a web development team member. The team member can then work on the task independently and management can assign them a new task once they are finished. The advantage of groups working dependently and reporting directly to upper management is that very little effort needs to be put into the coordination between groups and failure in a specific group does not affect the other groups.

The Complicated Task Design

The *complicated* task design has low divisibility and is highly repetitive. This means that a single group completes sub tasks repeatedly but do not complete all of the sub-tasks that make up the sum of the final product. Rather than units working independently to complete a task they work independently to complete subtasks whose results are shared between groups. An example of an organization that would use a complicated task design is an assembly line for manufacturing computers. Each unit works independently to create components (like motherboards, or USB connections). The advantage of this task design category is that mass production techniques can be applied to subtasks. Rather than creating a single type of result the results of a subtask can be combined in many different variations. For example specific components can be added to a computer motherboard to change its qualities allowing for different types of computers to be put together to meet the needs of a range of client types. This allows for customized solutions to be developed for customers. The disadvantage of this task design type is that management needs to put a large amount of resources into coordination between groups and because the completion of a large task can be dependent on several groups a failure in a specific group can stop production completely.

The Fragmented Task Design

The *fragmented* task design is highly divisible, but not very repetitive. This means that groups have the ability to break a larger task into sub tasks and produce the outcome independently. It also means that processes are not repeated, which forces the group to be innovative. An example of an organization that would use the fragmented task design is a academic school at a university. Within the school there are several professors who have clients that fund specific types of research projects. The professors manage students and research assistants who conduct research and write reports. All the work is completed within the group without the sharing of products with other groups Management does not need to invest resources into management coordination but does have to have the foresight to be able to provide the group with the resources and authority needed to complete tasks and produce desired outcomes. It requires a different kind of coordination to adjust to the ongoing variation across the subtasks, but adjustments for connectedness among subtasks is not required.

The Knotty Task Design

This task design is appropriate for tasks that are neither divisible nor repetitive. This means that groups do not complete sub-tasks repeatedly nor do they have the facility to produce an outcome on their own. Groups are required to develop creative methods for completing sub-tasks and to be able to share their work with each other. It stimulates innovative thought but the interdependency of the groups to share outcomes can create work stoppages. One group's failure to produce outcomes can directly affect the outcomes of other groups. The author uses organizations that specialize in technology or innovation as examples. *Knotty* tasks are not standardized allowing developers the freedom to be creative. *Knotty* task design is the most difficult to coordinate as adjustments to both connectedness and non-repetitiveness are required simultaneously.

2. Task Design Review

The Task Design space graph in Figure 6 can be used to help determine what task design type can best optimize the desired organizational outcomes. It contains the *knotty, complicated, fragmented* and *orderly* task design types which are placed in the quadrant that matches their specific (high or low) levels of receptiveness and divisibility. The horizontal rows represent levels of divisibility. The vertical columns represent levels of divisibility. To use the graph, management must look at the tasks that are performed by the organization and determine what levels of divisibility and repetitiveness they embody. Once this information is obtained they can used the levels as coordinates to map out where in the graph the tasks lay, and using that as a guide to determine the best way to organize and allocate task efforts.

The product of breaking tasks down into sub-tasks is the development of standard operating procedures (SOPs). SOPs provide a more granular step-by-step description of the processes that must be accomplished to complete tasks. They document how processes are to be completed they can also be used as a part of a coordination and control system to set standards and as a way of monitoring progress. We discuss SOPs as a part of coordination and control systems below. While task design stipulates how processes are completed, the coordination and control system ensures things are done correctly and that organization group members follow the established processes.

E. COORDINATION AND CONTROL SYSTEMS

Coordination and control systems and information systems are used to ensure that managers have tools to monitor the tasks and the associated sub-tasks that work together to achieve organizational goals. Information systems assist in coordination and control by providing management with computational power that automates services, aggregates data and produces reports that give management a clear view of important data. According to Burton et al., "Along with people and processes, coordination control,[and] information systems are important to assure smooth working together among the organizational components, so that all move in a common direction towards strategic goals" (2006, p. 157).

Coordination and control systems support organizational strategies and work within the organizational structure to define, monitor, and support processes. They manage the linkages between organizational components and support their integration. Coordination and control govern how work is done, and define directives. These systems establish levels of bureaucracy define levels of autonomy of workers and determine how flexible processes are (Burton et al., 2006).

Burton, DeSanctis, and Obel (2006) define five coordination and control system models. They are the: *Family, Machine, Market, Clan* or *Mosaic* coordination systems. These coordination and control systems are defined by their levels of formalization and centralization.

Formalization describes how regulated tasks are. Highly formalized tasks have rules defined in detail, recorded in policy statements, and consistently communicated within the organization. These regulations define the work that must be done, who must do the work, and the methods in which the work is to be completed. They are reinforced through monitoring and feedback systems. Training procedures, modeling of behavior or verbalization are methods of teaching workers what is expected of them (Burton et al., 2006). Burton, DeSanctis and Obel add, "The important thing to note about formalization is that it bases coordination and control in very strong expectations of how work should be done, with monitoring and feedback mechanisms in place. In highly formal organizations there are penalties for breaking rules" (2006, p. 160). In other words, workers must know what is expected of them and they are held responsible for the successful execution of tasks. References are made available to them so they can refer to the regulations and gain an understanding of the importance of the completion of assigned task in terms of the policies set in place.

