A Case Study of the Socialization Processes of the NASA Spacewalkers in the High Reliability Organizational Culture of the Extravehicular Activity (EVA) Teams

by Estella Hernández Gillette

B.A. in Business Administration, August 1986, University of Houston, Clear Lake
M.A. in Human Resource Management, May 1994,
University of Houston, Clear Lake

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Neal Chalofsky
Associate Professor of Human and Organizational Learning

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Dissertation Research Committee:

Neal Chalofsky, Associate Professor of Human and Organizational Learning, Dissertation Chair

Michael Marquardt, Professor of Human and Organizational Learning and International Affairs, Committee Member

Mary Volz-Peacock, Program Manager, Open Government, U. S. Office of Personnel Management, Committee Member

Dedication

This cause of exploration and discovery is not an option
we choose; it is a desire written in the human heart…
We find the best among us, send them forth into
unmapped darkness, and pray they will return.
They go in peace for all mankind,
and all mankind is in their debt.

– President George W. Bush, February 4, 2003
Memorial for the STS 107 Crew
NASA Johnson Space Center

I dedicate this dissertation to the men and women of NASA Johnson Space Center for their contributions to the cause of human space flight.

I also dedicate this dissertation to my mother Gerónima Palos Hernández (1912-2008) who instilled in me the quest for learning, perseverance, and keeping my faith in God. *Gracias*, Mama.

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Abstract of Dissertation

A Case Study of the Socialization Processes of the NASA Spacewalkers
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The qualitative case study of the Spacewalkers, members of the NASA Extravehicular Activity (EVA) teams, provided an understanding of their socialization processes in the high reliability organizational culture of the EVA teams. The 20 NASA astronauts/Spacewalkers who participated in the study shared their perspectives of their excruciating, challenging, yet satisfying experiences as they had become members of the Astronaut Corps and eventually of the EVA teams that prepared them for the spacewalk outside the Space Shuttle or the International Space Station, 250 miles from Earth, going 17,500 miles per hour.

The findings of the study described the EVA teams as inherently safe, demonstrating the characteristics of high reliability organizations (HROs) that are consistent with the literature on high reliability organizations. The findings also demonstrated the participants experienced newcomer socialization through many levels of training, beginning with Astronaut Candidate (ASCAN) to Spacewalkers. Their socialization occurred through formal processes, i.e., training, and informal processes, and through informal processes, including their relationships with trainers and mentors who taught them the norms and values, their own past experiences, and self-efficacy, as they adapted at each level to the organizational culture.

The researcher recommended four implications for research from the study: (a) a multi-level study of the members of the teams that comprise the EVA teams and how they are prepared as trainers; (b) a qualitative case study of the socialization experiences

of the operators of off-shore oil rig teams; (c) a follow-up study of the EVA teams to compare the findings from this study to future EVA teams; and, (d) research best practices of socialization processes in high reliability organizations to develop better training employees in HROs, focusing on building collaborative teams versus just team building. She also recommended three implications for practice for the socialization of newcomers into the high reliability organizational culture of the EVA teams: (a) the need to continue assessing formal socialization processes, also known as training, and their effectiveness in socializing newcomers; (b) the need for better identification and informal processes important to the socialization of newcomers in high reliability organizational cultures; and, (c) the need to pay close attention to what the participants have said in this study and their concerns for the future.

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Chapter 1: Introduction

Overview

When an accident occurs, it is a natural occurrence for attention to be drawn to that accident. Reactions and ramifications will differ depending on the widespread effects of the accident. Jennings (2010) refers to the lessons learned and the take-always belonging to the oil industry, engineers, and environmentalists in her article about the explosion at the BP Deepwater Horizon well and the "resulting months of oil spewing into the water and onto the shores of the Gulf" (p. 38). Wynne (1988) states that when an accident occurs, the public takes a curious "flip" on how it sees the experts in charge. Before the accident, the public had generally, if anyone was interested, believed that those responsible for the organization know what they are doing, "that everything is under control, that design and operating procedures have been rigorously checked, and maintained by careful inspection. In other words, everyone and everything are following carefully defined rules of mechanical, electronic and human performance, in which uncertainties are peripheral" (p. 147). The public trusts that the technical system is safely operating in the hands of those who know what's going on. The doubt emerges and the public questions why these experts would believe there was zero risk, yet how can the public be so naïve as to believe that "technical knowledge does not harbour areas of uncertainty, even legitimate ignorance? We cannot be blamed for the inevitable uncertainties that exist in developing expert knowledge and technological systems" (p. 147). When tragedy does occur, the loss is costly to everyone and unfavorable attention is drawn to that accident. Such was the case when the National Aeronautics and Space

Administration (NASA) experienced the very visible loss of a crew of seven astronauts and a Space Shuttle vehicle.

As a result of the accident, in 2003 the Columbia Accident Investigation Board (CAIB) conducted the investigation of the STS-107 Shuttle Columbia accident, when NASA) lost the crew of STS-107 and the Shuttle Columbia on February 1, 2003, upon return for landing. NASA was left with many challenges as a result of the findings and the CAIB Report. The CAIB (CAIB, 2003) "urged that NASA's Human Space Flight Program adopt the characteristics observed in high-reliability organizations" (p. 8). The CAIB strongly criticized NASA and its organizational culture and determined that NASA had as much to do with the accident as the foam on the Shuttle Columbia that disintegrated. The report was devastating to the NASA community in that it added insult to injury from the pain of the loss of members of the NASA family because everyone felt the "blame."

The CAIB concluded NASA needed to make organizational changes and further identified "the system of practices and patterns that have been validated simply because they have been around so long" (p. 208). The CAIB was also specifically critical of NASA's safety culture. Its findings were that NASA's safety culture had become "reactive, complacent, and dominated by unjustified optimism" (p. 180). The CAIB recommended, "Organizations that successfully deal with high-risk technologies create and sustain a disciplined safety system capable of identifying, analyzing, and controlling hazards throughout a technology's life cycle" (p. 180). It appeared to the researcher that the CAIB had generalized all of NASA in its critique, applying its findings to all levels of

the NASA organization. Did the same factors identified by the CAIB (p. 208) exist at the lower levels of the NASA organization?

NASA is a federal agency with 10 branches across the United States (U.S.). Approximately 18,000 federal employees work directly for NASA, along with thousands of contractors, working on missions that send spacecraft into space with payloads ranging from humans to exploratory technology and equipment. There are countless organizations within NASA that perform highly technical work and have not had the misfortune of something as catastrophic as the loss of human life and property. From the findings of the CAIB, the researcher became interested in the study of socialization in a high reliability organizational culture, asking herself, since the success of NASA's human space flight program cannot be overlooked, what have different NASA organizations done to integrate employees into their high reliability organizational cultures?

The researcher specifically thought of a team of people who have performed for 50+ years of human space flight with no fatalities or serious accidents in an extremely dangerous phase of human space flight. These are NASA's Spacewalkers. They are trained for the spacewalk at NASA Johnson Space Center in Houston, Texas, where they are members of the EVA teams that prepare them for the spacewalk that takes place with the darkness of the universe as their stage, orbiting 250 miles above the Earth, at a speed of 17,500 miles per hour. Something happens in the EVA teams' organizational culture that provides commitment to the task. What is so special about the EVA teams that makes Spacewalkers perform with what appears such ease to those outside of the immediate area?

Background of the EVA Teams

The concept of humans performing outside of the space vehicle became reality in March 1965 when Russian Cosmonaut Alexei Leonov performed the world's first EVA. The U.S. would follow in June 1965, during the flight of Gemini 4, when Edward White II performed the first EVA by an American. According to Launius (Portree & Treviño, 1997), Chief Historian, NASA:

> One of the most significant activities conducted in space takes place when human beings depart their spacecraft and travel about and perform work in a spacesuit. Extravehicular activities require some of the most complex technical skills, sophisticated technologies, and human capabilities of all missions undertaken in space. Since that time hundreds of hours have been amassed by humans conducting EVAs in both Earth orbit and on the lunar surface…EVAs have not only accomplished significant work in space, work impossible through any other means, but also yielded enormous knowledge, skills, and experience among the astronauts…about how to perform meaningful work beyond the confines of Earth's atmosphere (p iii).

With the establishment of the EVA program, EVA missions were performed in anticipation of the then near-future missions to the Moon, where astronauts would walk and work on its surface. The EVA missions were technical practice opportunities for hardware and experiences that had never before occurred, as well as practice opportunities for the human ability to separate from Earth to determine how well they could live and work in environments away from the planet. Humans performed spacewalks outside of the spacecraft, first in Earth orbit during the Gemini program, then

walked on the Moon during the Apollo program, then again in Earth orbit during the Shuttle and ISS programs.

After the Apollo program moonwalks, spacewalks were not necessary again until the Shuttle program era. Astronauts were again trained as Spacewalkers and prepared to assemble and repair payloads that were carried in the Space Shuttle, including satellites for defense and commercial purposes, and the Hubble Space Telescope, all for the "benefit of mankind." This group of Spacewalkers understood the requirements of the program and came together to revitalize the EVA program. They were joined by representatives from primary organizations that provided resources in the form of equipment and people who worked to respond to the EVA requirements for the Shuttle program. As the EVA requirements were identified, the group of Spacewalkers made the decisions of who else among the astronauts would qualify for the Spacewalker role. The group of Spacewalkers was comprised of all men, big, strong, and with mechanical abilities. Others would refer to them as the *EVA Mafia* because they seemed to be an exclusive club that allowed only others like them into membership. New astronauts, initially called Astronaut Candidates (ASCANs), would remain in training for at least a year. A component of the ASCAN training was in the water training, where they would undergo the basics of Spacewalker training. The members of the EVA Mafia were part of the assessment process that would determine who would quality for Spacewalker training to become a Spacewalker. Many of the ASCANs received an assessment that did not qualify them to proceed to Spacewalker training, which disappointed many of them, especially since they were not sure how badly they had missed the "passing" grade and

there were no further opportunities for changing their status. But those selected did expand the group by a few, including a few women.

Eventually, with changing program requirements, attrition, and the changing demographics of the Astronaut Corps, including women and minorities and more people who wanted to be Spacewalkers, members of the EVA Mafia acknowledged that it was necessary increase the number of Spacewalkers. They knew a handful of Spacewalkers could not effectively handle the estimated 100 spacewalks required to assemble the future International Space Station (ISS) in space. Spacewalkers, engineers, and management went to work to change the program to enable meeting organizational goals. After careful assessment of the "gaps" that kept so many from qualifying for Spacewalker training, a new level of training was implemented, the EVA Skills training, which allowed additional opportunities for practice and reassessment to the astronauts who had not initially qualified for assignment to the challenging Spacewalker training.

With the ongoing assessment of the skills and gaps of the increased number of astronauts who qualified for Spacewalker training, new data emerged that also provided new ideas and techniques for accommodating those astronauts who did not fit as readily in the spacesuits and/or who struggled with the cumbersome tools required for training and practicing in the NBL. By increasing the diversity of astronauts, the program made significant changes that allowed more astronauts to become eligible for Spacewalker training, eventual assignment to a space flight and an EVA team assignment, then eventually the spacewalk. Each time a flight crew was named and the flight included an EVA task, an EVA team was formed specifically for that flight and that EVA task. The future Spacewalker became a member of the specific EVA team. The EVA team would

generally include at least one or two other Spacewalkers, including a veteran Spacewalker, as well as representatives from the other organizations that were responsible for EVA training. These included not only the Astronaut Office, but also the Mission Operations Directorate and the EVA Project Office, and other supporting organizations, such as the Engineering Directorate and Safety and Mission Assurance Office. Programmatic changes in the overall human space flight program have again caused changes to the EVA program. Since 2011 anyone selected to become an astronaut will also become a Spacewalker.

Statement of the Problem

The researcher identified the problem that occurs when employees become members of an organization since they do not always know what is expected of them and sometimes are not "naturally fit" for the new role, much less know what's in the organizational culture and the expectations of others in the organization to allow them to early on make better contributions to the mission. Sometimes the employee may even misinterpret cultural signals because he/she didn't ask and no one thought to point them out. But if the individuals on a team know the expectations, they can all contribute to mission success.

An example of a well-prepared team of employees occurred during Shuttle flight STS-120 when there was demonstrated knowledge of the organizational culture of the EVA team as two Spacewalkers repaired the unexpectedly damaged solar array on the International Space Station (ISS). During this unexpected situation, the ground crew knew what to do—they cautioned the Spacewalkers not to touch the dangerous sharp edges around the array, including from bolts and solar cells while the Spacewalkers

performed the repairs (Schwartz, 2007). This mission was a NASA "first" because the task took a Spacewalker farther from the safety of the ISS airlock than during any other ISS mission, making the situation more dangerous because the levels in his oxygen tank may not have been sufficient to get him back into the ISS. Decisions made by members of the EVA team were critical, but the team worked smoothly together, while the Spacewalkers, including a rookie Spacewalker, restored the structural integrity of the solar wing so that it could continue to provide power to the orbital outpost. To the world, they were just doing their jobs but the team knew that the success was due to many hours of working together, including to be ready, just in case this happened.

Purpose of the Study

The purpose of this case study was to understand the Spacewalkers' experiences in socialization processes of the high reliability organizational culture of the EVA teams at NASA Johnson Space Center. This study conducted was about the Spacewalkers, members of the EVA teams, and their perceptions of their socialization experiences that prepared them for safe and successful performance of their tasks, in spite of an extremely hazardous environment in which they trained and worked.

Research Questions

The primary research question was: What are the socialization processes of the NASA Spacewalkers in the high reliability organizational culture of the Extravehicular Activity (EVA) teams at the NASA Johnson Space Center? The following two sub-questions provided the researcher with discussion opportunity.

(1) What are the formal socialization elements?

(2) What are the informal socialization elements?

Significance of the Study

The CAIB's (2003) findings greatly focused on NASA and the "importance of strong organizational culture and commitment to building successful safety strategies" (p.180). Since it is the operator, in this case the Spacewalker, who must ultimately demonstrate his/her understanding of those relevant factors handed down to him/her for performing the EVA task, the study provided an understanding of how well the Spacewalker perceived the organization prepared him/her for the task and to meet organizational goals. This researcher's study is important to the literature of several theories, including organizational behavior, socialization, safety culture, organizational culture, and high reliability because the human can best interpret for others those areas that technology cannot yet express in socio-technical relationships.

The results from this study can contribute to future training and socialization planning in high reliability organizational cultures, not only in NASA, in the preparation of employees who perform in dangerous environments. These include firefighters, pilots, and rescue workers in which unexpected situations and the performance of the operator can make the difference to the success of the mission. A better understanding of socialization from the operator's perspective and how it prepares him/her to influence the organizational culture can help to (a) redefine socialization in environments that require more attention to the integration of the employee because there are lives and other resources at stake, and (b) to reevaluate socialization from the employee's perspective and role to accelerate an understanding of the organizational culture of his/her organization. Understanding of socialization processes, both formal and informal, can

result in mutual contributions to the organization and employee in that both can maximize their respective goals for growth and can succeed together.

Conceptual Framework

The conceptual framework for this research comprises two bodies of knowledge, Spacewalker socialization and high reliability organizational culture of the NASA EVA teams. The focus of the study was at the intersection of these two constructs (as shown below), to understand how the Spacewalkers were socialized into the high reliability organizational culture of the EVA teams.

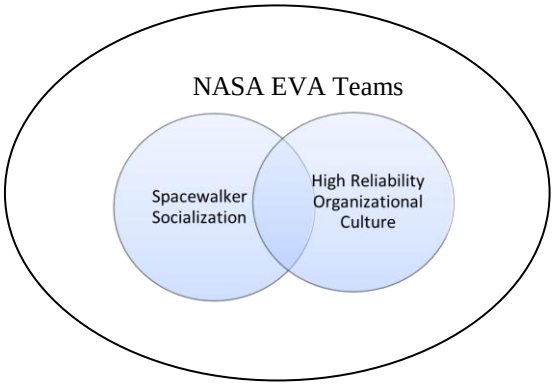

Figure 1: Conceptual Framework of the Study

The analysis of the data was conducted primarily from a sociological view with references to psychology, and organizational studies. Early studies conducted by Merton (1940) were foundational for future studies about training and behavior. The researcher found references by Merton, including Veblen's concept of "trained incapacity," Dewey's notion of "occupational psychosis," and Warnotte's view of "professional deformation." These were important concepts for studying human behavior as humans were acclimated to the formality of training and its effects on individuals, including creating blind spots that could affect performance. Also important in Merton's studies

were the discussion on individual reliability and its dependence on how an individual feels about his/her job, authority and competence, and the impact to the performance of routine assignments. Merton did acknowledge that the social structure in the organization ultimately could infuse group participants with the right types of attitudes and sentiments. Although Merton's study was not specifically about socialization and organizational culture, the findings from his work, as well as the work of other early theorists, demonstrated the evolution of the strengthening relationship between the organization and its workforce.

Other early studies that informed the two constructs were Weber's (1947) study of bureaucracies and their chief merit of technical efficiency, placing great significance on precision, speed, and optimal returns on the input. Weber did not place great emphasis on personalized relationships, although earlier studies, including Adler (1933a) who discussed social embeddedness and the necessity to belong that humans placed in their occupations, where they earned their livelihood. Adler pointed out the importance of cooperation, including between employee and organization.

Schutz (1966) (as cited in Wagner, 1970), referred to an individual's system of knowledge as being gained by the individual's self-interpretation of the cultural community into which he/she enters as a newcomer. Sometimes that knowledge is confused by lack of clarity for the newcomer. Those in the system have already accepted the standards that others, i.e., "ancestors, teachers, and authorities," have already put in place and guide all situations that occur in that social world. For the newcomer, the self-interpretation can make the experience less than satisfactory as he/she tries to fit into the new organization. And, according to Levinson (1965), individuals begin to rely on that

organization and begin to build a relationship of reciprocation—the individual expects as much from the organization as the organization expects from the individual. Barnard (1968) suggested that an organization cannot be an organization without its people, that the willingness of the individuals to contribute to the organization is what keeps the organization alive. Katz and Kahn (1966) discussed the need for maintenance of individuals in an organization. Individual members will decide to leave the organizational "system" if they do not receive proper attention and maintenance from the organization. They will depart physically or from acceptable behavior.