Centralization refers to how power is maintained or distributed within an organization. For example, in a highly centralized organization a high-level manager or group within the organization manages coordination and control. Centralization is viewed in terms of degrees of centralization (Burton et al., 2006). Coordination can be either centralized with a few individuals sharing control or decentralized with power lying within subgroups or within lower levels of management. The higher the level of centralization is, the less flexible the coordination and control systems. Decentralized coordination and control is more flexible and able to deal with diverse conditions (Burton et al., 2006).

Figure 7 represents Burton, DeSanctis and Obel's four coordination and control systems in relation to their levels of formalization and decentralization. The upper left quadrant represents Machine organizations that have low levels of decentralization and high levels of formalization. The upper right quadrant represents Mosaic organizations that have a high level of decentralization and a high level of formalization. The lower left quadrant represents family organizations that have low levels of formalization and low levels of decentralization. The lower right quadrant represents Market organizations that have low levels of formalization and high levels of decentralization. Management must analyze how formal and centralized the organization must be to perform the tasks and sub-tasks that together work to reach organizational goals. From this analysis the appropriate type of coordination and control system can be derived. The following sections describe the family, machine, market, clan or mosaic coordination and control systems.

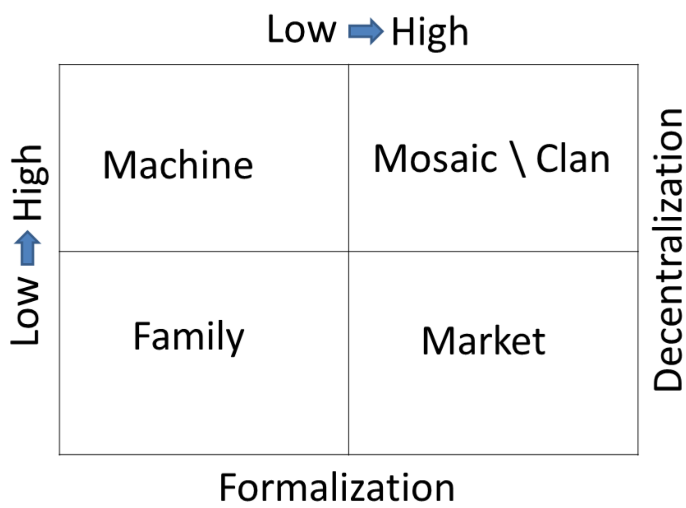

Figure 7. Taxonomy of Coordination and Control Systems (from Burton et al., 2006)

(1) Family

The family coordination and control design uses informal and centralized forms of coordination and control. Individuals are provided instruction on how to perform tasks by a centralized source, which is most often a CEO or a high level manager (Burton et al., 2006). Burton, DeSanctis and Obel describe it as “a family where the head(s) of the household dictate(s) what is to be expected and how work is to be done” (Burton et al., 2006). It allows for flexibility as long as individuals follow the instructions provided to them by the central authority. The disadvantage to Family coordination and control design is that if there is change in the organizational leadership or if new people join the organization the work flow may be disrupted because new members lack an understanding of how processes should work due to a lack of formalization.

(2) Machine

The machine coordination and control design has a high degree of both formalization and centralization. It utilizes the documentation of rules and procedures to specify how processes are completed. Burton, DeSanctis, and Obel state that machine coordination and design “makes high use of information to build efficiencies and adapt to changing demands by modifying rules so as to make the organization dynamic, not fixed”

(Burton et al., 2006, p. 162). The disadvantage is that it does not encourage flexibility and creativity and it requires that new coordination and control systems need to replace aging systems so that the organization does not become stagnant (Burton et al., 2006).

(3) Market

The market coordination and control design has low formalization and high decentralization. There is some use of formalized control systems but the focus in on using informal means of sharing information. People are expected to communicate their concerns; expectations are expressed through training and daily interactions (Burton et al., 2006). It is helpful for promoting innovation but if not executed correctly the environment can become confusing and subunits may find it hard to manage themselves.

(4) Clan and Mosaic

The clan coordination and control design has more formalization than it does centralization. The model relies on norms that are held by employees. The norms are reinforced by constant verbal communication and through formal and informal trainings. There are some written rules and procedures but just enough so that people can create standards when needed. The clan design model requires strong leaders who must set the norms and train individuals on how to meet these norms (Burton et al., 2006).

The mosaic coordination and control design leans towards having low centralization and formalization. It includes rules that are embedded but differ to a small degree to meet the specific needs of specific sub-groups. It may have some organization wide systems but not all functions will share forms of coordination and control. It works well for developing an organization that can adapt to change because each subunit has the ability to change without affecting other sub-units. The challenge with this design is that it is sophisticated and hard to achieve (Burton et al., 2006).

F. INFORMATION SYSTEMS

Information systems support to coordination and control systems by providing critical information to decision makers. They can be created using a variety of technologies ranging from pencils and paper, to sophisticated computer systems. A consideration for determining the necessary information systems is the amount of tacit (knowledge that is not written down and clarified) and explicit (documented and clarified knowledge) knowledge that is needed for organizational operations (Burton et al., 2006). If tacit knowledge is more important, information system must support the communication between people. If the organization depends more on explicit knowledge then more formalized systems (systems that are documented and have defined means for accessing them) need to be put into place. The choice of technologies must be determined by management according to the technology's ability to meet the needs of the coordination and control system. Burton, DeSanctis, and Obel describe two dimensions for determining an appropriate information system; they are the amount of data used and the need for tacit knowledge.

The diagram in Figure 8 represents Burton, DeSanctis and Obel's four information types in relation to how tacit they are and the amount of information that they consume. The upper left quadrant represents data-driven information systems that use high levels of information that is not tacit in nature. The upper right quadrant represents relationship-driven information systems that use high levels of information and have a highly tacit nature. The lower left quadrant represents the event-driven information types that use low levels of information and are not highly tacit. The lower right quadrant represents the people-driven information type which has a highly tacit nature and a uses low levels of information (Burton et al., 2006).

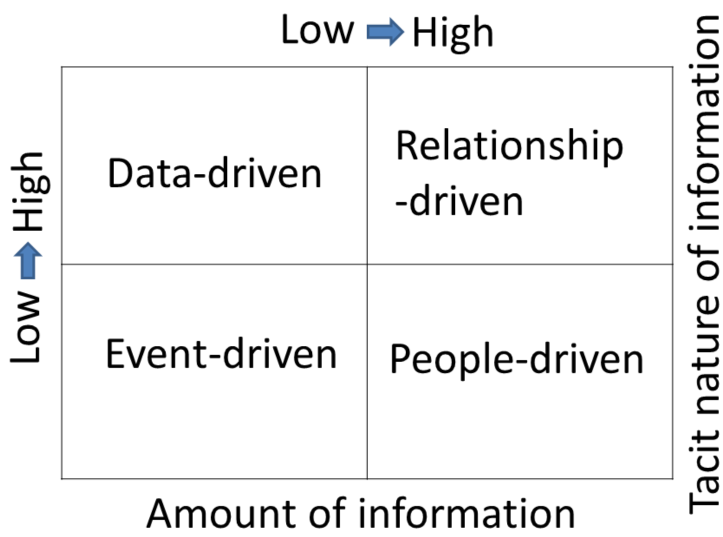

Figure 8. Four Information Types (from Burton et al., 2006)

(1) Event-Driven

The event-driven approach has a low amount of processing and tacit information. These systems can process information about specific events or occasions as they occur. They are reactive and send data from one source to another in the smoothest possible manner. They require little planning but require that information be well defined. They work well with small, reactive organizations (Burton et al., 2006).

(2) Data-Driven

The data-driven design supports organizations that conduct systematic, intelligent processes. It uses computational power to provide timely, detailed, and precise calculations that can be utilized to make decisions. The data-driven design allows for the processing of large volumes of data but require the support of enterprise database systems. They best fit with the machine coordination and control design (Burton et al., 2006).

(3) People-Driven

The people-driven design works well for highly tacit organizations that are not data driven. People communicate and share information face-to-face where it is possible to share highly tacit information. Information is shared in meetings and in training sessions. They work well with the machine coordination and control design (Burton et al., 2006).

(4) Relationship-Driven

The relationship-driven design is highly complex. It is used to capture links and relationships between people and data. It works well in data-driven, highly tacit environments. The relationship-driven design uses concepts from both the data-driven and people driven designs and includes both the data that is captured and the interpretation of the data. It is best aligned with the mosaic model (Burton et al., 2006).

G. DEVELOPING EFFECTIVE STANDARD OPERATING PROCEDURES

Once a coordination and control design has been selected standard operating procedures can be developed to document in detail how processes should be completed. These documents can be integrated into the coordination and control design as a way of evaluating performance and verifying that tasks are completed in the correct manner. David Grusenmeyer, provides a more detailed description of how tasks are broken down into subgroups in his article *Developing Effective Operating Procedures* (Grusenmeyer, 2003). He describes the advantages of using SOPs, how to organize the SOP writing process, and steps for developing and presenting SOPs.

(1) The Advantages of SOPs

Grusenmeyer describes the advantages of developing SOPs as improving performance and productivity and reducing variety. They provide step by step instruction that allow the facilitation of training and helps managers and employees to ensure that steps are followed and not missed. They can also be used for cross-training. The regular evaluation of SOPs helps to ensure that processes are continually reviewed for improvement (Grusenmeyer, 2003).

(2) Organizing the SOP Writing Effort

Grusenmeyer (2003) breaks the SOP writing process down into five steps. The first step is to identify the key areas of concern. The second step is to prioritize the areas of concern. The third step is to identify all the processes that make up prioritized areas of concern. The fourth step is to organize important processes, and priorities SOP development. The fifth step is to identify a lead for managing the SOP development effort (Grusenmeyer, 2003).

(3) SOP Development

Grusenmeyer also provides "useful and effective steps" for developing SOPs. The first step is to give the SOP a name that uses descriptive words that describe what the process actually does. The second step is to write a scope that informs the reader of what process will be covered in the SOP, and what processes will not be covered in the SOP. The scope also describes who would use the SOP. Step three is to write a task description that describes the number of people, needed resources, and skill level of technician who will complete the task. Step four is to describe each task in detail. Step five is to work to encourage organizational members to use the SOP. Step six is to setup methods for coordination and control.

H. PEOPLE AND LEADERSHIP

Many employees do not immediately see the benefit of change. To them, change represents more work when they may already feel overloaded. If change is to be implemented, management must create strategies that encourage employees to participate. Creating buy-in as described by Katherine Kane is "about motivation and influencing behavior, about breaking old habits and attitudes, and about creating an environment that is conductive to embracing the new" (Kane, 2005, p. 21). Management must be able to understand the complexity of changing behavior and must create strategies that encourage employees to change their behavior even when change is difficult. To introduce change, leadership must stage events. Events are conducted in the form of meetings and organizational functions that inform employees about the benefits of proposed change. These events help the employees understand how change may benefit them, how change may be implemented, and describe the resources and tools available to them. The objective is to ensure that the entire organization is aligned for change. To do this, champions must be selected to help employees gain a sense of ownership. Also, channels of communication must be created to face resistance, providing employees the support they need (2005). Without addressing the fears and the needs of the employees, the organization will not be able to implement the needed changes.