Individual expectations must be met, far greater than by just rewards. Socialization plays a big part as individuals are prepared for bigger roles in the organization. Other organizational studies that informed the two constructs included Schein (1968), Van Maanen and Schein (1979), Jones (1986), Pidgeon (1991), and Weick and Sutcliffe (2001), and several others to whom the researcher referenced in conducting her study. Schein's (1968) definition of socialization referred to socialization techniques that are not always in control of the organization, but rather more in the newcomer's control, such as the initial motivation of the newcomer and the degree to which the organization can hold the newcomer's interest. The focus on the newcomer's control and interest were of interest to the researcher because of her interest in high reliability organizational culture, where the roles of the individuals become more significant.

Van Maanen and Schein (1979) added how individuals use perspectives for interpreting their experiences "in a given sphere of the world" (p. 4); and, Van Maanen discussed the perspective of the "actor on stage," where more attention should be paid to those who are behind the scenes and who impact the actor's performance. The

cooperative nature among the people involved becomes a forum for socialization and a key factor to the organizational culture as the newcomer checks to see how to best fit. Jones (1986) suggested collective tactics would result in newcomers' accepting the status quo and whatever else came with the tasks or roles. This contributed to the two constructs in that the research would include both collective and individual perspectives, since the participants would share common experiences in gaining access to the organizational culture.

In discussing organizational culture, Van Maanen and Schein (1979) discussed how organizational cultures arise so that an organization can cope and make sense of its environment. Since safety culture was an element in the high reliability organizational culture, Pidgeon's (1991) description of safety culture specifically informed the constructs of organizational culture and socialization. Safety culture is "created and recreated as members of it repeatedly behave in ways that seem to them to be the natural, obvious, and unquestionable ways of acting, and as such will serve to construct a particular version of risk" (p. 134). In seeking to understand high reliability organizational culture, the researcher also referred to several other authors, including Weick (1987), who discussed the role of the operator and how with the complexity of the system to be operated comes the concern with the level of complexity the operator has or doesn't have. Since the study was about the operator (the Spacewalker) and his/her socialization into the high reliability organizational culture, understanding the role of the operator was important to the researcher. Several studies, including Weick and Sutcliffe (2001), defined high reliability organizations in terms of their characteristics, including their ability to manage the unexpected. Understanding high reliability organizational

culture from the findings from other studies was a contributing factor to this researcher's own study.

Methodology

The study employed a qualitative single case research design to explore the socialization processes of the NASA Spacewalkers into the high reliability organizational culture of the EVA teams. The study examined the socialization processes from the perspective of the Spacewalkers and their experiences in the Astronaut Corps and how the formal and informal socialization processes prepared them for their respective EVA team assignments. Creswell (1998) defined a case study as "an exploration of a 'bounded system' or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context" (p. 61).

Identifying Whom to Invite to Participate in the Study

The case study was the appropriate research design because the study examined the processes of socialization of the Spacewalkers into the high reliability organizational culture of the EVA teams. According to Patton (2002), the number of participants should be determined depending on what the researcher wants to be able to say at the end of the study. The researcher wanted to be able to understand what the perspectives of the Spacewalkers as they were socialized into the organizational culture, as well as for the reader to understand. The participants in this study were representative of several different EVA teams over the 30-year period of the NASA Shuttle Program and the International Space Station Program (ISS) between 1981-2011. The study was retrospective because it included participants who had arrived early in the 30-year period and others more recently. Because the Spacewalker roster included Spacewalkers who

had been astronauts within the 30-year span, the researcher identified a high number of Spacewalkers to invite, but fewer than she had anticipated. The researcher wanted to ensure the participants were diverse in backgrounds and would represent the perspectives of the present-day Astronaut Corps.

In order to determine whom to invite to participate in the study, the researcher reviewed NASA documentation, including the Astronaut Fact Book (2005), the Astronaut Selection and Training (2007) publication, Astronaut Candidate Training Program Class of 2009 (2009), and Walking Olympus: An EVA Chronology (1997). She reviewed website information for the Astronaut Biographies (2011) at http://www.jsc.nasa.gov/Bios/index.html. As she began to prepare for her study, several things happened that would change the number of Spacewalkers in the NASA work force, beginning with attrition by astronauts who had decided it was time to go, since opportunities for spacewalks were becoming fewer and fewer. Programmatic changes caused by the completion of the Space Shuttle Program, the completion of the construction of the International Space Station (ISS), and changes in the Spacewalker (EVA) program in general, caused a decrease in the number of Spacewalkers who remained in NASA. The documentation provided information from which to identify the list of Spacewalkers to invite.

The Astronaut Fact Book (2005) provided initial information about the status of all of the astronauts, including which astronauts were still in the NASA work force and who remained active astronauts or had been reassigned to management astronauts, an important distinction because management astronauts are no longer considered eligible for space flight. The researcher determined that she would include only astronauts who

were still in the NASA work force and who had performed at least one Spacewalk, to obtain perspectives that would include the EVA team training and the experience in outer space. The researcher reviewed the Astronaut Selection and Training document for a description of the training the Astronaut Candidates (ASCANs) had undergone to introduce them to the Spacewalker training environment, which is where ASCANs are evaluated for skills that are preferable for Spacewalker training. She reviewed the Astronaut Candidate Training Program (2009) to review a recent plan for training for ASCANs and to understand the sequence of the ASCAN training, including at which point the ASCANS were introduced to the Spacewalker segment of the training.

The EVA Chronology (1997) provided the researcher with an understanding of the history of EVA, not only for the U.S., but also for Russia, since she knew many of the Spacewalkers would have had an experience with Russian spacewalks or at least trained with the Russians at some point. She found this documentation extremely valuable from a historical perspective of the EVA program. Unfortunately, the EVA Chronology had not been updated since its publication in 1997 but contained enough history to provide the researcher with information from which to understand terminology and references about the EVA program when she began her interviews.

After reviewing the documentation about the status of the current work force in the Astronaut Corps, the researcher identified 37 Spacewalkers she could invite to participate in the study. In Chapter 3, the researcher has included more details about the 37 astronauts who were invited, the 21 who accepted the invitation, and the 20 who actually participated.

Limitations of the Study

The first limitation was the researcher's concern that the interview data could be affected by the feelings and opinions of the participants because of the uncertainty in NASA's lack of a well-defined program for future space exploration and the effect on employee roles in the program. Patton (2002) described the limitations of qualitative studies, including for interview data and the possible distortions that can affect the study because of the participants' personal bias, anger, anxiety, politics, and simply the emotional state of the participant at the time of the study. As it turned out, the researcher collected extensive interview data for this case study. The participants were very candid and described their experiences without too much frustration about the current state of affairs in the space program. The data enabled her to understand the perspectives of the 20 participants as they experienced the changes in the program. By opting to interview all 20 participants, the researcher gained additional diversity among the group, important for different age and gender perspectives. Fewer participants may have eliminated duplication in the data, but the data also served to confirm the existence of consistency across the data, including data derived from documentation, reports, and observations.

A second limitation was the potential for inaccurate information from the documentation the researcher had review in preparation for the study. Yin (2003) cautioned about the use of documentation for data collection because the documentation is not always accurate and can sometimes be biased, therefore, should not be accepted as "literal recording of events that have taken place" (p. 87). According to Yin, corroboration of the data is necessary from other sources, including those who have contributed to the writing of the documentation. Although initially a concern, the researcher found that accurate corroboration of the interview data was not a limitation for

the study because the most current documentation was readily available from NASA, including from the website and other internal sources.

A third limitation considered by the researcher was her becoming too involved in the participants' interviews because of her 40+ years of NASA experience. She listened carefully and did not get lost in the historical perspective of their experiences or their opinions of the current programmatic issues. She was clear on the experiences because she knew the people involved and even some of the "inside" stories associated with some of the experiences. To provide the reader with some of that background, the following is the list of definitions of key terms that support the constructs of the study.

Definition of Key Terms

The following are terms that are relevant to the constructs for this study. Other terms are defined within the study so that the reader can understand them within theterm's immediate context in the report.

High reliability organization (HRO)—enact a distinctive though not unique set of cognitive processes directed at proxies for failure, tendencies to simplify, sensitivity to operations, capability for resilience, and temptations to over structure the system (Weick, Sutcliffe, and Obstfeld, 1999). These are organizations in which the concern for life and death are is always present because of the hazardous conditions of the environment in which the tasks are performed.

High reliability theory (HRT)—Weick, 1987; Roberts, 1990; Rochlin, 1993; Schulman, 1993a, 1993b; La Porte, 1994 (as cited in Weick, Sutcliffe, and Obstfeld,1999) discussed Normal Accident Theory (NAT) and HRT, defining HRT as also considering high-risk technologies but focusing on a subset or high-risk

organizations (HROs) that take a variety of extraordinary steps in pursuit of error-free performance. Some of the necessary but not sufficient conditions that HRT emphasizes are a strategic prioritization of safety, careful attention to design and procedures, a limited degree of trial-and-error learning, redundancy, decentralized decision-making, continuous training often through simulation, and strong cultures that create a broad vigilance for and responsiveness to potential accidents (as cited in La Porte and Consolini, 1991; La Porte, 1994).

Newcomers—(Van Maanen & Schein, 1979) new individuals assigned to a new organization or position and

> …must first be tested either informally or formally as to their abilities, motives, and values before being granted inclusionary rights which then permit them:
>
> (1) To share organizational secrets,
>
> (2) To separate the presentational rhethoric used on outsiders to speak of what goes on in the setting from the operational rhetoric used by insiders to communicate with one another as to the matters-at-hand, and/or
>
> (3) To understand the unofficial yet recognized norms associated with the actual work going on and the moral conduct expected of people in the particular organizational segment (p. 21).

Normal Accident Theory (NAT)—Charles Perrow (1999) initiated theory that no matter how hard an organization tries, it will still have accidents because of intrinsic characteristics of complex/coupled systems. "It follows that if the systems have catastrophic potential they should be abandoned, drastically scaled back, or drastically redesigned" (p. 369).

Organizational culture--Van Maanen and Schein (1979) discussed that organizational culture arises in organizations as a way that organizations can cope with and make sense of a given problematic environment. The organizational culture consists of long standing rules of thumb, its own special language and special language that becomes part of the individual's every day experience, including standards that are relevant to accomplishing the critical work of the organization, "matter-of-fact prejudices," do's and don't of social etiquette and behavior for that organization, certain customs and rituals that tell the employees how they should relate to their superiors, their peers, their subordinates, and even with external entities.

Safety culture—Pidgeon (1991) identifies safety culture as the constructed system of meanings through which a given people or group understand the hazards of the world. Such a constructed meaning system specifies what is important and legitimate to them, and explains their relationship to matters of life and death, work and danger. A culture is created and recreated as members of it repeatedly behave in ways that seem to them to be the natural, obvious, and unquestionable ways of acting, and as such will serve to construct a particular version of risk, danger, and safety (p. 132).

Socialization—Schein (1968) described organizational socialization as "the process of 'learning the ropes,' the process of being indoctrinated and trained, the process of being taught what is important in an organization or some subunit thereof" (p. 2). "It entails the learning of a cultural perspective that can be brought to bear on both compliance and unusual matters going on in the work place. To come to know an organizational situation and act within it implies that a person has developed some common sensical beliefs, principles, and understandings, or in shorthand notation, a

perspective for interpreting one's experiences in a given sphere of the world" (p. 4) (Van Maanen & Schein, 1979).

Summary of Chapter and Overview of Dissertation

In the first chapter, the researcher has provided an overview, statement of the problem, purpose of the study, research questions, significance of the study, conceptual framework, methodology, limitations of the study, and definition of key terms. Chapter 2 will discuss the literature review conducted by the researcher related to the two constructs in the study—socialization and organizational culture—from a perspective of high reliability organizations. In Chapter 3, the researcher discusses the methodology of the study. In Chapter 4 she presents to the readers the findings of the study. In Chapter 5, the final chapter in this dissertation, the researcher discusses conclusions and theoretical implications, the summary of the conclusions, implications for practice, recommendations for future research, and concluding remarks.

Chapter 2: Literature Review

Overview

The purpose of the literature review was to seek the literature to inform the study on the constructs of socialization and organizational culture, in this study, high reliability organizational culture. In addition to the major sections on socialization and organizational culture, the literature review was also conducted to create a background of the theories of organization and process from which the concepts transitioned from a focus of firm to individual. Understanding how the organization became more inclusive of its human resources informed both constructs, since the operator's role in meeting the organization's objectives is increasingly important in the study of high reliability organization culture. Sources for the literature review were primarily through the GWU Gelman Library, which provided on-line access to JSTOR, ABI/Inform, ProQuest, and Research Library Core. Other sources included publications written by authors who have published their studies as books.

Socialization

The literature review indicated the socialization process of an organization is hard to identify. Socialization of newcomers into any organizational culture, regardless of how long an employee has been in the organization, is often briefly considered but more often ignored. Sometimes the orientation, if there is one, is confused as *the* socialization process.

Newcomer status can occur many times for an individual, even within the same organization. Each time an individual joins a new organization, the process of

socialization begins again, although perhaps not to the same depth each time. Van Maanen and Schein (1979) define socialization as:

> At heart, organizational socialization is a jejune phrase used by social scientists to refer to the process by which one is taught and learns "the ropes of a particular organizational role. In its most general sense, organizational socialization is then the process by which an individual acquires the social knowledge and skills necessary to assume an organizational role (p. 3).

Socialization has been viewed from a scientific approach as well as from a personality perspective. From the personality perspective, the fields of psychology and psychiatry and sociology overlapped from their starting points in regard to the socialization of individuals. Sociologists had studied the societal aggregate and had stressed the interpersonal rather than individual aspects. But overlapping occurred in the work of social psychologists because they brought together much of the work of both sociologists and psychologists. If employees spend as much as one-third of their lives at work (March & Simon, 1993), it is relevant to continue to study the influence organizations have on their work force and the influence that the work force has on the organization in order to mutually succeed in the performance of organizational objectives. As the studies of early theorists revealed the influence of the workforce on the organization and vice versa, many concepts developed as those theorists tried to understand the relationships between organizations, the human resources, and the resulting outcome of interpersonal relationships as the focus on individuals evolved. The concept of socialization evolved as organizational dynamics forced those relationships into being.

When the newcomer arrives into a new community, he/she has to rely upon that community to gain the specific knowledge required to successfully function within it. Wentworth's (1980) history of socialization "shows that it has always addressed the problem of individual adjustment to society…both the activity of socialization and its results are fused in a unitary reality; the novice's fitness results naturally and inevitably from members' training activity" (p. 39). During the early part of the 20th century, the new industrial order in this country required a definition of socialization that emphasized "training of adults to establish collective unity" (p. 40). By mid-century, the industrial system was well in place and attention "shifted to maintaining individual conformity to a now well integrated society" (p. 40). The path to understanding individual adjustment to society has been researched for a long time.

Early Theorists Preceding the Concept of Socialization

Merton's (1940) findings about training and behavior were foundational for future studies. His studies defined the organization as strictly a business entity, with little credit to the people involved in performing the functions for which the business was established. Merton considered the organization as a "formal, rationally organized social structure" with clearly defined patterns of activity around which all actions contribute and are 'functionally related to the purposes of the 0rganization'" (p. 560). Relations between the different offices of the organization were formal, with well-defined boundaries for the distance between those in the different positions. "Formality is manifested by means of a more or less complicated social ritual which symbolizes and supports the 'pecking order' of the various offices" (p. 560). The relationship that was acknowledged was among the components of the organization and not necessarily among

its employees. Merton's studies referred to the transition studies of the negative aspects of bureaucracy, including Veblen's concept of "trained incapacity," Dewey's notion of "occupational psychosis," and Warnotte's view of "professional deformation" (as cited in Merton, p. 251). These studies revealed:

(1) Regarding training: A concern for the employee as an individual with an early understanding of the effects of training that could become blind spots during certain situations. They acknowledged that inflexibility in individual skills could become counterproductive to the objectives of the task, that routines would lead people to develop certain attitudes of their work based on the demands of the roles of the individuals.

(2) Regarding behavior: The significance of individual behavior to high levels of reliability and how those levels of reliability were dependent on an individual's strong sentiments and devotion to his/her duties, attention to the level of authority and competence, and attention to the performance of routine activities. Merton acknowledged that "the efficacy of social structure depends ultimately upon infusing group participants with appropriate attitudes and sentiments" (p. 562). With the proper structure, an organization can influence individual attitudes and sentiments.

In spite of training and behavior, there is always the notion of unanticipated consequences, which is also addressed by Merton (1936). He states, "any system of action inevitably generates secondary consequences that run counter to its objectives. Unanticipated consequences of purposive social action can be differentiated into consequences to the actor(s) and consequences to the others that are mediated through

social structure, culture, and civilization" (p. 895). His reference can be interpreted for either individuals or organizations. Merton defined purpose as being "concerned with 'conduct' as distinct from 'behavior,' that is, with action which involves motives and consequently a choice between various alternatives" (p. 895). He also clarified that he was not inferring that purposive action "implies 'rationality' of human action (that persons always use the objectively most adequate means for the attainment of their end)" (p. 896). He differentiated action into two types: (a) unorganized and (b) formally organized and the potential for unanticipated consequences to follow both types of actions, stating that the formally organized action provides a better opportunity "for sociological analysis since the very process of formal organization ordinarily involves an explicit statement of purpose and procedure" (p. 896). In his discussion of unanticipated consequences, he also suggested the "most obvious limitation to a correct anticipation of consequences of action is provided by existing state of knowledge" (p. 898). Merton further suggested that "'chance consequences' are those which are occasioned by the interplay of forces and circumstances which are so complex and numerous that predictions of them is quite beyond our reach" (p. 900). He distinguished this area of consequences from that of "ignorance" because "it is not related to the knowledge actually in hand but to certain knowledge which can conceivably be obtained" (p. 900). He further commented that:

> Even when immediate action is not exacted, there is the economic problem of distributing our fundamental resources, time and energy. Time and energy are scarce means and economic behavior is concerned with the rational allocation of

these means among alternative wants, only one of which is the anticipation of consequences of action (p. 900).

Weber's (1947) study of bureaucracies addressed the ideal type of organization of that time, the bureaucracy, stating its chief merit is "its technical efficiency, with a premium placed on precision, speed, expert control, continuity, discretion, and optimal returns on input. The structure is one which approaches the complete elimination of personalized relationships and of nonrational considerations (hostility, anxiety, affectual involvements, etc.)" (p. 561). Weber's concept acknowledged relationships with individuals but only for the purpose of identifying there would be no personalized relationships.