I. REVIEW

This chapter suggests that organizations can develop organizational goals to improve processes. To do this, effectiveness must be defined by management in terms of goals. Once the meaning of effectiveness is defined, organizational strategies and the supporting organizational structure must be created to support these goals. Organizational strategies then define what tasks need to be completed, who will complete the task, and finally, how authority, information, and resources will be coordinated and controlled.

This chapter provided the needed background to discuss the implementation of new processes through the exploration of organizational design. These components are "goals, strategy, structure, task design, coordination and control and information systems and people and leadership" (Burton et al., 2006). It explained these processes in terms of change and describes how change must be addressed through organizational design. It used Burton, DeSanctis and Obel's, *Organizational Design: A Step by Step Approach*, along with current literature, for describing the organizational components affected by change. It also described how they are connected and essential for the implementation of change. Chapter IV discusses organizational design components in terms of the hastily formed network deployment team.

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IV. STRATEGY FOR PROCESS EVALUATION AND IMPLEMENTATION OF IMPROVED PROCESSES

This chapter introduces strategies for a HFN deployment team to evaluate and improve processes to ensure the effective deployment of coordination and control systems within a disaster area. It uses organizational design as a model for guiding processes improvement efforts within the HFN deployment team. Applying organization design to the evaluation and improvement of process with an HFN deployment team includes seven steps. The first step is to state external and internal goals. The second step is to develop supporting strategies. The third step is to determine structural needs. The fourth step is to select a task design. The fifth step is to select a coordination and control systems. The sixth step is to select an information system. The seventh step is to gain support from employees.

A. DETERMINE GOALS

The first step to evaluating and improving processes to ensure the effective deployment of coordination and control platforms within disaster areas is to declare external goals (the product that is provided to the client and not used for internal processes) and internal goals (products that are used to support internal processes). The external goal of the HFN deployment team is to effectively deploy platforms for coordination and control within disaster areas. This thesis suggests that this goal can be met by employing a strategy of creating two supporting internal goals. The first is an internal goal of continuous process evaluation and improvement. The second internal goal is gaining organization support for the improvement of processes and the implementation of improved processes within the HFN deployment team.

The ability of the HFN deployment team to introduce strategies for evaluating and improving processes and gaining organizational support for the implementation of improved processes requires formalized written goal statements. Once the goals have been written down the legitimization of the goal is communicated throughout the organization. The legitimization of goals provides management the authority to allocate resources needed to complete tasks. These resources include information, equipment, coordination and control systems and information systems. Most importantly the legitimization of goals provides management the authority to develop the strategic planning teams that are responsible for developing strategies for accomplishing goals.

B. SELECT STRATEGIES

The second step to evaluating and improving processes is to outline strategies. Goals state an organizational aim or intention while strategies outline the tasks that must be completed to achieve goals. Our proposed strategies for achieving the goals and gaining support for the implementation process improvement include holding four types of strategic planning meetings (planning, problem solving, after-action, process improvement) and the development of a process improvement team that incorporates input from members of all organization tiers, instilling a sense of ownership in the team members who will be responsible for implementing improved processes.

The strategy for achieving the goal of evaluation and improvement of processes is a cyclical process that consists of the four planning meetings listed above. The cyclical process starts by first, developing a deployment strategy based on the HFN team's current knowledge base and then recording problems and trouble-shooting methods and outcomes. Then using this captured data to make more informed decisions during future deployment strategy planning sessions.

***Strategic planning meeting*:** At home camp the strategic planning meeting is held to develop strategies for the deployment of coordination and control systems within disaster areas. Members of the strategic planning team use both formal and informal strategic learning (Sloan, 2013) to develop planned strategies that are formally documented and followed during deployments.

***Strategic problem-solving meetings*:** Problem-solving meetings are held when there are problems deploying planned strategies. During these meetings problems are described and shared within the HFN deployment team. All team members are encouraged to contribute their ideas. The outcomes of the meetings are written descriptions of problems, the steps that were taken to trouble-shoot the problem and the results of the troubleshooting effort. The written descriptions are recorded within the team's coordination and control system, and are used later during after action reporting meetings, process improvement meetings and future strategic planning meetings.

***After-action meetings*:** When the HFN team returns to home camp after-action meetings are held. During these meetings team members determine the effectiveness of the processes that made up the deployment effort. Processes that need improvement are identified and are tagged for tracking. The processes that are most in need of improvement are then prioritized and passed on to the process improvement team.

***Process improvement meetings*:** Process improvement meetings are held at the home camp. During these meetings the process improvement team writes new SOPs for the processes that have been prioritized from the after action report. The improved processes are then used in the discussions of future strategic planning sessions.

***Observations*:** The value of this strategy is in the team's ability to develop new deployment strategies based on a continually growing knowledge base. Recoding problems and problems solving methods allows the development of new strategies that include newly developed solutions. This helps the team to navigate avoidable problems decreasing deployment time and increasing capabilities of the deployed coordination and control system.

New processes cannot be deployed by the HFN team without the support of organizational members. The strategy for gaining support for implementing improved processes includes the incorporation of team members from all organizational tiers into the process improvement group. The structure for the process improvement team encourages team members to participate in the process improvement meetings. The idea is that the involvement of the technicians who are affected by change will give them a sense of ownership of the new processes. This since of ownership will encourage them to participate in the implementation of new processes.