Findings from other studies indicated that humans are very social and need and will find a social life, even in those organizations in which personalized relationships are not readily acknowledged. Adler (1933a) (as cited in Ansbacher & Ansbacher, 1956), in teaching and preaching about "the absolute truth" of social embeddedness and how we all need a well-developed social interest, pointed out that the main problems in life are based on human cooperation. These problems are based on the ties of an individual to social life. Adler classified them into three areas--occupation, society (social relations in general), and love (and marriage). His conclusion came about the time that he declared that individual psychology comes into contact with sociology and the "inseparable bond that of necessity links men together for association, for the provision of livelihood, and for the care of offspring" (p. 131). Adler believed that each of the three depended on a successful approach to the other two if either of the problems is to be solved.

The first—occupation--is necessary because the person who works in something useful is contributing to the advancement of human society. The second--society--is the means by which men become part of the human race and can associate with others like themselves. The third—love--is the membership man has in one of the two sexes and not of the other and how the continuance of mankind is based on the cooperation between the two. Adler pointed out the importance of cooperation here, too, including the division of labor brought about by occupation and the "good and friendly contact with other human beings" (p. 132), thus contributing to the preservation of life and to the advancement of life in the communities in which man finds himself. Adler's social embeddedness concept was relevant to the relationship that eventually evolves between employee and organization--occupation, society (social relations in general), and love (and marriage). The "marriage" between employee and organization also can advance life in the communities in which they exist.

The "marriage" between employees and organization continued to strengthen, as indicated by later studies, but to a depth that was becoming more involved because both the organization and its members began to seek satisfaction in the relationship. Katz's (1978) study contributed to this concept of relationship between organization and member in the study of the structure and functioning of organizations and the search for the best relationship between the organization and its members to both satisfy organizational productivity and members' satisfaction. He referred to sociology and social psychology as disciplines that overlap "in their interests in role systems, their origins, their changes, and the adaptation of people to such systems" (p. 786). Katz and Kahn (1966) referred to structural functionalists such as Parsons (1951, 1960), who

provided a wide framework for the study of social systems. They studied the organization from social frameworks that served "a broad social purpose rather than the self interests of a narrow group" (p. 268). There are enough common objectives among subgroupings that the focus also becomes one of maintaining social stability and equilibrium. Maintaining social stability and equilibrium are important for both the organization and its members.

Lack of maintenance has its consequences. Katz and Kahn (1966) compared social systems to biological systems and the lack of boundlessness that exists for social systems. Because organizations are such social systems and structures, not properly maintained, individual members of the social system can decide to leave it. Leaving can include not only the individual's actual physical departure from the social system, but also a departure from acceptable behavior. According to Worthy (1950), the Weberian (1947) model, Gulick's (1937) public administration theory, and Taylor's (1923) scientific management approach (as cited in Katz, 1978) were preoccupied with the maintenance of the production subsystem and not the maintenance subsystem, i.e., the human component of the system. Although rewards and recognition were already included in the production subsystem, proponents of the maintenance subsystem began to use rewards and returns as well, plus paid more attention to employee socialization into the system and to their recruitment for elite positions in the organization. Individuals had greater expectations from the organization.

Individuals' expectations included the need to belong, thus socialization. Parsons (1951) equated socialization with internalization, including both the process of socialization and the result of learning. "To be internalized in Parson's sense, values had

to be experienced by the individuals as their own, definitive of their true nature, not merely as external demands" (p. 40). In this scenario, internalization was taken for granted and assumed the "corrigibility of the newcomer and correctness of training by the group members" (p. 40). Individuals were willing to go along with the social discipline and members knew what to get across, making sure that the results were the desired ones. Brim and Wheeler's (1966) study and their notion of adult socialization was understood to build on primary socialization by "extending, elaborating, and specifying what the individual had already internalized" (p. 40). Organizations had to be able to provide employees with mechanisms that made it easier for employees to "re-interpret" their experiences in the new organization to something they already knew or eventually could understand. Individuals strive to understand, to be able to participate, some better than others.

When an employee first enters the new work place, in many cases, according to Schutz (1966) (as cited in Wagner, 1970), the system of knowledge is gained by self-interpretation of the cultural community, but what the newcomer observes can be incoherent, inconsistent, and unclear. Those who have been within the community already accept the standards of the community as they are handed down by "ancestors, teachers, and authorities as an unquestioned and unquestionable guide in all the situations which normally occur within the social world" (p. 81). As long as there is no evidence to the contrary, the knowledge is taken for granted because it is a trustworthy recipe for "interpreting the social world and for handling things and men in order to obtain the best results in every situation with a minimum of effort by avoiding undesirable consequences" (p. 81). Not everyone falls readily in line with what is already in the

organization; therefore, the self-interpretation can make the experience for the newcomer—and for the organization—less than satisfactory as the newcomer attempts to find his/her place in the new organization.

Levinson (1965) discussed the relationship between man and organization in which he works and the concept of reciprocation. According to Levinson, employees have many expectations from the organization. In his study he explained the psychological meaning of the organization to man and vice versa. It is interesting how deep that relationship can become, but so much is derived by the human from his/her relationship with the organization, growth, power, self-esteem, innovation, the need for inclusion. Schutz (1966) (as cited in Wagner, 1970) states, "…the social world into which man is born and within which he has to find his bearings is experienced by him as a tight knit web of social relationships, of systems of signs and symbols with their particular meaning structure, of institutionalized forms of social organization, of systems of status and prestige" (p. 80). The individual's interpretation of the organization becomes more critical depending on the objectives of the environment. Expectations, therefore, have value to the employee and psychology of the relationship with the organization can lead to feelings of achievement as well as feelings of disappointment. Those relationships are not just with the organization, the expectations are also based on employees' relationships with one another.

The relationships among the members of the organization resulted in Barnard's (1968) calling the organization a socialized entity, a "system of consciously coordinated activities or forces of two or more persons" (p. viii). He suggested that an organization cannot be an organization without persons, but that it is actually the services or acts or

actions or influences of persons which really constitute the organization (p. 82). It is the willingness of individuals to contribute to the organization that keeps the organization alive. He described the organization as being comprised of elements: (a) communications among the persons in the organization; (b) the persons' willingness to serve; and, (c) a common purpose. The organization benefits from the employees' expectation for reciprocation because employees want to belong to the organization and have a common purpose for being there.

The preceding literature review focused on the organization as it began to transition into valuing the significance of the individual to organizational objectives. The following is the literature review on the role of socialization and its importance to individuals as they strive to become members of the organization. The research also demonstrated the importance of employee socialization for the organization, as well.

Studies of Socialization

Socialization became an organizational process in which the newcomer could learn the system's values, norms, and behaviors of the group and organization he/she was entering. Schein (1968) refers to the learning of the organization's or group's point of view as necessary for the newcomer, as the "price of membership." According to Schein, organizational socialization evolved from a fairly clear meaning in sociology but was difficult to assimilate in behavioral sciences and management. The concept was often confused with the concept of socialism, so it was not popular at the time of his early studies. But, he did determine that the concept of socialization provided a good way to study the interaction between a stable social system and the newcomers into the system.

Schein (1968) discussed the need to involve the novice (newcomer) in the organization in learning those cultural manifestations in an organization, including values and norms. The amount of previous socialization plays a large role in how to socialize the newcomer. If the newcomer has already anticipated the norms of the new organization, then the socialization process becomes a reaffirmation of the norms, "through various communication channels, the personal example of key people in the organization, and direct instructions from supervisors, trainers, and informal coaches" (p. 3). But, what if the newcomer has behavior patterns and values that are not synchronized with the new organization? The situation can become destructive if attention is not paid to the level of socialization a newcomer may need. The newcomer has to be separated from his/her former values and redefine him/herself in terms of the new organization. Factors to redefine can be obvious, such as changing into a uniform or out of a uniform to match the new environment or detaching him/herself from a meaningful previous title or status. Sometimes the status can go away because the newcomer is now one of several being trained as "rookies" and will have to be challenged beginning with possibly being trained by those who were "less" in stature than he/she might have been. That can happen regardless of how simple or complex the organization may be.

Schein (1968) also spoke of successful socialization techniques that are not always under the control of the organization, but more under the control of the newcomer. These included: (a) the initial motivation of the newcomer; and, (b) the degree to which the organization can hold the newcomer's interest throughout the socialization period. If the newcomer has high motivation, he/she is likely to ensure uncomfortable socialization experiences and make personal sacrifices. As to the

newcomer's interest throughout the socialization, the organization can provide techniques to engage the employee, including training. Unfortunately, motivation and newcomers' levels of interest are not the only factors that are not under the control of the organization, therefore, ensuring newcomers are observed and evaluated is important not only for their success but also for interventions if the newcomer is not adapting well. Not intervening when there are weak signals (Vaughan, 1996) can lead to negative consequences for both the employee and the organization. Identifying other tactics for newcomer adjustment is key to intervention.

Jones (1986), in his study of socialization tactics, self-efficacy, and newcomers' adjustments to organizations, discussed two types of tactics used by organizations to provide information to newcomers, including (1) collective versus individual socialization tactics and (2) formal versus informal socialization tactics. Jones hypothesized collective tactics would produce divergent role orientations because the new recruits share common learning experiences and learn standard responses to situations. According to Van Maanen and Schein (1979) collective tactics will result in the newcomers' acceptance of the status quo and the requirements of tasks or roles (as cited in Jones, 1986). But individual tactics provide newcomers with opportunities for diverse responses and innovative approaches to performing their roles, possibly changing the methods for performance of their roles and missions. In the formal setting, newcomers are segregated from others in the organization as they learn their new roles, but informal tactics result in the newcomers working in groups to learn on the job. Jones adds that pairing with collective practices offers a better opportunity for the newcomer to learn what others already know is important in the organization. For the newcomer, it

accelerates sharing common norms, values, and attitudes. Informal and individual tactics will provide great latitude for the newcomer's own responses and innovation.

According to Cooper-Thomas (2004), the initial period of socialization is crucial and can change newcomers' fit perceptions as a result of three mechanisms: (a) newcomers who are confronted with the different values of others in their work environment have to reflect on their own values and determine whether to eventually adapt to those new values; (b) the newcomer's initial perception of the organizational values may change because of the experiences in the organization; and, (c) the organization's values can also change as a result of internal and external factors over time. The outcome of the measure of the socialization during the time the newcomer is observed may be enhanced if his/her perceptions are also measured, since others around the newcomer can make the difference to the outcome of the socialization.

While the newcomer is the focus of the attention of the socialization process provided by his/her organization, there are also people behind the scenes who are responsible for providing the newcomer with necessary learning experiences. In the Van Maanen (1975) study about police officers, he spoke of studies in which the actor is "on stage" and how little attention is paid to the performers who are behind the scenes and impact the actor's performance. Other individuals involved in the process have also had experiences with socialization into their environments and can help the "actor" through their knowledge. The knowledge is repetitively being transferred to the newcomers who eventually also become the "behind the scene" teachers of others because they choose to stay in the organization.

Louis's (1980) study expanded previous research conducted on socialization from the perspectives of recruitment turnover and socialization. According to Louis, the newcomer's involvement with insiders rather than just other newcomers expedites the informal socializing and the acquisition of information from "someone who knows and is willing and able to share with the newcomer a particular part of 'how things operate around here'" (p. 245). The socialization process becomes easier when the newcomer can relate what appears to be new knowledge to something he/she already knows. Depending on the relevance of the newcomer's experiences when he/she is selected into the new organization, the entry and his/her experiences can consist of "surprise, contrast, and change" (p. 226). Therefore, socialization practices that "facilitate sense making…encourage appreciation of the local culture and acquisition of a setting-specific interpretation scheme ultimately facilitate adaptation to the new setting and progress through the stages of socialization" (p. 245). Louis added that "in response" socialization practices make it easier for sense making and adaptation, "specific information is made available in response to newcomers' needs," (p. 245) versus "in advance" practices such as written orientation material which generally does not provide it. These are also organizational tactics that enhance both the organization's and the individual's achievement levels.

Anakwe and Greenhaus (1999) found that the primary outcome of the socialization process is enhanced achievement of both the individual and the organization. "The organization teaches the newcomer skills of the new job, and the norms and values or organizational culture that guide behavior and enhance the newcomer's performance" (p. 316). How well the newcomers acquire that information

and the organizational norms and values determines how effective the socialization processes in place are doing for achieving organizational goals. Ardts, Jansen, and Van der Velder (2001) added that important to the newcomer's understanding are variables such as:

> …structure, goals, history, traditions, rituals, myths, language and politics of the organisation; the group or work unit, such as, the personalities, interests, attitudes and behaviours, and the way to deal with colleagues, superiors and subordinates; the way in which the tasks and functions have to be fulfilled, the required knowledge and skills, priorities, the use of resources, and finally personal change relating to identity, self-image and motivation (p. 159).

Although some of these variables in the organizational culture are more important than others, even the smaller ones can get the newcomer in trouble if he/she does not know what the "right" way is to do things. Sometimes the employee can become disenchanted with the new position and the employee's expectations are challenged.

In their study about organizational success, Cooper-Thomas and Anderson (2005) investigated newcomer learning, job satisfaction and intent to quit as common indicators of socialization. They distinguished the different objectives for organizational socialization. According to Falcione and Wilson, 1988; Morrison, 1993b; Louis, 1980 (as cited in Cooper-Thomas & Anderson, 2005) learning as the central component of organizational socialization fits theories of Uncertain Reduction and Sense-Making. These theories support the finding that newcomer learning results in better outcomes and is at the heart of any organizational socialization model. The study resulted in the following findings: (a) because learning outcome from socialization is hard to measure,

socialization content and dimensionality of the socialization domain should be defined and include criteria to assist in judging success; (b) just focusing on learning does not take into account individual attitudes, assimilation and performance, key outcomes of successful organizational socialization; and, (c) just focusing on learning results in important relationships being ignored, including social learning.

Organizational leaders create the "mood" for everyone else in the organization and influence how seriously employees will comply or, better yet, willingly learn and participate in organizational activities that sustain the organizational culture. Barnard's (1968) definition of an executive (leader) also placed the survival of the organization in the hands of the executive and his ability to "provide a system of communication, to maintain the willingness to cooperate, and to ensure the continuing integrity of organization purpose" (p. viii). He acknowledges the impact of external factors, "The initial existence of an organization depends upon a combination of these elements appropriate to the external condition at the moment" (p. 83). Interdependency among the elements will vary with external factors and to stay in equilibrium, when one element changes because of external factors, then variations must occur in other corresponding systems. Barnard suggested that the same principles "that govern simple organizations may be conceived as governing the structure of complex organizations, which are composite systems" (p. 95). Schein (1992) added to Barnard's expectation of the leaders and their impact on building culture by acknowledging that most important for cultural beginnings is the impact of the founders of an organization: "(a) the beliefs, values, and assumptions of founders of the organization; (b) the learning experiences of group members as their organization evolves; and, (c) new beliefs, values, and assumptions

brought in by new members and leaders" (p. 211). Not only do the leaders choose the basic mission and environmental context of the organization, but they also choose who will belong in the group and "bias the original responses that the group makes in its efforts to succeed in its environment and to integrate itself" (p. 212). Building a culture is important to any organization, but the ramifications of not integrating the work force into the culture could be greater for high-risk organizations.

Weick and Roberts (1993) elevated the significance of socialization in the study of heedful interrelating in the high-risk environment of flight decks. They discussed the importance of experience that is handed from experienced insiders to inexperienced newcomers, particularly in an organizational culture that has the characteristics of or *is* a HRO, such as the flight deck of a carrier ship. The sharing of experience creates opportunity for the insiders to be reminded of the need for heedfulness and heedful action, "Newcomers are often a pretext for insiders to reconstruct what they knew but forgot. Heedful know-how becomes more salient and more differentiated when insiders see what they say to newcomers and discover that they thought more thoughts than they thought they did" (p. 367). This would suggest that newcomers can also reinforce the knowledge of those who are their teachers, by the reinforcement of knowledge already gained, including of the organizational culture. The following provides a background of the literature and the importance for individuals to gain knowledge of the organizational culture.

Organizational Culture

The researcher was interested in how newcomers to high reliability organizations are socialized into its organizational culture. The literature review includes studies of

social structure and social systems, the theories that became the pillars on which organizational studies have taken place as researchers began to understand the importance of people in studies expanded into the world of natural sciences.

The research began with studies of organizational culture, not specifically in high reliability organizational cultures. Parsons' (1949) studies explained the relationship between empirical science theories and the special status of culture. He discussed the emergence of organizational culture from his study, "three great classes of theoretical systems. They may be spoken of as the systems of nature, action and culture" (p. 762). The first two constituted empirical scientific theory, but the third, according to Parsons, constituted a special status. Culture systems, unlike nature and action, are both non-spatial and atemporal. The relations of culture systems to action, as he stated, are very complex. Culture systems can be considered products of processes of action and can "constitute unproblematical data, knowledge of which is essential to the solution of concrete problems" (p. 764). The three systems must be distinguishable from one another because they are each part of a consistent whole of objective knowledge, therefore, leading to the assumption that there are existing interrelationships among the three, giving rise to "borderline disciplines" (p. 764).

Parsons further described the borderline between action and culture as the German term *Wissenssoziologie*, which is concerned with culture systems as products of action, how the action elements influence them, and their development of concrete processes. He also made the distinction between empirical analytical sciences by dividing them into two great groups—natural sciences and the sciences of action. Together each group constitutes one great system, since there are common frames of reference, and

there is interdependence among the subsystems of each of the groups. The interdependence creates many emergent properties of action systems, which then lend themselves to be studied. Parsons described the action frame of reference as one of those in which "certain of the facts of human action can be for certain scientific purposes adequately described" (p. 756). Parsons, along with others, was searching for the proper stage from which to study human action since that type of study did not fit into the natural science schema of "space-time and idealistic schema" (p. 756). In his study, he wanted to take account of several subgroups that made up the relatively independent subsystems that "could be considered variables from the point of view of the action system" (p. 756).