C. DETERMINE STRUCTURAL NEEDS

The third step to evaluating and improving processes is to determine an organization structure that can support the process improvement strategies described in this thesis. Organizational structures map out organizational groups and sub-groups and define lines of authority, responsibility and the distribution of resources. Springer states that structure contains three key components which are lines of authority, knowledge sharing, and the coordination and control of information systems that allow for the gathering, tracking, processing and sharing of data (Springer, 2001). He also introduces four organizational structures, which are *traditional, product, matrix* and *project*, as discussed in Chapter III (Springer, 2001). This section will first look at the structure of the process improvement team which lies at the heart of our proposed solution for evaluating and improving processes. Second it examines Springer's three key components in terms of the HFN team's deployment environments in order to determine which of the structures best supports the organizational goals and supporting strategies.

1. Process Improvement Team

The process improvement team is responsible for evaluating the task design of processes and developing SOPs for improving processes. The structure and development of the process improvement team is critical to addressing the goal of gaining organizational support for implementing improved processes. The process improvement team is a collaborative team made up of three smaller teams, with representatives from the management team, the department heads, and the technicians team. The structure of the process improvement team ensures that information and viewpoints from all three tiers are shared. Together all three tiers share goals, justifications for decisions, and the ability to influence the decision making process.

The HFN deployment team's upper management is responsible for selecting members of the management team, the department head team, and the technician team. This is a hierarchical structure with the management team at the top and authority communicated downward to the department head team, which manages the efforts of the technician team. Each of these teams is responsible for producing specific outcomes that together allow for the development and implementation of process improvements. These teams work interdependently and share results, supporting each other's efforts. Including members from all three organizational tiers (management, department heads and technicians) helps to ensure that the widest range of organizational knowledge is used to develop improved processes.

2. Management Team

The management team consists of members of the organization's management plus one representative from the department head team. The management team is responsible for process improvement assignments to the department head team. The team monitors the overall performance of the process improvement effort. The management team defines the structure, determines strategies, defines the task design, and establishes coordination and control and information systems that support process improvement efforts. The management team is also responsible for tracking progress and working with the department head team and technician team representatives to resolve any problems with the development of the new SOPs. Once the SOPs have been developed, it is the management team's responsibility to introduce the SOPs for improved processes to the larger HFN deployment team.

3. Department Head Team

The department head team consists of department heads and one representative from the technician team. The representative from the technician team shares insights from both groups and works as a conduit for sharing information and communicating authority. The department head team is responsible for receiving process improvement assignments from the management team. The department head team develops the task design by breaking larger processes down into smaller sub-tasks. These sub-tasks are then provided to the technician team so that they can be developed into step-by-step instructions (SOPs). The department head team is also responsible for the management of the technician team. They provide the technician team with materials, information, and feedback needed to support SOP development.

4. Technician Team

The technician team consists of highly skilled professionals. The team is responsible for developing strategies for improving processes described in SOPs. As the SOPs are developed, team members peer review each other's drafts. Validated SOPs are pushed upward to the department head team where they are either validated or returned for further editing.

5. Three Key Components/Deployment

At home camp the process improvement team requires horizontal and vertical lines of authority that allow managers and department heads to share authority over team members from different groups. Horizontal and vertical sharing of knowledge ensures that information is shared between groups. Horizontal and vertical coordination and information systems are required to support the collaborative efforts of the process improvement teams.

We now define the requirements for the HFN team during deployment, so we can look at the requirements of both the process improvement team and the HFN team during deployment, together, to determine what organizational structure best meets the needs for our process improvement strategies.

Sharing authority**:** During deployment, horizontal and vertical lines of authority provide group leaders authority to assign tasks to subordinates and to the subordinates of other group leaders. Horizontal lines of authority provide group leaders with authority over subordinates within their group. We propose that vertical lines of authority allow group leaders to work collaboratively. For example, vertical lines of authority allow a group leader with a resource-intensive task the authority to assign tasks to a group member under the supervision of another group leader. This supports the goal of effective deployment by reducing downtime for team members who may have finished their task and are waiting to start another (Springer, 2001).

Knowledge sharing**:** Horizontal and vertical access to knowledge allows for HFN deployment team members to share information. This information provides technicians with instructions for completing processes and supports decision-making during deployment. It includes SOPs that describe organizational processes and the data captured when technicians report issues and log strategic patterns. The sharing of knowledge works in partnership with the sharing of authority. It allows group members to support tasks that are outside the scope of their group. SOPs provide the technician with step-by step instructions for completing a task with which they may be unfamiliar.

***Coordination and control and information systems*:** The coordination and control and information systems must meet the requirements of horizontal and vertical sharing of authority and knowledge. Managers must be able to receive status updates of the work of team members from other groups. They must also be able to monitor the work of their team members who are temporarily working for other managers in order to track the availability of those members. Information must be accessible to all team members.

6. Selecting a Structure

The traditional, project, matrix, and product organizational structure models are options that can support the three components (lines of authority, knowledge sharing, and coordination and control and information systems) described in Chapter III. Upon consideration at the three key structural components of the HFN deployment team in terms of both the team's deployment and home station environments we find that the vertical and horizontal channels of authority, knowledge and coordination and control are critical to the team's ability to meet organizational goals.