Parsons identified cultural systems as having the status of science because cultural systems have a body of objectively verifiable propositions. He referred to examples of symbols, which are observable, plus there is evidence that there is verifiable knowledge of eternal objects. This in itself, however, does not lead to causal understanding of events. There are also ideas, art forms, and other types of culture systems that create the same kind of understanding. Parsons also discussed the problem of social order from Hobbes' (1928) study of the consequences of unlimited struggle for power. To create a stable system when there are more people, there has to be a "normative regulation of the power aspect of the relations of individuals within the system; in this sense, there must be a distributive order" (p. 768), which becomes known as the political system.

Parsons further noted how the number of complex features in social action systems involves a common reference to integration of individuals, to a common value system, according to the organizational norms, including in the overall modes of

expression in the organization. He referred to the phenomena as "common-value integration" and made the distinction from both the economic and political action systems included in his study as subsystems within action systems. According to Parsons, this property, if designated the sociological, then defines sociology as the "science which attempts to develop an analytical theory of social action systems in so far as these systems can be understood in terms of the property of common-value integration" (p. 768).

The concept of organizational culture is not easily defined by everyone, especially those who are more inclined to view the world from an empirical scientific perspective.

Socialization and Organizational Culture

Schein (1996) discussed the historical progression of organizational culture from the roots of psychology and sociology and the difficulty in defining concepts that rely too much on abstractions that are not enough for the practitioner to put to good use. His experience in studying the behavior of prisoners of war (POWs) in the Korean conflict led to a connection between social needs and empirical research. This was a good example of how going into the actual environment of the study will clarify ideas and beliefs by exposing the outsiders to some things that are not quite that easy to understand. Schein's study was conducted to understand what had happened to individual POWs who were imprisoned on the Chinese mainland. What the researchers viewed was a "cynical kind of social psychological torture, the capture viewed as a normal process of teaching Westerners the realities of Chinese Communism…" (p. 233). The Chinese shared a common experience that had resulted in a shared view of the world, that "can legitimately be called a culture" (p. 233). Everyone involved on the Chinese side—interrogators,

prison guards, and ordinary citizens—displayed what observers called a "passion for unanimity…a zeal that often proved decisive opening up the mind of the prisoner, not the discomfort of prison life" (p. 233). Schein's experience allowed him to see more clearly what Van Maanen and Barley (1984) also understood, that "cultures arise in whole occupational communities and that, therefore, parts of organizations are as much a reflection of the occupational backgrounds and experiences of some of their members as they are of their own unique organizational histories" (p. 234). The differences can cause respective assumptions.

Schein (1996) acknowledged problems with successful organizational learning. He attributed learning failures because there are three particular cultures among the subcultures of an organization, with only one of them having the roots within the organization, but each one entrenched in its respective assumptions.

> Every organization develops an internal culture based on its operational success, what I call the "operator culture." But every organization also has, in its various functions, the designers and technocrats who drive the core technologies. I call this the "engineering culture"; their fundamental reference group is their worldwide occupational community. Every organization also has its executive management, the CEO his or her immediate subordinates—what I call the "executive culture." (p. 9).

Learning can occur in any of the three cultures to which Schein referred--operator, engineering, or executive cultures—learning that can create an understanding of the interrelationships among the three cultures. One way is the informal sharing of stories from within each of the cultures. Weick (1987) placed great emphasis on the value of an

organizational culture in which stories, storytellers, and story telling are reliable as a substitute for trial and error and for avoiding learning failures. Kurtz (2003) also discussed the link between culture, decision-making, and trust and its importance to organizational integrity. Not only does the link occur within the formal process for socialization in the organization, but also in the informal process, as in the telling of stories, as Weick discussed. Bolman and Deal (1997); Louis (1980); Stone (1989); Weick (1987) (as cited in Kurtz, 2003) discussed the importance of stories to the newcomers, "…make sense of an organization's unwritten rules and decision-making processes…adapt to and overcome the surprise and bewilderment outsiders feel when exposed to a new culture…stories become part of the organizational mythology that helps employees find meaning and purpose (p. 306).

Trust is also built through the telling of stories, "proper cultural induction helps to channel the ideas and potential disruption that new employees bring to an organization" (Bolman & Deal, p. 307). In larger, more complex organizations in which subcultures and inter-organizational systems exist, trust is harder to achieve, according to Kurtz (2003). If the values in the different organizational systems are loose and ill defined, disruption can occur when crisis episodes act as a catalyst, creating further divisiveness. Bolman and Deal (1997); Louis (1980); Stone (1989); and Weick (1987) (as cited in Kurtz, 2003) suggested that employees will rebel against the traditional decision practices of the organization and contribute to the organizational disorder.

Van Maanen and Schein (1979) discussed that organizational culture arises in organizations as a way in which organizations can cope with and make sense of a given problematic environment. Although an organization is not cognizant of establishing its

organizational culture, the culture that results will consist of long standing rules of thumb, its own special language and special language that becomes part of the individual's every day experience. This includes standards that are relevant to accomplishing the critical work of the organization, "matter-of-fact prejudices," do's and don't of social etiquette and behavior for that organization, certain customs and rituals that tell the employees how they should relate to their superiors, their peers, their subordinates, and even with external entities. There is also a "sort of residual category of some rather plain 'horse sense'" (p. 2) regarding the do's and don't of the organization. How that "residual category" becomes known to everyone can make the difference in the success of an individual in the organization. Depending on the nature of the business of an organization, specific factors in the organizational culture are important to understand, i.e., safety.

High Reliability Organizations (HRO)

Organizational culture includes several subcultures that evolve as the organization grows and becomes more complex, including high reliability organizational culture. The researcher included safety culture in this literature review as another subculture of organizational culture because of its relevance to high reliability organizational cultures that would inherently require attention to creating a safety culture. Understanding safety culture provided for the researcher a better understanding of its role in high reliability organizational cultures. The literature review also included studies on HROs and operators, leadership, and organizational culture in order to understand the overall characteristics of HROs. In spite of the diversity of tasks and skills among HROs, the

organizational culture in each case was characterized by the continual threat of disasters which, according to the studies, can be averted.

Safety Culture

Studies in organizational culture acknowledge the need for organizations to distinguish safety culture separately from other aspects of organizational culture. In these organizations, safety culture is institutionalized and is integrated into the set of people's shared beliefs, norms, attitudes and expectations, thus creating an environment that minimizes the human element's exposure to dangerous conditions. There is the added dynamic to organizational culture created by the different career disciplines and skills involved in the mechanics of the operations of an organization, such as space flight or aircraft carriers.

In their study, Boin and Schulman (2008) discussed their study of NASA and how its culture impacts individual decisions. For the NASA approach, according to Boin and Schulman, there is no room for gut feelings, just decisions made only on hard science. They cited Vaughn (1996), who found that NASA's approach to decision-making is based on protocols and procedures, although reliability often "comes down to single, real-time decisions in individual cases—to launch or not to launch is the returning question" (p. 1056). NASA managers often must "balance real-time safety concerns with other organizational and mission values" (p. 1056). According to Vaughn, although NASA agreed that its safety approach was not perfect, NASA will cling to its safety approach and attributes periodic failure not as "the outcome of a flawed philosophy but a fateful materialization of the ever-existing risk that comes with the space territory" (p. 1056). If

risk is a constant factor in an organization, then how can the organizational culture become inherently safe?

Gherardi, Nicolini, and Odella (1998) cited several studies conducted about safety culture in organizations. According to Douglas (1985), Pidgeon (1992), Turner (1992), Richardson (1995), it is important that an organization maintain a safety culture that encourages accident-free operation of systems (as cited in Gherardi, Nicolini, & Odella, 1998). In their study about an organizational culture of safety, Gherardi, et al. (1998) discussed organizational culture "as a variable influencing the genesis of crises and accidents" (p. 202) and interest in organizational culture arose with research into the organizational dimension of accidents. Turner (1978) studied the model of Man-Made Disasters (MMD) in which culture was at the core of failures of foresight. Roberts (1989; 1990) and the Berkeley School of High Reliability Organizations identified high reliability culture as a causal factor in "explaining positive safety records" (p. 202). The Gherardi study further discussed the "pessimistic view of the role of organizational culture" (p. 202) and Perrow's (1984) Normal Accident Theory and his argument of the inevitability of accidents in complex and tightly-coupled systems. They also referred to Clark's (1993) argument that organizational cultures may be organized to enhance imagination about risk and safety, but they may also perpetuate myths of control and maintain fictions that systems are safe" (p. 203). The Gherardi study also referred to the negative views of organizational culture as an impediment to employees for seeing or recognizing warning signals instead of its being a source of assumptions, artifacts, and tacit knowledge that enhance working practices. The greatest impact in the literature,

according to the Gherardi study, was the ambiguity between organizational culture and safety culture, conceived as positive and negative, respectively.

LaPorte and Consolini (1991) made the distinction of the work involved at the operations level of an organization and made the point of including socialization of the operator as a good investment to be made by organizations. The operator is challenged with core technologies that are hazardous and time critical, therefore, "Effectiveness in decisions about operation is crucial. Such organizations invest a great deal in recruiting, socialization, and incentives to assure that there is agreement about organizational mission. At the operating levels, there is rarely any question at all" (p. 8). The operator has the duty of the real-time performance of the task for which he/she has been trained. Sometimes it appears that the organization takes for granted how much responsibility the operator really does have and how much is at stake if there is failure at that level.

Organizing HROs

The following studies describe the importance of high reliability organizational cultures that emerge as a result of the way HROs are organized, including to meet internal and external expectations. The literature review provided for the researcher a better understanding of HROs and how they related to the study.

Reason's (2000) study observed HROs and the negative and positive side of safety. Accidents—including fatalities, injuries, and environmental damage--occur, even if the primary objective of safety is to avoid accidents. He referred to the positive side of safety as, "…far more secretive. It relates to a system's intrinsic resistance to its operational hazards…safety sciences understand far more about how bad events happen than about how human actions and organizational processes also lead to their avoidance,

detection, and containment" (p. 4). His study examined four paradoxes to be considered in dealing with the imbalance between human actions and organizational processes to achieve and preserve a safer culture. These were: (a) safety is defined and measured more by its absence than by its presence; (b) measures designed to enhance a system's safety can also result in its destruction; (c) often engineering-based organizations believe that safety is best practiced through consistency and procedures for processes and behaviors, it's humans who can apply what's necessary to maintain safety when conditions occur that are different from the norm; and (d) believing that absolute safety can be achieved can create impediments to those safety goals. Reason added a fifth paradox--"if an organization is convinced that it has achieved a safe culture, it almost certainly has not. Safety culture, like a state of grace, is a product of continual striving. There are no final victories in the struggle for safety" (p. 4). For a HRO, this is especially true.

Weick and Sutcliffe (2001) defined HROs as sharing the demand, i.e., they have no choice but to ensure reliable functions. Compromising reliability can lead to severe and harmful results. HROs are successful because of the way they organize. They organize in ways that allow early detection of the unexpected and can stop its development because HROs focus on containing the unexpected. If, however, the containment does not suffice for keeping the unexpected from breaking through, then the HRO will focus on "resilience and swift restoration of system functioning" (p. 3). A high reliability team's incentive, just as for the high reliability organization, should be to "contain the unexpected because when they fail to do so, the results can be catastrophic…lives can be lost, but so can assets, careers, reputations, legitimacy, credibility, support, trust, and goodwill" (p. 18). The technical training should consist of

those processes that require attention to maintain alertness. The newcomer should be exposed to other technical training that focuses on maintaining alertness as well as to other types of training and opportunities to interact with others. This allows the newcomer to begin interpreting information and relating his/her knowledge to the new organization to increase the level of awareness required for the task at hand. A clear understanding of organizational objectives and processes in place to meet them can prevent undesirable ramifications, including those that impact the external community.

According to Wynne's (1988), public debate also played a factor in the question of "embedded public understanding of the intrinsic nature of scientific and technological processes" (p. 148) because of the public's concern with risk and acceptability of technology. When an accident occurs, the public takes a curious "flip" on how it sees the experts in charge. Before the accident, the public had believed "that everything is under control, that design and operating procedures have been rigorously checked, and maintained by careful inspection. In other words, everyone and everything is following carefully defined rules of mechanical, electronic and human performance, in which uncertainties are peripheral" (p. 147). Wynne expresses his concern for the "huge contradiction between the neat and tidy public image, and the messier reality which routinely confronts practitioners on the 'inside' of the technological system" (p. 147).

Wynne (1988) examined technologies as having to follow rules that emerge from practices when rules should actually control the practices. He suggested there were implications for public decisions and social control as mostly due to the lack of understanding between those who understand technology and those who don't, "Expert and public discourses present a more rule-bound concept of technology than the more

private, contingent world of practice" (p. 147). The public trusts a technical system is safely operating in the hands of those who know what's going on. The doubt emerges and the public questions why these experts would believe there was zero risk, yet how can the public be so naive to believe that "technical knowledge does not harbour areas of uncertainty, even legitimate ignorance? We cannot be blamed for the inevitable uncertainties that exist in developing expert knowledge and technological systems" (p. 147).

Weick (1987) focused on high-risk organizations and was convinced that the cultural mode of control can be that source of administrative control that seemed to be missing in high-risk organizations. In his study Weick (as cited in Bierly & Spender, 1995) discussed that high risk and HROs are not the same. These differ because HROs choose reliability above profit or any other organizational objective. Weick's notion of failure is different from Perrow's (1999), who focused on failure on the overall technological and administrative systems, beginning from incident to catastrophe. Weick's focus was on the people who are at the operations level of the system. He argues that accidents occur because sometimes those humans who manage complex systems are not themselves complex enough to sense and anticipate system problems, but "the organization's culture comprises a substantial body of higher level collective knowledge (or mind) which can support individuals when they are under pressure in high risk organizations" (p. 112). Sagan (1993), on the other hand, placed more emphasis on design and management techniques as a safe way to control hazardous technologies.

Sagan added to the points made about HRT, finding that high reliability theorists believe that hazardous technologies can be safely controlled by complex organizations, as

long as wise design and management techniques are followed. The optimistic conclusion can happen if the organization can meet four specific conditions necessary to create and maintain adequate safety: (a) political and organizational leaders truly consider safety and reliability a high priority; (b) backup and overlapping units are in place in case of failure, creating redundancy in the system; (c) "error rates are reduced through decentralization of authority, strong organizational culture, and continuous operations and training" (p. 27); and (d) organizational learning takes place through trial-and-error, anticipation, and simulation.

Perrow (1999) described the fundamental differences between HRT and NAT. Basically, HRT's optimistic view is that if organizations try very hard, they will be virtually accident-free, in spite of being complexly interactive and tightly coupled; NAT's view is that no matter how hard an organization may try, there will still be accidents. Perrow referred to HRT as "attempts to specify the actions organizations can take to achieve very high reliability" (p. 369). He also commented that he was concerned about the optimistic view of HRT "…because of intrinsic characteristics of complex/coupled systems" (p. 369). Perrow identified another difference, bounded rationality and group interests that pose the empirical questions "what role these might play in causing accidents and near accidents short of complexity and coupling. How hard…can we expect risky systems to try?" (p. 369).

Sagan and other HRT researchers studied organizations and their safety and risky stems, including nuclear power plants, commercial aircraft, oil tankers, petrochemical factories, and other potentially dangerous high-technology systems. Results of some of the studies conducted regarding HROs include:

(1) Joseph Marone and Edward Woodhouse's [1986] Averting Catastrophe: Strategies for Regulating Risky Technologies, a study of management of toxic chemicals, nuclear power, recombinant DNA research, ozone layer depletion, and global warming problems in the United States. The conclusion was that these organizations are doing well, considering the challenges they face with the type of technologies with which they are involved.

(2) The work of a multi-disciplinary group of scholars based at the University of California at Berkeley that a studied the "design and management of hazardous organizations that achieve extremely high levels of reliable and safe operations that they argue have achieved 'nearly error free operations'" (p. 16), including the Federal Aviation Administration's (FAA) air-traffic control system, the Pacific Gas and Electric Company's electric power system (which includes the Diablo Canyon nuclear power plant), and the peacetime flight operations of two U.S. Navy aircraft carriers.

(3) Aaron Wildavsky's *Searching for Safety*, a more deductive effort to develop "a theory accounting for the considerable degree of safety achieved in contemporary society" (as cited in Sagan, p. 16). The book presented evidence on how much anticipation and resilience have contributed to improved safety in several systems, including power plants, the human body's immune system, and the Food and Drug Administration (FDA) drug approval process.

The examples of the organizations involved served to make the point that these are real organizations and they decrease adverse activities because they know their business of extremely reliable operations with highly hazardous technologies.

Rijpma (1997) identified the debate between these two dominant schools on the origins of accidents and reliability. He asserted the two theories are sometimes in conflict, but sometimes they do reach similar conclusions when applied to case events or generic safety problems. Cross-fertilization is possible. Rijpma summarized the differences as: (a) NAT holds that, no matter what organizations do, accidents are inevitable in complex, tightly-coupled systems; and, (b) HRT asserts that organizations can contribute significantly to the prevention of accidents.

Roberts and Libuser (1993), upon reviewing the history of HROs, discussed those organizations that were first studied because they had a history of very safe operations, although the environment of the operations was one in which errors could occur and result in "catastrophic physical consequences to the organizations and/or their environments" (p. 16). Roberts referred to organizations that can be characterized as HROs, including the Federal Aviation Agency's air traffic control system and the U.S. Navy's nuclear-powered aircraft carriers. Interestingly, the study, although in a different environment, was relevant to Roberts' study of two banks on the brink of collapse, concluding there were internal factors and inattention to factors in the external environment that were preventing decision making from mitigating in the right direction. Internal factors can include leadership within the organization.

Leadership was another factor in HRO studies. Weick, Sutcliffe, and Obstfeld (2005) provided a definition of HROs in their study of leadership within this type of organization. They described HROs as having an organizational culture characterized by the continual threat of disasters which are averted because of effective sensemaking. The organizations include naval aircraft carriers, firefighting companies, and nuclear power

plants. Employees work in contexts "characterized by frequently dangerous, time-sensitive problem situations as well as extreme ambiguity retarding the nature and significance of potential threats and what strategies, tactics, and resources are needed to remedy them" (p. 43). Baran and Scott (2010) conceptualized the process required leadership and define leadership as "the social process of reducing contextual ambiguity through interaction to achieve goals" (p. 43).