When selecting an organizational structure to support we must therefore first determine which structures support vertical and horizontal channels of authority, knowledge sharing, and coordination and control and information systems. Both the traditional and product structures are not suitable for the HFN deployment team. The traditional structure lacks horizontal communication across groups and the product structure is based on distinct operating units that do not work together. The two structures that can support the horizontal channels of authority, knowledge and coordination and control are the matrix and the project organizational structures. They are similar, except for the fact that the project structure has a director of projects who oversees group leaders. Either of these structures would work to successfully achieve the goal of evaluating and improving processes. The dynamics of the HFN team would need to be evaluated to determine which of these structures works best.

D. SELECT TASK DESIGN

The fourth step to evaluating and improving processes is to determine the task design. In Chapter III we discussed the orderly, complicated, fragmented, and knotty task designs. Each of these task designs is determined by its level of divisibility and level of repetitiveness. Management selects a task design that best fits the HFN deployment team by determining the team's tasks' collective level of divisibility and level of repetitiveness. The strategies for process improvement described in this thesis are: to use formal and informal strategies to develop deployment plans, to document and share problems faced during deployment; to use informal and formal strategic learning to help develop strategies for resolving issues; to document informal learning strategies and strategic patterns; to hold after action meetings; to assign the process improvement team with the task of analyzing high priority issues and reporting solutions; to improve processes and develop SOPs; to add improved processes to existing planned deployment strategies; and to gain organization support for the implementation of improved processes by organizational members.

All of these tasks have low levels of divisibility and high levels of repetitiveness. As we discussed in the structure section of this chapter, the structure of the HFN team requires both vertical and horizontal channels of authority, knowledge, and coordination and control. This means that the tasks that are completed to accomplish the goal of deploying a coordination and control system into a disaster area and associated goals of process improvement are tasks that are shared throughout the HFN deployment team. The tasks that are completed during deployment are repetitive. Though process improvements are made to ensure the effectiveness of deployment, the majority of the tasks remain the same.

Using the task design space graph (see Figure 6) we can see that the task design that has both low levels of divisibility and high levels of repetitiveness is *complicated* task design. The complicated task design allows for groups to work independently to complete tasks that, once completed, are shared. It allows for groups to mass produce products while also allowing for results to be shared between groups. For example, technicians can work independently to develop SOP drafts that other team members peer review. The finished SOPs can then be stored in a central database that can be accessed by any organizational member.

E. SELECT COORDINATION AND CONTROL SYSTEMS

The fifth step to evaluating and improving processes is to determine the coordination and control system. The goal of evaluating and improving processes requires that the HFN team has their own internal coordination and control system. Coordination and control systems provide the HFN deployment team with the tools needed to manage linkages between organizational components, support process integration, govern work flow of the deployment team, define directives for the deployment team, define levels of autonomy of workers, define flexibility of work environment, and track deployment team task progress. This section will discuss the HFN deployment team's requirements for coordination and control systems.

When evaluating the internal coordination and control system for the HFN deployment team we look at requirements of the HFN deployment team's goals, strategies, structure and task design in terms of centralization and formalization. As discussed in Chapter III centralization refers to how power is distributed within the organization. Organizations with a high level of centrality consist of a few high level managers who maintain power. Organizations with low levels of centrality have power distributed throughout the organization. Organizations with high levels of formalization are highly regulated, with established rules, and penalties for breaking rules. Organizations with low levels of formalization will have fewer established rules and regulations.

The effective deployment of a coordination and control system in support of the disaster response team within a disaster area requires the HFN team to have a high level of formalization and a high level of centralization. Strategies for continuous evaluation and improvement of processes and gaining organization support for the implementation of improved processes by HFN organizational members requires groups, processes and resources to be shared. During deployment and at the home camp organizational managers share authority over subordinates. Resources in the form of equipment and knowledge must also be shared to ensure effective deployment. The need to manage shared resources within a chaotic environment requires a high level of formalization. Rules are established and followed so that order can be kept during deployment and at home camp when the process improvement team meets. Organizational members must be incentivized to comply with organizational strategies. Managers must have forms of quality control to ensure compliance. This is critical because a lack of quality control represents possible points of failure. If strategies are not followed the deployment can fail. Problems need to be documented, and informal learning and strategic patterns must be captured, or the data needed for future analysis may be lost. The coordination and control system is also highly formalized because the rules for capturing data must be consistent.

The required formalization of coordination and control must be supported by a central authority. The centralization of coordination and control systems ensure that all team members have access to the documents that describe goals, strategies, structure, task design, and step-by-step instructions for completing processes. The vertical and lateral requirements for authority and knowledge require that coordination and control is shared and not isolated. It also ensures that all managers and subordinates have quality control tools that allow them to track and report their progress.

When looking at the taxonomy of coordination and control systems (Figure 7) we can see that the coordination and control system that has a high level of formalization and a high level of centralization is the Machine coordination and control system. The Machine coordination and control system utilizes documentation and establishes rules and procedures that state specifically how tasks should be completed.

F. SELECT INFORMATION SYSTEMS

The sixth step for evaluating and improving processes is to determine the information system used to support coordination among deployment team members.

Information systems provide critical information to decision makers using a variety of technologies. The information system that best supports the HFN deployment team can be selected by analyzing the tacit nature of the knowledge and the volume of data used by the organization. In the case of the HFN deployment team information needs to be tacit, and the volume of information that needs to be processed is low.

The strategy of capturing informal learning and strategic patterns is a process that takes tacit information and makes it explicit so that as much information as possible is available to the process improvement and strategic planning teams when they are analyzing processes. The information system that supports the process evaluation and improvement strategies proposed in this thesis must support this transformation of tacit information to explicit information. (Burton et al., 2006).