Burke, Salas, and Wilson (2005) discussed the strategy for transforming organizations to HROs as they related to the Weick's, et.al. (1999), characteristics or factors that contributed to HROs. Cognitive-cultural systems that exist within organizations play a role in guiding behavior. Scott (2001) (as cited by Burke, Salas and Wilson, 2005) discussed that shared conceptions exist "that constitute the nature of social reality and the frame through which meaning is created" (p. 518). Shared conceptions are products of internal socialization.

> …meaning arises in interactions and is maintained and transformed as it is employed to make sense of the ongoing stream of activities. Here, one is talking about such cognitive aspects as symbols, mental models, and scripts for behaviour. Finally, the cultural portion of this system is the recognition that internal cognitive frames are shaped by external cultural frameworks…It is felt that these systems are especially important not only for lasting change, but are also the hardest system to change because members often take these actions for granted. Within the current framework, an example of such a taken-for-granted assumption is that operational skill and technology are all that is needed to increase safety…(p. 518).

Burke (2005) also made a point in that those taken-for-granted assumptions are not all that is needed to increase safety within the organization. Anything that is taken for granted is that way because those involved have operated within that environment and either have been co-opted into thinking that way or helped make it that way. How does the newcomer make the transition so that those "taken-for-granted" assumptions are understood well enough to perform according to desired organizational outcomes?

Weick and Sutcliffe (2007) (as cited in Baran & Scott, 2010) discussed HROs as organizations that have an organizational culture characterized by the continual threat of disasters which are averted because of effective sensemaking. These types of organizations include naval aircraft carriers, firefighting companies, and nuclear power plants. They maintain "resilience within highly ambiguous and dangerous work contexts due to team members' abilities to make adequate sense of hazards in the early stages of threat emergence when they are still manageable" (p. 43). Employees work in contexts "characterized by frequently dangerous, time-sensitive problem situations as well as extreme ambiguity regarding the nature and significance of potential threats and what strategies, tactics, and resources are needed to remedy them" (p. 43). The study concluded little is known about the characteristics of leadership in dealing with life-threatening hazards, unexpected risks, and rapidly unfolding events, situations in which leadership is very important. Baran and Scott (2010) conceptualized the social process required leadership. The questions guiding their study focused on the actions or processes that characterize and contributed to leadership in dangerous, highly ambiguous, and time-sensitive operations.

Leaders can adopt mindfulness as an outcome of the socialization of everyone in the organization from newcomer to top executives, in order to institute mindfulness for managing unexpected events, which then leads to reliability. Langer (1989) attributed experience and additional reflection and the passage of time as contributors to the concept of mindlessness and mindfulness and want to better understand "these basic modes of human life" (p. 137). Her research on mindlessness and mindfulness focused on individuals. By understanding both mindlessness and mindfulness it may be possible to extend human performance far beyond currently accepted limits" (p. 168). Does this mean that those who are successfully working in these environments are performing "far beyond currently accepted limits?" (p. 168). Weick (2001) did provide the literature with a process for achieving mindfulness in a HRO. However, rather than defining mindfulness as a goal, he described mindfulness as a means to achieving mission success and safety, which are more likely the desired outcomes of a HRO.

Organizational Culture and HROs

Klein, Bigley, and Roberts (1995) defined HROs as those that, although not very visible to the public, are mandated "to do everything possible to avoid altogether certain kinds of negative outcomes" (p. 772). One key point made here is that the authors contend that organizational culture has been researched quite generally, probably because only generalizabilities can be applied across most organizations. But, they do not suffice for research of HROs and consequently, "cannot suggest specific values and norms that might operate to enhance reliability" (p. 773). Others have studied submarines with some success.

Schwartzman's (1992) study on culture and HROs was the case of a nuclear submarine (as cited in Bierly & Spender, 1995). He had three different approaches to culture, his third approach the concept of organizational culture as we understand it today:

> (1) One thread treats culture as an external (national) variable, leading researchers to contrast organizational processes in different national contexts…from the work of Taylor and early anthropologists.
>
> (2) A second thread treats culture as the non-formal aspects of organizational life…goes back to the Hawthorne studies and the "discovery" of the informal within the formal organization.
>
> (3) The third thread comes from more recent anthropological developments and treats the organizational culture as evidence of the institutional system within which all of the organization's processes, even the most formal, are embedded. In this approach culture is the underlying pattern of meaning articulated into both the formal and the informal aspects of the organization. This kind of culture is recreated and reconstituted by the organization's cultural activity (p. 642).

Wilkins and Ouchi (1983) concluded that organizational culture is a source of categories, routines, and examples of good and poor solutions for organizational decision makers. They concluded those conditions were long history and stable membership, absence of institutional alternatives, and interaction among members. Wilkins and Ouchi were not paying attention to the high-risk organizations that were Perrow's (1984) focus (as cited in Bierly & Spender, 1995). Ouchi's (1980) (as cited in Bierly & Spender, 1995)

culture-based approach required a different kind of understanding by those involved, something above that of the "formal, for the formal is subsidiary to the institutional" (p. 642) one would find in simpler bureaucratic or market-based modes of control. Wilkins and Ouchi (1983) researched the conditions that would develop these higher level cultural modes of organizational control. These result in control commanded at the levels closer to the immediate actions normally controlled under bureaucratic and market-based modes. They determined that the cultural mode is inherently more flexible and more efficient when circumstances call for flexibility.

There is concern that when decision guidelines are culturally derived, they can become a hindrance to effective decision making. Petty (1995) and Vaughan (1996) discussed their concern that these taken-for-granted assumptions can suppress employees' innovation and new ideas because they will stick with tried-and-true problem-solving formulas. Taken-for-granted assumptions can evolve from the norms and mores of an organizational culture. Kurtz (2003) discussed these taken-for-granted assumptions that become part of the organizational culture's norms and mores and their impact on the decision-making process. "The general success of these norms and mores contributes to their legitimacy, providing reinforcement for veteran employees, who teach them to new employees as the correct way to perceive, think, and feel about problems the organization frequently encounters" (p. 306). Taken-for-granted assumptions can influence the decision making of the operator when the urgency of a situation calls for innovation and new ideas, especially when the unexpected occurs. There are studies of organizations characterized as HROs that have learned to be mindful of the unexpected.

Weick and Sutcliffe (2001) referred to good management of the unexpected as being *mindful* management of the unexpected. Their study of mindfulness extended to organizations characterized as HROs. They, along with other theorists, studied HROs, organizations that "operate under very trying conditions all of the time and yet manage to have fewer than their fair share of accidents" (p. 3). Among these organizations were "power grid dispatching centers, air traffic control systems, nuclear aircraft carriers, nuclear power generating plants, hospital emergency departments, and hostage negotiation teams" (p. 3). In spite of their numerous unexpected events, the better of these organizations rarely fail. The environment in these organizations includes complex technologies and has constituencies with varying demands. The people who run these systems often have an incomplete understanding of their own systems and exactly what they face day-to-day. Weick and Sutcliffe attributed the success of the HRO in managing the unexpected to the determined efforts of the organization to act *mindfully*. This meant organizing themselves in ways that would allow better awareness of the unexpected when it is happening and can stop its development or at least contain it. If containment is not possible, "then the focus changes to resilience and swift restoration of system functioning" (p. 3). HROs and other organizations manage the unexpected by looking for weak signals, signs of trouble that sometimes are treated with weak response. "Mindfulness preserves the capability to see the significant meaning of weak signals and to give strong responses to weak signals. The counterintuitive act holds the key to managing the unexpected" (p. 4). In addition, Weick and Sutcliffe defined the characteristics of a HRO.

Weick and Sutcliffe (2001) defined five hallmarks of organizations that "persistently have less than their fair share of accidents" (p. 10). These characteristics of HROs make up what Weick and Sutcliffe have termed as mindfulness. They are:

(1) Preoccupation with failure—HROs are preoccupied with their failures. Lapses are treated as symptoms of something wrong in the system, possibly with severe consequences if separate small errors happen at the same time. Errors are reported, the experiences of near misses are lessons learned, and they are "wary of the potential liabilities of success, including complacency, the temptation to reduce margins of safety, and the drift into automatic processing" (p. 11).

(2) Reluctance to simplify interpretations—HROs position themselves to see as much as possible because they know the world in which they live is complex, unstable, unknowable, and unpredictable. "They encourage boundary spanners who have diverse experience, skepticism, toward received wisdom, and negotiating tactics that reconcile differences of opinion without destroying the nuances that diverse people detect" (p. 12).

(3) Sensitivity to operations—HROs have an ongoing concern with the unexpected, which usually originate in "latent failures, loopholes in the system's defenses, barriers, and safeguards whose potential existed for some time prior to the onset of the accident sequence, though usually without any obvious bad effect" (p. 13). These loopholes can be found in processes for supervision, reporting of defects, engineered safety procedures, safety training, briefings, certification, and hazard identification. Sometimes these

latent failures are not discovered until after an accident occurs, although, according to Weick and Sutcliffe, frequent assessments of normal operations can reveal the development of unexpected events. HROs can distinguish themselves if they are attentive to the front line and the sensitivity between operations and relationships. It is important for people to be able to speak out and not be afraid of repercussions for doing so, otherwise "fear [will] enact a system that knows less than it needs to know to remain effective" (p. 13).

(4) Commitment to resilience—HROs learn from failure and develop anticipatory activities, i.e., "capabilities to detect, contain, and bounce back from those inevitable errors that are part of an indeterminate world" (p. 14). HROs are not disabled by errors. The resilience they develop results from a combination of keeping errors small and implementing workarounds that prevent the system from not functioning. In order to accomplish this, however, members of the HRO must know the organization's technology, system, co-workers, self, raw materials, and value the experts and becoming experts so that they recognize when systems can malfunction.

(5) Deference to expertise—The more expertise there is among the members of the HRO, the better. The diversity of knowledge and ideas increases the ability to deal with complexities as they are spotted. HROs push decision making downward so that decisions are made at the front line and the authority then belongs to the people with the most expertise, regardless of their level. It is not experience that necessarily constitutes expertise, since sometimes experience results in applying same knowledge without looking

> beyond that knowledge. Weick and Sutcliffe refer to this as "migrating to expertise" (p. 16), an approach used in flight operation on aircraft carriers where "uniqueness coupled with the need for accurate decisions leads to decisions that 'search' for the expert and migrate around the organization…in search of a person who has specific knowledge of the event" (p. 16).

Sensitivity to operations creates the ability to detect signals that may or may not require decision making.

In her study of NASA and the Challenger accident, Vaughan (1996) distinguished the three types of signals that become interpretations upon which organizations make decisions, factors especially relevant to HROs. Vaughan described signals that were "observed and intuited" (p. 245) by those responsible for deciding whether to launch or not, resulting in the accident. According to the post-tragedy analysts, the Challenger engineers had defined cold temperature as a *weak signal* and "intuited a relationship between the cold temperature and the damage they saw" (p. 245). But, the engineers did not have systematic data "that showed a causal connection between the cold and the damage. The information they had was observational, thus informal and ambiguous—a weak signal" (p. 246). Vaughan defines a strong signal as a signal with "formal, quantified data (a stronger signal than observational data at NASA)" (p. 246), which affirms risk acceptability.

Vaughan (1996) described as *mixed signals* those that occurred during the time of the Challenger launch decision, both "signals of potential danger were followed by signals that all was well, reinforcing the belief in acceptable risk" (p. 245). Based on other Shuttle flights, erosion issues with the joints in question recurred but consequences

from those flights did not indicate completely that the anomaly was a real problem, "each time an anomaly occurred, they [the engineers] believed they understood it and implemented what they considered to be an effective solution. Each time, their decision making was affirmed by post-flight analysis that signaled that all was well" (p. 245). Vaughan also describes *routine signals* as those that recur when "the frequent event, even when acknowledged to be inherently serious, loses some of its seriousness as similar events occur in sequence and methods of assessing and responding to them stabilize (p. 246). This type of signal encourages decision makers to classify recurring similar events as a normal or typical case. "The more frequent the similar events, the more routine the individual case. Seriousness itself becomes routine, a taken-for-granted characteristic of the case, reducing the experience of seriousness for the workers" (p. 246). The operator must look out for these.

The Operators in HROs

The literature review includes studies of the first construct, socialization, and includes literature at the operator level in the organization. The operator's role is vital to the success of the mission as the implementer of the organization's objectives. Mixing the best skills and knowledge each individual brings to the organization to accomplish the organization's goals often does not occur fast enough because the people do not clearly understand what the organization expects, why it expects that, and why things work the way they do. The new employee brings his/her own perspectives of how things work because of previous experiences but must be able to adapt them to the new organizational culture and new technologies.

LaPorte and Consolini (1991) studied the serious issue of operators and their work with technologies that perhaps are not well understood. They noted the distinction of the work involved at the operations level of an organization and the emergence of technologies that not only have great productive powers, but also great destructive powers. There are many organizations that operate industries within this category, including nuclear power plants, air-traffic control, genetic engineering; dangerous drugs; monitoring bridges and dams; pesticides in agriculture; and, "less dramatically, distributing electric power. …and costs associated with major failures in some technical operations are greater than the value of the lessons learned from them" (p. 19). These organizations then engage in trials without error.

Depending on the importance of the benefit, the organization will need to sustain failure-free organizational performance, avoiding altogether certain classes of incidents or accidents which overseers determine would result in consequences that must be avoided. LaPorte and Consolini pointed to the contradiction of such thinking among organizational and political leaders and the public. The perception is that bureaucracies routinely make mistakes, yet, "We demand this or that operation be run perfectly, or we'll withhold funds and take away authority. These organizations must not fail; we do not wish to have to learn from such failures" (p. 20). The perception by operators and the public is that failure of any of these technologies potentially has such grave consequences that failure is not an option, something that should not be taken for granted. The operator becomes very crucial in HROs.

According to Perrow (1999), if operators' skills are not at the required level, organizations with high-risk systems will be doubly penalized because accidents

characterized as normal will occur from the interaction of failures that are often unrecognized. Then the operators, because they are closest to the systems in which these interactions occur, have to independently make quick and creative decisions. But there is also the "interactive complexity" of the high reliability system that makes the work of the high-reliability team one of high catastrophic potential. An organization does have the responsibility to ensure that individuals are properly prepared to make their contribution for avoiding catastrophe, including proper socialization. Some individuals will prepare better than others, although an organization should expect that all of the individuals of a high reliability team are similarly equipped to be on such a team. When these individuals come together as a high reliability team, individuals must deal with their own ability to exceptionally prepare themselves. Repetitively, their knowledge and skills are compared to others on the team so that a select few will eventually undertake the dangerously genetic tasks that, according to Perrow, make accidents inevitable and the accidents even become normal.

Summary of the Literature Review

In Chapter 2, the researcher provided an overview of the literature review, discussions on the literature on socialization, organizational culture, high reliability organizations and safety culture, including the role of the operator. The literature provided the basis from which the researcher could understand the experiences of the participants in the study. The literature related to early studies by Adler (1933a), Merton (1936, 1940), Weber (1947), Levinson (1965), Katz and Kahn (1966), Van Maanen and Schein (1979), Weick (1979), Wentworth (1980), and others, who depicted the different perspectives on organizational approach to integrating individuals into the organization.

The literature emphasized both a concern for technical aspects of the work and for the interrelationships between individuals in an organization and the relationship between management and the employee. Parsons (1949) discussed the emergence of organizational culture as a system of nature, action, and culture. Weick (1979) referred to organizing "is like a grammar in the sense that it is a systematic account of some rules and conventions by which sets of interlocked behaviors are assembled to form social processes that are intelligible to actors" (p. 3). As individuals are integrated into an organization, the quality of the socialization process in place, formal or informal, can affect their effectiveness as team members, especially in a HRO. According to findings from the literature review, high reliability theorists believe that accidents can be prevented when an organization has good organizational design and management (Vaughn, 1996). According to Vaughan, it is difficult to identify and control unacknowledged and invisible social forces on information, interpretation, knowledge, and action. As technology becomes more complex, so do organizations and their tasks, and the probability of accidents increases. Studies conducted by Turner (1978), Roberts (1989, 1990), Perrow (1984), and Clarke (1993) focused on safety culture and the work of the operator in hazardous environments. This literature review did not reveal any studies of the socialization of the Spacewalkers, the operators of the mission of an organization with a high reliability organizational culture in which much complexity exists in technology, organization, and task. The literature review included examples of high reliability organizations but did not provide any findings of studies conducted on the experiences of others who work in this type of organizational culture.

Chapter 3: Research Methods

Overview

This chapter presents the research methods and design used in this case study. The researcher has included an overview of the methodology, the research questions, the research procedures, data collection, data analysis, the importance of understanding subjectivity, and human and participant ethics throughout the study.

The purpose for the research was to understand the socialization of new employees into a high reliability organizational culture. The findings of the study will bridge the gap in literature by understanding how an organization with a high reliability organizational culture builds a successful team through its socialization processes.

The qualitative methodology selected for this study allowed the researcher to gain understanding from the experiences of the NASA Spacewalkers in the process of their socialization into the high reliability organizational culture of the EVA teams. The researcher collected valuable information that provided the Spacewalkers' perspectives on how they were prepared for success in the hazardous environment, not only from the formal perspective, but also from the informal perspective gained from experiences of others around them and from the relevance of the newcomers' own previous experiences.

Interpretive Paradigm

The assumptions of this study fall under the interpretive paradigm quadrant of Burrell and Morgan's (1979) model. This ontological perspective was an approach from which to understand the world as it is, at the level of subjective experience, "seeks explanation within the realm of individual consciousness and subjectivity, within the frame of reference of the participants as opposed to the observer of action" (p. 28). The interpretive world view seemed appropriate for the researcher to seek understanding

regarding how individuals make sense of the environment in which they sought to gain membership.

The epistemology that guided this study was anti-positivist, meaning an approach outside of the "ground rules commonly applied to natural sciences" (Burrell & Morgan, 1979, p. 3). This assumption was used because the social world can "only be understood from the point of view of the individuals who are directly involved in the activities which are to be studied" (p. 5). One can only understand by getting "inside" of the participant in action. The assumption was significant as participants in this case study began to share the experiences from which they gained knowledge to become full members of the team.

Another assumption discussed by Burrell and Morgan (1979) was one concerning human beings and their relationship to the environment that leads to an ideographic methodology for the study. "The principal concern is with an understanding of the way in which the individual creates, modifies and interprets the world in which he or she finds himself" (p. 3). The individuals are autonomous and free-willed to determine whether or not to participate on the team, suggesting to the researcher that the better subjective perspective is volunteerism. By conducting a case study, the researcher individually joined the participants in their world and, in turn, the participants collectively contributed to the researcher's understanding of their newcomer experiences beginning as Astronaut Candidates (ASCANs) and through the EVA Team.