The process evaluation and improvement strategies presented in this thesis do not require that the supporting coordination and control systems process large amounts of data. Most of the information that is needed should be in SOPs and documents that support the logistics of deployment. SOPs, text documents, and supporting images generally do not require large amounts of processing power. Strategies for ensuring the effectiveness of the HFN deployment team to deploy coordination and control systems within a disaster area requires that the team's information system allows for the tacit information to be made explicit, but does not require a large amount of computational power.

Large volumes of data may be pushed over the deployed coordination and control system provided to the disaster area. This represents external outcomes and not internal requirements for meeting organizational goals. The information required by the HFN for the process improvement strategies presented in this thesis is tacit in nature and does not consume larger amounts of data. Given the four information types depicted in Figure 8, we see the People-driven information system type best fits the needs of the HFN deployment team. The People-driven information system focuses on capturing processes. It encourages people to get together to share information and to use information systems to support the transfer of information (Burton et al., 2006). It is also important to note that information system needs to have limited down time and that interfaces have high levels of accessibility and usability. This allows data to be collected easily, and disseminated and accessed easily.

G. GAIN SUPPORT FROM EMPLOYEES

The seventh step in evaluating and improving processes is to address the needs of employees. Many employees may not immediately see the benefit of change. To them, change represents more work when they may already feel overloaded. If change is to be implemented, management must create strategies that encourage employees to participate. Creating buy-in, as described by Katherine Kane, is “about motivation and influencing behavior, about breaking old habits and attitudes, and about creating an environment that is conductive to embracing the new” (Kane, 2005, p. 21). Management must be able to understand the complexity of changing behavior and must create strategies that encourage employees to change their behavior even when change is difficult. To introduce change, leadership must stage events. Events are conducted in the form of meetings and organizational functions that inform employees about the benefits of proposed changes. These events help the employees understand how change may benefit them, how change may be implemented, and describe the resources and tools available to them to affect the change. The objective is to ensure that the entire organization is aligned for change. To do this, champions must be selected to help employees gain a sense of ownership. Also, channels of communication must be created to face resistance, providing employees the support they need (Kane, 2005). Without addressing the fears and the needs of the employees, the organization will not be able to implement the needed changes.

H. REVIEW

The book, *Organizational Design: A Step by Step Approach*, by Burton, Obel, and DeSanctis, provide us with an organizational design model that we use to create strategies for evaluating and improving processes to ensure the effective deployment of coordination and control platforms within a disaster area. Using this model we developed a seven-step process, depicted in Table 1, for evaluating the effectiveness of processes and implementing process improvement within the HFN deployment team.

Table 1. Seven-Step Process Improvement Strategy (after Burton et al., 2006)

1. Goals	The external goal of effective deployment of coordination and control systems is supported by two internal goals. The first is evaluating and improving processes. The second, is to gain support from organization members.
2. Strategy	The process improvement strategy includes holding planning, problem solving, after- action, and process improvement meetings.
3. Structure	Both matrix and product organizational structures support the vertical and horizontal channels of authority or communication, knowledge, and coordination and control needed to support external and internal goals.
4.Task Design	The complicated task design best matches the low levels of divisibility and high levels of repetitiveness, of the tasks that make up the process improvement strategies.
5. Coordination and Control	The Machine coordination and control system support the high levels of formalization and high levels centralization needed to support process improvement strategies.
6. Information Systems	People-driven information systems meet the requirements of low data consumptions and the transition of tacit information into explicit information.
7. Address needs of employees	Education and in inclusion of organizational members within the development and implementation of process improvement strategies will help to gain support from organizational members.

(1) Goals

Before a strategy for process improvement can be planned and executed both external and internal goals must be written down and formalized. The legitimization of goals provides management with the authority to allocate resourced towards meeting formalized goals. Our proposed process improvement strategy requires both external and in internal goals. The external goal describes the services that the HFN team provides to the disaster area. The internal goals describe the outcomes of the internal processes that must be completed to meet the external goal. The external goal of effective deployment of coordination and control systems within disaster areas requires the FHN deployment team to be able to setup as quickly as possible and to provide the best quality of coordination and control services. The internal goals of evaluating and improving processes ensure that processes are evaluated and when possible improved. The internal goal gaining organizational support for the improvement of processes and the implementation of improved processes ensures that organizational members support the process improvement strategies.

(2) Strategy

We developed a strategy of conducting four types of strategic planning meetings (planning, problem solving, after-action, process improvement) and capturing data that describes issues faced and the strategy employed to resolve them. Together the four meeting include, the of holding planned deployment strategies, complying to planned strategies, communicating problems throughout the HFN deployment team, capturing informal strategic learning and using it to help resolve problems, documenting the trouble shooting process and capturing strategic patterns, holding after action reporting meeting where problems are identified and prioritized, developing a process improvement team, evaluating problematic processes and creating SOPs for improved processes, using SOPs and captured deployment data for the development of future planned deployment strategies. Once the strategies were identified we were able to evaluate structure in terms of the development of the process improvement team and the need for shared authority, knowledge and coordination systems during deployment and at base camp.

(3) Structure

The structure of the process development team that we selected includes members from all organizational tiers. This enables managers to share authority over resources and personnel. We found the process improvement team at base camp and the HFN deployment team benefit from established vertical and horizontal channels for authority, knowledge and coordination and control. These channels allow groups to work together collaboratively and to share information and resources. We compared these needs to the qualities of Springer's organizational structures (traditional, project, matrix and product) and determined that both the matrix and project organizational structures can support the HFN team's process evaluation and improvement strategies thus creating synergistic efficiencies.