To answer the questions in this study, the researcher conducted a qualitative case study approach. Creswell (1998) recommended using qualitative study in order to "study individuals in their natural setting. This approach involves going out to the setting or field of study, gaining access, and gathering material" (p. 17). Yin (2003) referred to the case

study as an appropriate approach when the researcher has "how" and "why" questions, when the researcher has little control of the events being studied, and when the focus of the study is a "contemporary phenomenon within some real-life context" (p. 1). This study was conducted within the context of a closed-knit organization characterized as a HRO in the federal sector. The EVA team was the case or unit of analysis evaluated by the researcher. The participants in the study, representing several EVA teams, provided multiple perspectives within the data collected, which emerged as answers to the questions under investigation.

Research Questions

The study focused on a primary research question (RQ) and two sub-questions with supporting questions.

RQ: What are the socialization processes in the high reliability organizational culture of the Extravehicular Activity (EVA) teams at the NASA Johnson Space Center? The following two sub-questions provided the researcher with discussion opportunity.

(1) What are the formal socialization elements? (a) What does the general orientation include? (b) What does your safety training entail? (c) Where are the interactions of the teams, members of the other teams besides the EVA) Team members? (d) Who provides your safety training once you have been assigned to a specific mission? (e) When does the team start developing?

(2) What are the informal socialization elements? (a) How did you determine what were the norms and principles of the team? (b) Who are the experts around you? (c) What were some "upending experiences" (those deliberately planned or accidentally created circumstances) that made the team members become closer? (d) What were some

of the "taboos" you learned from others? (e) How can you tell when the team members have built commitment and loyalty to the team? (f) How did others let you know you were ready for the Spacewalk?

The questions prompted the participants to describe in their own words the environment in which they were socialized. The next section discusses the research procedures used to conduct the case study.

Research Procedures

The researcher selected the interpretive view to guide the case study, therefore, the epistemology was anti-positivist. According to Burrell and Morgan (1979), "by and large, interpretive theories concentrate on the study of ways in which social reality is meaningfully constructed and ordered from the point of view to the actors directly involved. They present a perspective in which individual actors negotiate, regulate and live their lives within the context of the status quo" (p. 254). The following is the researcher's theoretical perspective of this case study.

Theoretical Perspective

Schutz's (1970) theoretical approach to understanding the subjective meaning of group membership provided a means for the researcher to conduct the study to understand the participants' experiences to gain "knowledge of a common situation, and with it of a common sense of typifications and relevances" (p. 82). From the various phenomenological approaches, Patton (2002) found in common "a focus on exploring how human beings make sense of experience and transform experience into consciousness, both individually and as shared meaning" (p. 104). Glaser and Strauss (1967) (as cited in Seidman, 1998) cites discussed that in qualitative research, theoretical

frameworks developed in other contexts cannot be used to force fit the words derived from participants in a study. Seidman agreed with them and also advised against reading and gleaning too much from the literature, that it was better for the researcher to interview the participants without the weight of ideas derived from the literature. The following describes the methodology for this study.

Methodology

Combining the qualitative descriptive case study methodology and the interpretive view to guide the case study allowed for the collection of data describing the socialization experienced by the participants. The primary data was collected by one-on-one participant interviews because the study was about the collective individual experiences. Using this approach, the researcher was able to understand the participants' perspectives of how they became full members of the team. The following is the description of the site for the interviews.

Site Selection

The site for this study was an organization based the NASA Johnson Space Center in Houston, Texas, one of 10 NASA centers in the United States, and one of four centers that focus on human space flight exploration. The specific organization was the Extravehicular Activity (EVA) Team, which had primary responsibility to train the Spacewalkers, who perform the EVA-related tasks during the spacewalk during a space flight. For each flight that will require spacewalks during the mission, an EVA team is formed. The participants represented several EVA teams, since most of them had been assigned to more than one Shuttle or ISS Expedition flight crew.

The term *EVA team* applies to the specific team designated to prepare the astronauts who are the designated Spacewalkers for those specific space flights that will include a spacewalk or more as part of the mission plan. The team will consist of representatives from three other key organizations: the Mission Operations Directorate (MOD) Training Division provides the trainers; the Astronaut Office provides the Spacewalkers and Instructor Astronauts (IAs)/mentors; and the EVA Project Office provides policy and guidance. Other organizations will provide matrixed support to every mission, depending on their specific role for the mission. The total number of members of the EVA Team will vary, depending on the objectives of the space flight. The researcher interviewed only the Spacewalkers on the EVA teams, since the purpose of the study was to acquire perspectives based on their Spacewalker's experiences.

The following depicts the organizations that comprise an EVA Team, based on the participants' descriptions.

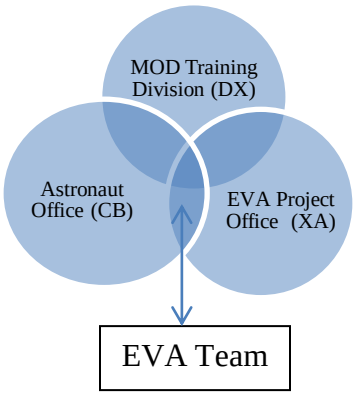

Figure 2: Organizations that Comprise an EVA Team to Prepare for an EVA On Orbit.

Recruitment of the Participants

Patton (2002) discussed purposeful sampling in qualitative inquiry with a focus "in depth on relatively small samples, even single cases (N=1), selected purposefully" (p. 230). Bernard (2000) discussed the different types of purposive sampling, including

typical case sampling (as cited in Patton, 2002). Bernard recommended typical case sampling when "describing a culture or program to people not familiar with the setting studies, it can be helpful to provide a qualitative profile of one or more typical cases" (p. 236).

Bernard (2000) suggested recruiting key informants and knowledgeable participants who can assist in identifying who or what are typical in the setting to be studied. The researcher selected the EVA Team for her study partly because of her on-going conversations with a veteran Spacewalker who was a co-worker and friend. The conversations revolved around the different generations of astronauts being selected into the EVA program and the challenges involved for ensuring they will be able to fully participate in the EVA program, since ongoing program requirements have required ongoing changes to the EVA program. The qualitative study was a viable method to provide the participants an opportunity to share their experiences in the socialization since they had performed spacewalks, some of them several, and knew enough about the process to help the researcher understand what was involved.

The Participants in the Study

When the researcher recruited the participants, she followed two criteria: (a) the participants were still employed by NASA; and, (b) they had conducted at least one spacewalk on-orbit (in space). Based on her research as to the current assignments of the remaining 47 Spacewalkers in the NASA work force, the researcher identified 37 Spacewalkers to invite. The potential invitee group included several veteran Spacewalkers who had performed more than one EVA. Because of this, the EVA program considered them experts and had promoted them to instructor astronauts (IAs) to

mentor and coach new trainees. For the researcher, this was an advantage because the veteran Spacewalkers provided a different perspective. As a group, the participants were diverse in several ways, not necessarily just in race and gender, but also in career backgrounds, including whether or not they were or had been in the military. The researcher invited the 37 Spacewalkers by e-mail note, stating the request, purpose of the study, the intended method of one-on-one interviews, and a sample of the Informed Consent Form for the invitee's review. The researcher was surprised at the number of invitees who responded.

A total of 21 invitees accepted the invitation, although only 20 were interviewed. One of the volunteers became unavailable due to training schedules in preparation for a launch in Russia. The researcher has maintained confidentiality regarding the identity of the participants in this study. She did not provide information about the individual participants in this report, only general information as it related to the data in the study. The researcher included the following information about the backgrounds of the participants to provide some insight for the reader about them. The participants' educational backgrounds ranged from bachelor's degrees to Ph.Ds. and Medical Doctor degrees, including several professional disciplines, from both military (USAF, USMC, USCG, USN, and USA) and non-military backgrounds, including high-performance jet aircraft pilots, engineers, mathematicians, and researchers in chemistry, biochemistry, physics, geological sciences, computer science, and medicine. Their ages ranged in birth years from 1948 to 1972. Between Space Shuttle and International Space Station Expedition missions, the Spacewalkers had trained for and flown one to five EVA missions each. Women (3) and minorities (2) comprised 25 percent of the group.

Diversifying the Astronaut Corps has been a conscious effort since 1978, when the program was made accessible to women and minorities.

Diversity was an important factor for the researcher, since her role as a member of the Astronaut Selection Board was to identify highly-qualified women and minorities in the applicant and interview pool. The following is the diversity among the 21 invitees who accepted the invitation to participate.

Gender	Asian	Black	Hispanic	White	Total	Military	Non-military	Total	Actually Participated
Male	1	1	1	15	18	8	10	18	17
Female				3	3		3	3	3
Total					21			21	20

Table 1: Diversity among the 21 Spacewalkers who agreed to participate in the study

Having the representation of women and minorities among the participants provided the researcher with data that is better representative of the true culture of the EVA teams.

Data Collection

Creswell (1998) defined data collecting as a "series of interrelated activities aimed at gathering good information to answer emerging research questions" (p. 110). Creswell suggested maintaining a checklist of the series of data collection activities that connect interrelated activities so that the researcher can ensure none of the multiple phases of collecting data is missed. The researcher followed Creswell's recommendation to collect data using interview methods, including structured and semi-structured interview questions. She also referred to documents and reports, as well as to

documentation that provides information about the research subjects and their environment. She ensured the data was representative of the time span of the study.

Time Span of the Study

Because the study included participants who were Spacewalkers during the Space Shuttle era and International Space Programs, research for the study spanned a period of 30 years, between 1981 and 2011. This period included the years during which time the Space Shuttle program and the ISS program overlapped and required higher numbers of trained Spacewalkers for both programs. Not all of the participants were astronauts during the full 30 years, but together they represented the early Space Shuttle program and the current ISS program. The participants who had been trained as Spacewalkers early in the program contributed data about their own socialization experiences, although very retrospectively. The value of their data, however, was in their more current knowledge gained as trainers and mentors of the new generations of Spacewalkers. These "tenured" Spacewalkers had also been involved in changes in the EVA program and provided historical background for the study. Before proceeding with the study, the researcher had to acquire permission from the Internal Review Boards (IRB) of both GWU and NASA.

Research Approvals

Patton (2002) discusses two separate parts required for entrance into the field in which the research is going to be conducted: (a) negotiation with the gatekeepers, whoever they may be, about the nature of the fieldwork to be done; and, (b) actual physical entry into the field setting to begin collecting data. The primary "gatekeeper" for the study at JSC was the NASA JSC Institutional Review Board (IRB), specifically,

the Committee for the Protection of Human Subjects (CPHS). The researcher followed the instructions provided by the CPHS, the "Guidelines for Investigators Proposing Human Research for Space Flight and Related Investigations" (JSC 20483, 2004).

Both JSC and GWU initially approved the study for 15 participants; however, because some of the astronauts' responses were delayed, a final 21 astronauts accepted the invitation to participate. The researcher requested a modification to the approval to change the number from 15 to 21 in the approved proposal, and both GWU and JSC approved the modification. It was at this point the researcher proceeded to the next step to prepare for the interviews.

Proceeding with the Interviews

The main method for collecting the data for this case study was one-on-one interviews that allowed the participants the opportunity to provide open-ended responses to the research questions. Patton's (2002) strategy for variations in interview instrumentation was appropriate for this case study: (a) the informal conversational interview, the most open-ended approach to interviewing; and, (b) the interview guide, which listed the questions or issues that were asked during the interview. Patton referred to the practical use of an interview protocol to assist the researcher in maintaining comprehensiveness of the data and to make the data collection more systematic as each person was interviewed. The interview questions allowed the interviews to be more conversational and situational so that gaps in the data were anticipated and dealt with. Patton did warn, however, that a weakness of this approach was the danger of the data resulting in responses that were too different and could affect the comparability of those responses. Scheduling time on the volunteers' schedules was the next challenge.

As it is, most of the participants had schedulers who plan all of their activities weeks in advance. Therefore, all 20 interviews were conducted within 8 weeks, with only a few postponements because of changes in the participants' schedules. The researcher conducted all of the interviews in the same conference room, familiar to the participants, and provided by the JSC Public Affairs Office. Two of the interviews were by teleconference because the participants were on assignments outside of Houston. Prior to the interview, the researcher sent each participant an electronic copy of the list of questions and the informed consent form, then provided a hard copy of each at the beginning of each interview. She collected the original signed copy of the informed consent form for her records. Having the questions prior to the interviews allowed each participant time to prepare.

The Participant Interviews

The researcher found that some of the participants did prepare for the interview and had organized thoughts as they spoke. Other participants had not read the questions or forgot to take them to the interview, but the researcher had extra copies for the participant to use as a guide. The participants were knowledgeable insiders who easily described the environment in which they were trained, worked, and learned to become full members of the team. By the time they had qualified to become members of an EVA team, the participants had had the team experience several times during their training stages from their "newcomer" status until their actual EVA on orbit.

The participants provided described their training in great detail, including the training facilities, the suits, experts, trainers, mentors, role models, tasks, and experiences, as well as other training prior to their becoming Spacewalkers. As they

talked, and as true members of the NASA culture, the participants exercised something very prevalent in the NASA and JSC cultures—they used acronyms throughout their interviews, including calling out the names of organizations by mail code, i.e., CB is the Astronaut Office, DX is the Training Division in the Missions Operations Directorate (MOD), and XA is the EVA Project Office mail code. The researcher understood, therefore, it was not necessary for the researcher to interrupt the participants for clarification in this area.

Creswell (1998) cautioned that for one-on-one interviews, it is necessary for the researcher to have participants who will not be hesitant to speak or share ideas. Each participant was very candid in his/her interview and appeared to be very comfortable with the conversation between him/her and the researcher. The participants were descriptive of their technical training and experiences, and as they became more comfortable, included experiences about their challenges, pains, and joys as they gained membership on the teams.

Post-interview

The researcher had originally scheduled 1.5 hours per interview session and 1 hour each after the first interview. The follow-up interview was included in the design to provide the participants the opportunity to review the transcribed data and then meet again with the researcher to discuss editions, additions, or additional comments. The researcher recorded and transcribed all of the interview data and sent an electronic draft to each participant. After each participant reviewed and returned his/her transcript, the researcher determined that the second 1-hour interview was not required. They made very

few changes to their respective transcripts, but the majority commented they would avail themselves if additional time was required. Others volunteered to be readers, if required.

Additional Sources of Data Collection

In addition to the interviews and documentation as sources of data collection, the researcher utilized methods including observation and documentation, but was not required to use audio-visual material, as originally planned. She was invited to observe a scheduled practice run in the Sonny Carter Training Facility, which houses the Neutral Buoyancy Lab (NBL), the football field-size swimming pool that simulates space for the trainees. Two of the participants performed the NBL run, along with NBL team members. The researcher observed the pre-briefing in the control room with approximately 20 other people who were involved in the run, including the two Spacewalkers. They were wearing the Liquid Cooling and Ventilation Garment (LCVG) (thermal underwear), which incorporates clear plastic tubing to enable the flow of chilled water for body temperature control and ventilation tubes for waste gas removal. The other people were the medical doctors, technicians, divers, the test director, and the test conductor. The divers and technicians "suited-up" the Spacewalkers for the NBL run, then the Spacewalkers descended into the NBL wearing the 300-pound space suit designed for the water practice, along with tethers, and divers in and about them in the water, technicians on the deck of the NBL, and others observing from the control room to ensure the astronaut's well-being. The event was a marvelous demonstration of a day of activity for an EVA run and provided for the researcher an excellent opportunity to visualize what the participants would later describe to her. She had prepared for the activity by reading documentation about the NBL run prior to the exercise.

Yin (2003) referred to documents as the best way to "corroborate and augment evidence from other sources" (p. 87). The researcher reviewed NASA documentation about the current astronaut work force, historical information about the Shuttle and ISS programs, and other data that provided background for the interviews. For example, the researcher reviewed the "Astronaut Fact Book NP-2005-01-001JSC" (2005), which contains information about all of the astronauts who have been members of the Astronaut Corps throughout the history of the U.S. program for human space flight. "Walking to Olympus: An EVA Chronology" (1997) was the source of information for all space flights that included an EVA, up to 1997.

The researcher also reviewed the Astronaut Candidate (ASCAN) Training Plan (2009) prepared by the JSC Human Resources Office because it is a comprehensive overview of the one-year training provided to the ASCANs The researcher gained a better understanding of the relevance of the astronauts' training for eventual selection into the EVA program and the assignment to an EVA Team. The researcher also reviewed the NASA public website for astronaut biographies to determine which astronauts were Spacewalkers, since until recently, not all astronauts became Spacewalkers, and to familiarize herself with each of the participant's background. She also verified the information with the NASA JSC Astronaut Selections Office, which keeps current records of the Astronaut Corps because of ongoing astronaut recruitment efforts. The information provided good background for the researcher to prepare for the data analysis.

Data Analysis

Girden (2001) referred to narrative analysis as a means to better understand what the narrator is saying and stresses that "the researcher is interested not only in content but in why the story was told that way: why were certain experiences reported at certain times in their sequence, and why were some emphasized more than others? This describes what the components of the event meant to the narrator" (p. 49). When she began to organize the data, the researcher used narrative analysis to understand the participants' experiences clearly and in the manner in which the narrator meant them.

Data Organization

Lincoln and Guba (1985) discussed the advantages and disadvantages of computer-aided data processing. Advantages are the assistive features of using software to manage and organize great amounts of data, but disadvantages are in the interpretive phases of data analysis. Although using a program for computerized data base can improve the reliability of the case because data and data sources are easier to track and organize, "No way yet exists that permits the analyst to utilize the computer in ways that would take context into account—a critical shortcoming from the naturalist's point of view" (p. 351). Miles and Huberman (1994) also cautioned about the level of flexibility in the features of the software, as well as its user friendliness. The researcher took these two factors seriously and opted not to use software for the data analysis.

Miles and Huberman (1994) also recommended data should be analyzed using three concurrent flows of activity:

(1) Data reduction (i.e., coding, clustering, identifying themes).

(2) Data display (matrices, graphs, charts, networks).

(3) Conclusion/drawing/verification (noting regularities, patterns, explanations, possible configurations).

The following describes the activities for data reduction and conclusions the researcher used in this study. She organized data into charts as visual tools for herself as she analyzed the data, but used the charts only as aids for herself and did not include them in the report because they contained information that identified the participants.

Coding

Creswell (1998) and Miles and Huberman (1994) recommended writing notes and memos to begin to separate the data into categories, or identify codes, to make it easier to analyze the data. The researcher's interview protocol provided a good framework from the beginning and initially served to keep the data in clusters of information. Taping the interviews and listening to the speaker during the interviews assisted in capturing the tone of the conversations. Once she transcribed the recordings, the researcher reviewed the hard copy transcripts and began to separate the data into categories, using key words for codes. Content analysis, according to Patton (2002), involves "identifying, coding, categorizing, classifying, and labeling the primary patterns in the data" (p. 463). Miles and Huberman also recommended coding as a process for condensation and analysis to allow for "ongoing, iterative reflection" (p. 56) as the data is reviewed and generate the thematic approach or "small number of themes or categories, perhaps five to seven, for a research study" (p. 194). The coding strategy results in "'chunks' of varying size—words, phrases, sentences, or whole paragraphs, connected or unconnected to a specific setting" (p. 56) relevant to the constructs. These five major "chunks" or themes emerged from the data in this study:

(1) Expectations defined by organizational culture.

(2) Safety inherent in organizational culture.

(3) Participants' relevant experiences.

(4) Experts build trust.

(5) Organizational culture of collaboration.

Conclusions

Creswell (1998) referred to the themes as a way to make sense of the data. For the researcher, the strategy resulted in units of meaning to the study from which to identify the themes for interpretation and reaching conclusions of the study. The conclusions are discussed in Chapter 5.

Using the data from the transcripts, the researcher used direct quotes made by the participants to support relevant statements in the narrative of the analysis for the discussions in the themes and conclusions sections. She was careful to maintain the confidentiality of who was speaking, as she had told the participants she would. Prior to beginning the analyses, the researcher had transmitted to each of the participants the draft of his/her draft, which they reviewed and returned to the researcher, generally with minor edits and clarifications.

Trustworthiness

Creswell (2003) referred to validity as the strength of the qualitative study and suggested various strategies to ensure that findings are accurate from the viewpoint of not only the researcher, but also the participant and the readers of an account. He recommended at least two procedures in conducting the verification of the data collected, including triangulation; member-checking; rich, thick description; and, clarifying bias of

the researcher. To strengthen trustworthiness, Lincoln and Guba (1985) advised using certain methods as the inquiry begins, including maintaining field journals, avoiding distortions, apprising the participants on what is going to happen, and developing an audit trail. The concern was to what extent could the evaluator's findings be trusted? Lincoln and Guba further suggested the traditional mandate to be objective should be replaced by trustworthiness and authenticity. Patton (2002) suggested carefully selecting methodological language and to stay away from language such as objective, subjective, trustworthy, neutral, authentic, or artistic. He suggested it is better to describe the processes and what the researcher/inquirer brings to those processes, and "then let the reader be persuaded, or not, by the intellectual and methodological rigor, meaningfulness, value, and utility of the result" (p. 576).

Trustworthiness can be achieved in several ways, all dependent on the researcher's ability to describe the data and its analysis. Although Creswell (2003) recommended eight primary strategies for trustworthiness, the researcher used the following three:

(1) Triangulation among different data sources of information (interviewing, documentation review, observation) by examining evidence from the sources and using it to build a coherent justification for themes.

(2) Member-checking to determine the accuracy of the qualitative findings through taking the final report or specific descriptions or themes back to participants and determining whether these participants feel that they are accurate.

(3) Clarifying the bias the researcher brings to the study, which allows for self-reflection that creates an open and honest narrative that will resonate well with readers (p. 196).

For the researcher, such strategies were important to ensure respect for the participants and to avoid ethical issues at any time during the research.

Subjectivity

The researcher was very aware of the procedures in place at JSC, the research site, including the requirement to acquire approval from the CPHS, the JSC institutional review board, in addition to acquiring approval from the GWU IRB. The researcher was concerned with the time factor, since once the Space Shuttle program was completed in June 2011, the rate of retiring astronauts expedited. By the time she began her interviews, one invited Spacewalker had resigned to return to private industry, so was no longer available for the interview. By the time she finished the interviews, another Spacewalker had retired. However, because she had 21 volunteers and 20 actually participated in the study, an insufficient number of participants was never an issue.

The researcher had no issues of conflict of interest for herself. She is currently a consultant and most of her work is with a small, disadvantaged, women-owned business which currently has no direct business activities with the Astronaut Office or any of the current Spacewalkers. Regarding the concerns for bias, Creswell (2003) suggested the researcher should clarify the bias she brings to the study. "This self-reflection creates an open and honest narrative that will resonate well with readers" (p. 196). For the researcher, self-awareness becomes self-analysis, which, according to Patton, has become a requirement of qualitative inquiry.

Patton (2002) also commented on reflexivity and voice and referred to the qualitative analyst as the reflective owner of his/her own voice and perspective and provides another mechanism for the researcher as she collects, analyzes, and reports the data, ensuring trustworthiness. "A credible voice conveys authenticity and trustworthiness; complete objectivity being impossible and pure subjectivity undermining credibility, the researcher's focus becomes balance—understanding and depicting the world authentically in all its complexity while being self-analytical, politically aware, and reflexive in consciousness" (p. 494). Reflexivity reminds the qualitative inquirer to be attentive to and conscious of the cultural, political, social, linguistic, and ideological origins of one's own perspective and voice as well as the perspective and voices of those one interviews and those to whom one reports (p. 65).

It was a positive factor that the researcher had observed the research site for over 40 years as her place of employment and has maintained strong friendships and professional relationships there. However, she was constantly cognizant of her perceptions and interpretations to avoid disrupting the analysis of the data and conclusions. Her knowledge of the organizational culture at JSC and of the Astronaut Office added value to the study because she understood the interviewers' discussions without having to ask more questions to understand meaning. Knowing the organization and the people provided a comfort level for both the participants and the researcher and contributed to very meaningful data. The participants did not appear to become uncomfortable at any time, either with the questions or with the process of the interview. No interview was stopped because the participant became uncomfortable or wanted to stop early.

Human Participants and Ethics Precautions

The researcher followed the procedures defined in the GSEHD Handbook as they related to collecting data from human participants. She also followed IRB procedures, both GWU's and JSC's, including acquiring the informed consent form for each participant. Although the IRB process was tedious, the researcher ensured that both processes were satisfied before proceeding to the next step of the study. The participant data is filed and secured, along with the tapes and each of the signed Informed Consent Forms, the reviewed transcript with her margin notes, the interview protocol with her notes taken during the interviews, the official biographies, and the summary of the biographies she used during the interviews. Although some of the participants knew other Spacewalkers were participating in the study, no one other than the researcher knew exactly who was interviewed. To ensure confidentiality, no identifying data for the participants was included in this report, although descriptions of unexpected incidents during spacewalks will be familiar to people in the program and perhaps make it easy to identify the speakers. If desired, a final copy of the publication will be provided to the organization for review and the researcher will ensure protection of confidentiality. As expected, there were no risks to the participants from whom data was collected for this research.

Summary of the Chapter

In Chapter 3 the researcher discussed the research methods for the study. This is a case study because the researcher determined that was the best methodology to capture the information she would require for the study. One problem the researcher encountered was the participants' tendency to speak only about their technical environment and their

tasks, which concerned the researcher with results that may have been less descriptive for the qualitative study. However, as the analysis proceeded, there was more than enough data to eliminate further concerns. The data was not difficult to obtain, the participants were more than cooperative and seemed to enjoy the opportunity to talk about their roles. The questions initiated a flow of discussions that were very informative of the experiences of the participants. The data collected were analyzed to understand the socialization process within the organizational culture. However, the participants did not describe the process as *socialization* in a high reliability organizational culture, but rather as the everyday routines of people working in an inherently dangerous environment. The findings from the literature review add to the literature relating to organizational creation of environments that create members who feel as though they really belong in the organization and maximize their contributions to the organizational culture.

Chapter 4: Results

Overview

The purpose of this study was to answer questions about the socialization of employees into an organizational culture, in this case, the high reliability organizational culture of the EVA teams. This chapter describes the findings of the qualitative one-on-one interview study of 20 participants who are designated as EVA (Extra-vehicular Activity) astronauts, or Spacewalkers. To maintain their confidentiality, only general information about them was provided in Chapter 3 and no identification was included in the verbatim quotes included in this chapter. The participants described in their words the experiences in the formal and informal processes of their socialization as newcomers in different organizational cultures as they trained to become astronauts, beginning with ASCAN training through EVA team training, which prepared them to perform an EVA on orbit (in outer space). The interview data provided five major themes.

The major themes of this case study derived primarily from the interview data provided by the participants, but also from the documentation reviewed by the researcher and observations made by the researcher in the EVA environment. The researcher reviewed documentation to better understand the background in which she would conduct the study and to clarify any specific topics to put things into context during the interviews and later during the data analysis. By conducting a qualitative study, the researcher was able to collect data described by the participants as they talked about their experiences as newcomers, which occurred several times after their selection as ASCANs, the trainee level upon selection into the Astronaut program. The outcome of their training was visible when they finally performed a spacewalk, but the participants generally described routines and the people behind the scenes who not only prepared them for the hazardous

work, but also helped them to succeed in the high reliability organizational culture of the EVA teams.

To review, this case study focused on a primary research question: What are the socialization processes in the high reliability organizational culture of the Extravehicular Activity (EVA) teams at the NASA Johnson Space Center?

The following two sub-questions provided the researcher with discussion opportunity.

(1) What are the formal socialization elements? (a) What does the general orientation include? (b) What does your safety training entail? (c) Where are the interactions of the teams, members of the other teams besides the EVA) Team members? (d) Who provides your safety training once you have been assigned to a specific mission? (e) When does the team start developing?

(2) What are the informal socialization elements? (a) How did you determine what were the norms and principles of the team? (b) Who are the experts around you? (c) What were some "upending experiences" (those deliberately planned or accidentally created circumstances) that made the team members become closer? (d) What were some of the "taboos" you learned from others? (e) How can you tell when the team members have built commitment and loyalty to the team? (f) How did others let you know you were ready for the Spacewalk?

The questions prompted the participants to describe in their own words what the organization, the environment, and the people provided for their socialization into the culture. Five major themes emerged from the interview data, documentation, and the

researcher's observations. The participants' verbatim excerpts are in this report to reinforce the results.

Major Themes

The participants' perspectives were the most supportive in understanding their socialization into the organizational culture of the EVA teams. When necessary, other sources were used by the researcher to clarify understanding of the environment and the organizational structure as described by the participants. The major themes were relatively consistent across the participants' descriptions of their experiences in the socialization processes in the high reliability organizational culture of the Astronaut Corps and eventually the EVA teams. The following are the five major themes that emerged from the participants' data derived from the description of their and their experiences.

(1) Expectations defined by organizational culture.

(2) Safety inherent in organizational culture.

(3) Participants' relevant experiences.

(4) Experts build trust.

(5) Organizational culture of collaboration.

Discussion of Major Themes

Theme 1: Expectations defined by organizational culture.

Training for the participants was provided by the three major organizations depicted in Figure 2 in Chapter 3, the Mission Operations Directorate, the Astronaut Office, and the EVA Project Office, with support from several other organizations. These are highly technical and structured organizations matrixed to one another for support and

have historically managed the EVA component of the human space flight programs. NASA and JSC funding and human resources are spread among them. Representatives from the different organizations bring to the teams the cultures of their respective organizations, merging organizational cultures the participants, as newcomers, began to recognize as the foundation of the culture of the EVA team.

As in the case of most newcomers in any organization, the context of the participants' knowledge of the organizational context revolved around only what pertained to them, which was the training and the trainers. For them, it was the trainers who were important. In some cases, the participants would have the same trainers as they advanced through the different levels of training from ASCAN to EVA Team. Although the training was supported primarily by the three organizations, the participants' immediate world was the closed-knit communities in which they were trained, small components of a much larger picture. The participants knew the policies and the training procedures and curriculum were developed jointly or specifically by several organizations. They knew that the EVA program management was responsible for developing the assessment criteria for the newcomers, but they also knew the implementation of the training would be carried out by the trainers and that they would make the comments to others about how well the newcomers were doing. For the participants, the organizational context was the immediate surroundings at each level of their training, that's what was important as newcomers.

When the participants had been selected into the Astronaut Corps, they were classified as Astronaut Candidates (ASCANs). The cohort classes participated in a 1-year program of very structured curriculum that included lectures, tours, and training in the

various training facilities. Once their training was completed, the participants were designated as *astronauts*. Following in the many traditions of the Astronaut Corps, when they "graduated" to astronaut level, they were presented with the silver astronaut pin. That was one big step for all of them. Each astronaut would receive a gold astronaut pin after his/her first space flight.

At first, the participants couldn't believe they were following in the footsteps of people about whom they had read and heard. Even when they had interviewed for the Astronaut Selection program, they had met or knew astronauts who had told them about the rigidity of the training, so they knew what they were up against. During that first year of training, the participants were introduced to the physical challenges of the NBL training, and soon they discovered their trainers behaved and spoke in ways that began to demonstrate norms, values, and attitudes for them as newcomers. The teams the participants encountered were seamless teams in which everyone had a role to play, no matter which organization they represented. Organizational success depended on everyone.

Stages of the Training

According to the participants and the documentation the researcher reviewed, there are several stages of training to become a Spacewalker. Based on how the participants described the different stages of their training, the process they experienced is depicted as follows.

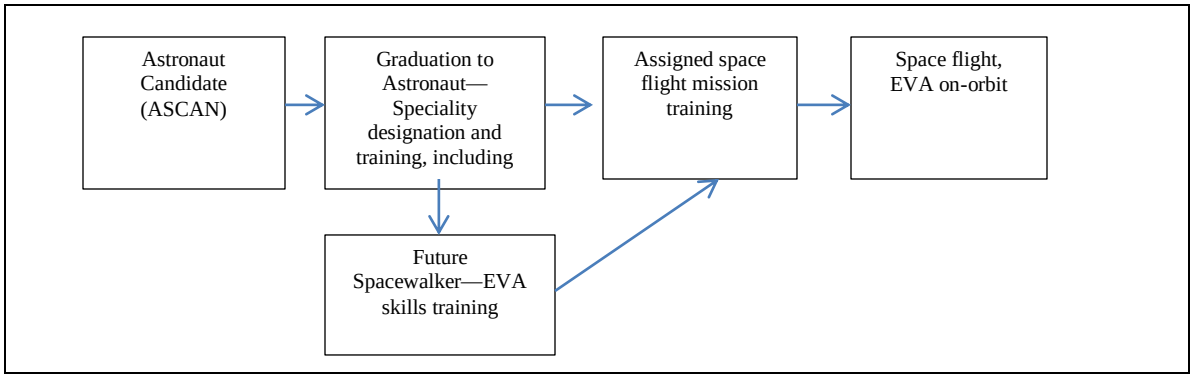

Figure 3: Astronaut Training Process for the Spacewalker

As the participants progressed through the different levels of training, they saw a hazardous environment with well-kept training facilities and people who had been there a long time and knew what they were doing. The expectation from others for the participants was to succeed by following the rules, listening to the trainers, practicing, voicing concerns, and always looking out for the others, the hardware, and themselves. If they did not succeed in all of this, they would be out of the program. For the participants the challenges weren't just about learning "the ropes" of the astronaut world, they were also about establishing their own reputations and meeting their own expectations to become full members of an EVA team.

The Price of Membership

The participants soon discovered that the price of membership in the Astronaut Corps was high, risky, and challenging both physically and mentally. They identified two primary factors which they said had made it difficult to qualify for the EVA program, much less an EVA team. One factor was somewhat of an organizational barrier, the organizational decisions made by those in charge of the EVA program during the early Shuttle era—remnants of that philosophy were still around. The second factor was the

challenge, both physical and mental, for becoming a Spacewalker. The former is not as difficult as it was when some of the participants first were selected to the Astronaut Corps, but the latter is just as difficult today as it has always been.

Organizational barrier—the EVA Mafia. According to some of the participants, the early leaders of the EVA program, mostly astronauts, made decisions based on assumptions about who could or could not perform an EVA. These people were legendary—they were called *the EVA Mafia*. These few "good 'ole boys" were built "right," had the "right" strength, and had what appeared to be inherent skills to perform the challenging manual and tasks requiring dexterity for the EVA in a training space suit that seemed to only fit them, while using cumbersome and heavy tools. They seemed to control anything to do with the operational aspects of the EVA program and set the standards and much of the discipline of the EVA program. It seemed they decided who would perform the spacewalks. No one seemed to challenge their decisions.

The participants pointed out that although the early EVA training was structured, they had soon discovered there were no clearly written procedures, no standardization, and much of the evaluation appeared to be subjective. Several participants called this the EVA Mafia philosophy. The participants remembered others saying that without an objective assessment, it was difficult to truly say why some astronauts were selected for the EVA program and others were not. Those who asked didn't always get a response that would allow them to try again. A participant described what he had experienced himself when he first joined the Astronaut Corps. "…we had to meet that standard or you weren't to be considered…there was definitely a mindset that if you complained or

whined or said anything negative, that the Mafia would make sure that you would never do one [an EVA]."

Another participant had heard others say about becoming members of the EVA program—you just did—or didn't. He said, "They [EVA Mafia] had some criteria by which you could be part of the team, it probably wasn't very fair, not very realistic, from the space flight standpoint, big heavy tools to fix the Shuttle, for instance. You have to handle all of the tools, [even though] you don't have to worry about the weight of them in space…"

Other participants noted that although the EVA Mafia was historical in the Astronaut Office by when they had arrived, they could see remnants of their philosophy as they went through the training. They defined the training as very task oriented, with little attention to friendlier methods for familiarization in the NBL and in the suit. A participant said, "The EVA Mafia wasn't necessarily present then, but some of the artifacts and the way the training was set up seemed to reflect that…not a whole lot of instruction…how you get in the suit, here's the tools, here's the tasks, go at it, but nothing on proper body position, or here's your work envelope, here are some concepts to consider out there, just the procedures…"

One participant had been part of the so-called EVA Mafia. When the EVA Mafia had evolved during the early Shuttle era, other than what had been historically defined by the early Apollo EVA [moonwalkers] program, there was little definition of the requirements. A handful of other astronauts who wanted to be Spacewalkers, including him, had assumed the role of managing the program and defined it in their own terms

according to how they had understood the requirements. They had made changes to accommodate the Shuttle program requirements.