(4) Task Design

We examined task design in term of its three key functions and determined that when evaluating processes we must evaluate them in terms of how well they were broken down into smaller components, how well the teams worked together to complete tasks, and whether or not the coordination and control system supported the effort effectively. We also analyzed the required tasks design for the HFN deployment team and determining that the tasks completed by the team had high levels of repetitiveness and low levels of divisibility which matches the complicated task design.

(5) Coordination and Control

When evaluating which coordination and control system best supports the complicated task design we found that the required coordination and control system was defined by the organization's need for vertical and horizontal channels of authority, knowledge, coordination. We concluded that the supporting coordination and control system required a high level of formalization to insure that strategies were complied with and a high level of centralization to make sure that data was accessible to all HFN deployment team members during deployment and at the base camp when planning strategies and evaluating processes. We also found that the coordination and control system that requires high levels of formalization centralization fits most closely with the machine coordination and control system.

(6) Information Systems

Coordination and control systems must work together with information systems. The information system that best supports our proposed process evaluation and improvement strategies is the people-driven information system asour proposed strategies do not require large amounts of data processing and it supports the transformation of tacit information into explicit information.

(7) Address Needs of Employees

The effectiveness of the deployment team's coordination and control systems can be ensured by process evaluation and improvement. This however, is dependent upon the enculturation of the value of evaluation and improvement. People and leadership need to be involved in all the described organizational design components. Their expertise is required to develop effective processes and their support is needed to ensure that they are open and enthusiastic about participating in this collaborative effort to improve the probability of mission success.

V. CONCLUSION

A. CONCLUSIONS

There is currently a lack of a systematic strategy for improving the hastily formed network team's (HFN's) deployment of coordination and control systems into disaster areas from one deployment to the next. What is at stake is the effectiveness of HFN deployments. Although we can currently deploy coordination and control systems within a disaster area to provide critical, lifesaving services, we can also do better. This paper addresses this problem by using organizational design as a framework for introducing strategies for documenting, evaluating, and designing improved processes, and gaining organizational support for the implementation of improved processes. This is a cyclical strategy that documents the progression of processes and strategies so that more informed deployment strategies can be developed in the future. This strategy includes developing teams for creating strategies and improving processes. These teams are made up of members from all tiers of the organization and ensure that process improvement, development, and implementation is inclusive and therefore supported by the organizational members who are affected by the change represented by these process evaluation and improvement efforts.

The implications of this work are that the strategies presented can be used as a model for process improvement that can be used by any organization that seeks to continuously improve their capabilities to deploy coordination and control systems within disaster areas. The documenting of problems and the strategies used to resolve them records a history that can be referenced by technicians who face similar problems in the future. This supports their ability to solve problems with solutions that otherwise may not have been captured in the past. This saves valuable time troubleshooting problems and helps prevent work stoppages during deployments. The cycle of planning, evaluation, and improvement of processes allows for continuous improvement of deployment strategies and ensures that the organization can effectively deploy coordination and control systems within the disaster area.

B. FUTURE STUDY

The strategies developed in this thesis as based on the organizational design model. The descriptions of organizational design components are limited to the theories and methods used by the authors that were chosen to support this work. To be able to make these strategies work further research is required to describe in detail the functionality of three components. The first is a process improvement. A handbook is needed to describe in detail how processes are improved. The second is Information Systems. The minimum technical required for the Information System needs to be described. The third is incentives. An incentive program is necessary to encourage team members to practice the described strategies and to put theory into motion.

(1) Process Improvement Handbook

This thesis provides general descriptions of the strategic meetings that are held to select processes that need to be improved and a structural view of what the process improvement team would look like. It also suggests that the final outcome of the process improvement strategy is a step-by-step standard operating procedure (SOP) that describes how processes are to be completed.

Future research is needed to develop a process improvement handbook that can provide the HFN team with step-by-step instructions and analytical tools needed to systematically create and evaluate standardized SOPs. The handbook needs to address the development of the process improvement team, the prioritization of processes to be improved, and what tools are needed to support the process improvement team.

(2) Information Systems

In Chapter IV we looked at the organizational design model and analyzed how tacit in nature the data associated with process improvement is, and the volume of data that a process improvement information system is required to support. Our results are that the data associated with process improvement is tacit in nature and does not require large amounts of data processing. We determined that out of the four information system types described by Burton, DeSanctism, and Obel (2006), the *people-driven* information system best fits the needs of our process improvement strategies. The people-driven design works well for organizations where people communicate and share information face-to-face and information is written down and shared.

Future research is needed to determine the minimum technical requirements for an information system that can support our process improvement strategy, both at home camp and during deployment. This system must be functional and accessible during all phases of the deployment and at home camp. It must be integrated into the HFN team's coordination and control system. It must have a user-friendly interface and associated database that can be used to enter, tag and retrieve data.

(3) Incentives

In Chapter IV, we argued that it is critical to the success of the proposed process improvement strategies that management gain organizational support from team members. We addressed this by developing inclusive team structures that leverage members from each organizational tier, creating an inclusive environment.

Future research is needed to determine what types of incentives are needed to encourage team members to follow process improvement recommendations. Clear incentives encourage team members to make increased efforts. Incentives must be able to improve moral, encouraging team members to follow instruction, while also including methods of discipline.

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