A new era of inclusion in the EVA program. The participants realized that if things hadn't changed in the selection process for the EVA program, some of them may not have had the opportunity to participate. They discussed four primary factors that caused the EVA program to change to allow more access for all of the astronauts, instead of just a few:

(1) The program required more spacewalks for the "Wall of EVA," an anticipated 100

EVAs to build ISS. A participant said, "There were very few EVAers, you couldn't even get people involved…The program became operational, deployed, and you couldn't do it with the same five-six people." For example, EVA had been tested and operated for the Shuttle era, including launching and repairing the Hubble Space Telescope, and had made the EVA operational.

(2) The "club" could no longer be exclusive and senior astronauts knew that attrition was

taking its toll and corporate memory was going out the door with it. This participant remembered, "…I was…talking to a couple of senior guys who were…going to fly [in space]…they could see the handwriting on the wall, that they can't fly in space forever…a lot of their colleagues have left…a lot of knowledge is walking out of the door… two guys, in my opinion…started

really working hard to identify people…they said, 'yes, we can teach this person and we can pass along…'"

(3) The tools with which the astronauts trained in the NBL were redesigned. They were no longer bulky and heavy, thus not as cumbersome for those who did not have larger and/or stronger hands or ease of dexterity.

(4) An additional phase was added to the EVA training, the EVA *skills* training for those astronauts who demonstrated *potential* for becoming Spacewalkers. These astronauts would be assigned to the EVA program, along with those who had met the requirements right away during the initial training. A participant said, "We set up the EVA skills program…the training…the evaluation…we could measure how people were succeeding. Training + evaluation=success…" The EVA skills program provided metrics to determine additional steps for improvement instead of immediate rejection from the program, as had previously been the case when the astronauts did not do well in their initial astronaut training.

The organization had made access possible by making decisions based on fact and data, not just assumptions. Data had been collected, evaluated, and redefined into new techniques and activities that would allow for practice and evaluation opportunities for those who aspired to become Spacewalkers. All astronauts now had an opportunity to become Spacewalkers. A participant explained why the changes were good, from his perspective. "It's [EVA position] pretty coveted. It's a highlight. Being a commander [in a Space Shuttle or ISS mission] would be a coveted position. But, probably in a lot of folks' minds, it's the top. It's the most challenging, obviously very invigorating. In terms

of rewards of the experience, it's definitely a highlight to go outside, climb around outside." Another participant summarized the differences between the era of the EVA Mafia and now. He said, "…everybody has a fair shake, it's a lot more structured now, we have a lot of boundaries and definitions and conditions and criteria...if you can pass the criteria, you could be qualified for EVA...if you can't, then you know why you can't…you can improve them, maybe pass them one day." The new era provided more opportunities but also added complexity to the program and to the environment.

Theme 2: Safety inherent in organizational culture.

The participants were quite descriptive of the excruciating and overwhelming training challenges they experienced, not only physically and mentally, but also in their ability to keep up with their ASCAN cohorts. They soon learned that they were always being evaluated, everything mattered, not only their skills, but also their attention to safety, especially not becoming untethered from the mock up ISS in the NBL. Some of the participants remembered how their success greatly depended on the people who were training them no matter how much rank the ASCAN had had in his/her past career. It was the trainers who would provide the understanding of the inherent dangers of the work. Working together was key to personal safety and to the lives of others—"egos were quickly checked at the door," according to a participant.

The participants described the environment of the EVA community as very structured around the inherent dangers of the training and the spacewalk. When the researcher asked about their "safety training," most of the participants said safety was not presented as "Safety 101," but rather that it was an inherent factor in the environmental context of the EVA Team, not a topic set aside for separate discussions. Safety was built

into everything they did. For the participants, the environmental context mostly consisted of the Neutral Buoyancy Laboratory (NBL), the simulated environment in which the participants practiced continuously for the EVA on orbit; wearing the space suit for training and working in the NBL; working with the tools to practice using them for the tasks to be performed later in space; and, a multitude of people who were there to train, evaluate, and transition the newcomer into that environment. The following is their perspective of the environment in which they learned the ropes of the EVA Team culture.

Learning the Art of Choreography in the NBL

A few of the participants referred to the NBL training as *learning the art of choreography* because it required very specific motions. They learned that the NBL had its own culture and that their success depended on getting to know that culture. They depended on those around them to familiarize them with the many details that could quickly create a dangerous situation, not only to the newcomers, but also to the divers and veteran astronauts working with them. The participants discovered it was hard to function in the NBL while wearing the suit and using the tools at the same time. But, they had to learn. The NBL experience determined many factors about their skills as newcomers/trainees and provided the future Spacewalker with the level of confidence to do the real EVA. Reinforced with the importance of situational awareness, the participants made sense of the harshness of the NBL environment, intent on becoming qualified in the NBL, as full members of the EVA program, and someday an EVA team. A participant talked about the feeling of responsibility they immediately developed with the trainees and the divers. "There's a huge safety culture in the NBL…it's like scuba safety on steroids…with a lot of people underwater. Everybody in the water is focused on

a task…all of the divers…are focused on holding a camera on somebody, helping with a tool…on somebody going up and down which could do damage to their ears, and you don't want them to get the bends because they went up too fast. The divers also have to be watched, but they have their procedures and then there's guest divers who come, we go in as divers, too, because it's so much easier to survey a task on scuba" [versus in the suit]. They had to be aware of one another.

The participants described the NBL as a close simulation of the environment in space, with the immersed ISS mockup in it to make the trainees feel as if they are in real space. For the participants, the experience raised the consciousness of the many factors that impact the Spacewalker. The NBL run was a forum in which others could watch, help, and evaluate them. A participant remembered how generic conscientiousness was a shared norm as he observed the actors in the NBL environment. He said, "… they also provide safety for their facility and you in their facility, and that's always real obvious…that gives you this…generic conscientiousness that, 'hey, we have to be safe here because, somebody could get hurt and it's not just me I'm looking out for, I'm looking out for my safety divers who, they are responsible for getting me out if something happens'…" The situation required more than just looking out for them. Training in the NBL was overwhelming for the participants, but they knew that they were never alone in there. Wearing the water space suit, this participant worried about basic things, such as going to the bathroom. He remembered, "…you're so overwhelmed, you think, "oh, my God, how do I do that, what if I can't pee, where do I pee, I have to do all of these things…" He soon learned that not only was he surrounded by people in the NBL, but there were also others ready to help him, "…there's a whole room in [NBL]

mission control with all of the people who designed the thing that you are manipulating, and they can help you…" For some, the experiences seemed familiar.

To make sense of the environment, the participants talked about relating it to previous experiences, including experiences as military pilots with aircraft experiences: "Going into the NBL was for me no different than taking a test aircraft out onto a range somewhere for a test mission. There's a control room, there's maintainers, here's a crew member, and then there's this piece of hardware out there, a system, that is going to take you out into this environment, you're not going there by yourself." Others had skills from their sports and hobbies, where they knew how to control floating in water and had an appreciation for the forces of gravity. Sometimes the NBL experience just didn't compare to anything else they had done, "…and if, you're in the suit, you're just moving around in a box…you're upside down, your whole body weight is all in the middle ring around your neck...You're in a casket that's shaped like you. The metal rings will hurt…there's always like a torque in the suit…" Their previous experiences had not prepared them for these new extremes.

The participants learned not to rush and become unsafe because that would affect their on-going evaluations. To some of the participants, it also meant they could affect the reputations they were establishing among their peers and others. More importantly, reputations could determine whether or not they would get to perform an EVA on-orbit. A participant said, "Developing a reputation, it's the whole process, not just the final exam and the grade…you may not get to do a spacewalk..." The participants' NBL experiences were even more challenging in the water training suit.

Becoming a "Suit Whisperer"

Mastering the water suit requires overcoming the challenge of getting into the suit and becoming familiar with the suit to the level of comfort where the suit is not a distraction for the task being performed. A participant called that level becoming a *"suit whisperer,"* getting the ill-fitting suit to do almost anything. The comment was made in reference to the television show, "*Dog Whisperer*," about the character that makes any dog do what he wants it to do. The participants actually had to learn to master two suits both of them close enough in design. One suit is for training and practicing in the simulated space environment provided by the NBL and the other is for the actual spacewalk. In the NBL, the participants wear a water suit, but for the EVA on-orbit, they wear a space suit different from the water suit, the Extravehicular Mobility Unit (EMU). They called the space suit by several names--a personal spaceship, a body outside of a body, a casket, an efficient piece of hardware, and the EMU. Both suits are very heavy. It takes a team of people to prepare and immerse the astronaut into the NBL, once he/she is wearing the suit.

The participants had to understand the differences between the water suit and the space suit, especially once in space. There were also adaptations the Spacewalker had to make while in either suit to ensure safety and efficiency, including the tether on both of them. A participant compared both suits, which helped to understand the complexity of the situation.

> You're in a self-contained space ship…you're dealing with the suit…the oxygen system …safety procedures…your safety awareness…when you go into vacuum and as pressure changes in your body, there are medical things to be aware of…in

> the NBL…it has its umbilical cords…behind you are extra lead weights…there's stuff on you…to balance out your buoyancy…the tools are exactly the same, the [EMU] is the same…what's binding you is an umbilical cord [in water suit] that is going off the surface, to provide you with the coolant and oxygen…the divers have to constantly be moving that big cord all around …sends water in, gas and data that's going through it...the divers have to manage it…In space, we don't have an umbilical. We just have a…very thin tether, on a reel that goes back to someplace that locks it to the structure…reels out and is attached …we can replug and put it other places to go further out…we have to manage that tether, know where it is...

The participants knew that mastering the space suit was critical to their successful EVA training and performing the real EVA, both challenging activities, especially as newcomers. A participant remembered how he had wished for more help from veteran Spacewalkers who had already worn and mastered the suit in space [EVA Mafia era]. With this type of help, he thought he could have learned to master the suit faster instead of going through his "mental battle of adjustment," as he called it. The participant said, "…their techniques and tricks and best practices were very rarely communicated down…you were pretty much forced to learn this on your own, thru trial and error in the water, thru failure with a veteran Spacewalker watching you screw up and telling you you'd screwed it up. Sometimes we didn't know we weren't supposed to do some of those things, no one had told us…" Little hints meant a lot.

Other experienced Spacewalkers did tell the participants that the mental capability required to work with the suit was not the same in the water as in space. In the NBL, the

suit was quite burdensome to work in, but once in space, the suit was much more manageable, except that in space there are other factors to be considered, such as the speed of the spacecraft, which is 17,500 miles per hour, while the EVA is being performed. Regardless of whether the Spacewalker performed in the water or in space, a participant pointed out that the mental capability of the Spacewalker played a large part in becoming a suit whisperer. A participant said:

> Much of the work you are doing is overcoming the deficiencies of that suit. You're fighting the suit. We move 800-pound modules inside the Space Station [in space]…you'll see 5'3" women out there who can't make 100 pounds soaking wet…moving things around the size of a grand piano, practically with their fingertips…some people are just smarter than the suit, but it takes an extreme mental capability to do or you do some combination of brains and brawn..."

An outcome of mastering the suit was *trusting* the suit, as well.

Trusting the suit. The Spacewalker is considered the operator, since it is his/her role to perform the EVA. As the operator, the Spacewalker has control over his/her mistakes, but little control over what happens to the suit. Maintaining the safety standards of the suits at required operational levels is a collaborative effort among many other people, not the participants. The participants trusted the people who took care of the suits and considered them experts at their work. Because of this, the participants didn't need to worry about the hazards and could focus on the tasks. A participant praised the suit maintenance experts: "We have extremely good hardware [the space suit], it's been in service for 30 years…and that is due [in large part] to a couple of organizations, like XA [mail code for the EVA Project Office], it tracks problems and makes sure it's safe. And

then people like Sunstrand [contractor company that built the suit but originally under a different company name]…the reason we are safe, it's…those guys." In spite of that good work, sometimes the suit was uncomfortable.

To whine or not to whine. When the participants were uncomfortable or in pain in their suits, they did not want to complain, although they were repeatedly told to talk about issues with the suit, especially when they were wearing the suits during the training. Others could then make adjustments to customize the suit fit. Some of the participants felt the culture did not allow them to complain. Others just wanted to please the instructors so refrained from saying anything. For others, it was their reputations at stake and it was important to establish credibility with their peers, the veteran Spacewalkers, and the other members of the team. No one wanted to be perceived as "whiner." Eventually, they had to overcome that mentality because there were very good reasons why it was important to report suit discomforts. One participant said, "…we are trying to deal with that mindset [of not complaining] because we were hurting, injuring people's shoulders, and we have tried to break that mindset and encourage people to speak out and to say, 'hey, that's a problem, this is an issue.'" When veteran Spacewalkers started listening to the trainees and legitimizing their discomforts since they had been through them already, the participants did bring up their issues.

A female participant remembered how proactive she had become in identifying the issues with her ill-fitting suits. She knew suits were only available in extra-large and medium sizes; therefore, she was aware she wasn't the only one whose suit did not fit right. By being proactive about her discomforts, others familiar with the same problems had helped her. In fact, the data collected from observation of the astronauts during both

water and space operational practices in the suit resulted in new techniques that accommodated a better suit fit for the NBL runs for everyone. She commented it was ironic that the data had made it possible to change the EVA Mafia philosophy about individual size and strength, since that philosophy had made only certain people eligible for the EVA.

> I don't want to make it a boy/girl kind of thing…being a woman in those suits and working in the pool, there are definitely some disadvantages just because they don't make small suits...we have discovered…the way that we do EVA in space, is not so dependent on that suit sizing and kind of a muscle, the man-handling you have to do in the pool to be successful. It's more about finesse, it's really a very…graceful event in space versus [what] you have to do in the pool…with gravity and the resistance of the water on you…I think it's funny they've [the organization] learned a lot about how the suit works and about what we should do with future suits by having a wide variety of people in them.

The participants knew that the suits had been built during the era when only a few astronauts were Spacewalkers and were all more or less the same stature, with past experiences that lead one to believe they were inherently skilled to perform the type of EVA tasks required at that time. Since the demographics of the Astronaut Corps and the needs of the program have changed, this participant hoped that a more accommodating suit design is in the plans so that there are well-fitting suits for any of the participants, not just a few.

> …a lot is based on the limitations of the suit design itself…we need more suits that are more forgiving of different people's sizes, those [current] suits are

> designed for the big guys. That's not any policy, that's just the way it is, it's an artifact, that's the way we were doing it, with just these big guys…it wasn't like a conspiracy or anything like that, …people designed the suit for the people doing the task [at that time]…So, hopefully with a little bit of malice of forethought, the next suits we design are going to be more adaptable.

The suits were one issue, but that still left the challenge of using the tools while in the NBL.

The Challenging Tools

Training with the tools while trying to control the suit, the tether, and dealing with the underwater environment added to the participants' challenges in the NBL. Some developed their own techniques for handling the tools, since the bulky suit gloves were sometimes an impediment. They learned that dropping a tool while in the NBL was something that was evaluated and potentially dangerous to others and to the equipment--and also embarrassing.

The tools were developed for use in space with tasks that could be tedious, intricate, and would often require an inherently skilled worker to use them. A participant described how the development of the tools during the early Shuttle-era EVA led to standardizing other things, such as bolts and the training for the Spacewalkers. This allowed the Spacewalkers to focus on the task and to not be distracted by the differences in the working environment. A participant remembered:

> A lot of things [were] developed over time to try to [anticipate] the next failure…how could you counteract it? We also tried to standardize the training…we standardized the interfaces…common size of bolt, a common

> double high-hit bolt…it was easy to operate and crews could train on the bolt one time and whatever piece of hardware that had that piece of bolt on the thing they [would know] how to operate it." With the tools, repetitive training would help.

Handling the tools. The participants learned that working with the tools on repetitive tasks resulted in repetitive training, with the trainers stressing the risks. For the participants, situational awareness became the norm. One participant said, "…they'll teach you individual tools, what you can and can't do with the tools…it just gets reinforced as you go in the water, you do the one-G's on the ground, they show you how to use it, then you get in the water, and you use the tools…" By the time they were in orbit, everything was second nature. They knew all of the rules, the risks associated with doing things a different way, but they also knew that at certain times they wouldn't have any choice if an environmental factor was suddenly changed. Repetitive training for potential risks made the participants careful and being organized at all times would help focus on a change in the environment.

In spite of all of the rules and caution, keeping the tools organized was often a concern for the participants, especially when they had a complex task to perform. Some of the participants had developed self-imposed techniques. A participant would say to himself while training in the pool and then on the actual Spacewalk—"it's safety, config, and task." This mantra provided a process for him to work in scenarios in which things could easily become chaotic.

> ...you have all of these tethers and all of these tools flopping all over the place and you need to be able to just close your eyes, and…know exactly where everything is…I've seen a lot of folks blow it off…it just propagates into making your life

harder and then creating a safety problem…It's when the other things are screwed up…then that's like the Swiss cheese, it all lines up and the accident happens.

Several of the participants talked about self-imposed techniques that helped them.

Another participant was determined to learn the tools well. He would go back to the NBL tool room at night, the second shift for the NBL workers. He said, "I'd go after work, I'd pull the tools out, work with the guys, ask them how to set the tools up…I'd talk to the divers all of the time. I remember…getting ready to do a skills run and the pre-brief we got was not very detailed …I don't know what I'm supposed to do…got to the NBL and one of the divers said to go get some tanks, and a ratchet and went to the truss, showed...how all of the hardware works." Seeking extra practice opportunities helped those who did not possess certain inherent skills.

Inherent and potential skills among the cohorts. The topic of inherent skills came up several times during the interviews. Some of the participants talked about how some of the cohorts had struggled to learn the tools while others seemed to have inherent skills, they were "naturals" when it came to certain skills. A participant described one of his cohorts, but the description of someone with inherent skills was not exclusive to that one cohort.

> …Drew in the office…he's a mortar head, he builds engines…has a very good reputation. You have to be taught the tools, it's not even those successful Spacewalkers who weren't mechanical or had adaptability or the familiarity, or intuition, they are good…when things have gone off schedule, that's when I've heard that someone like Drew knew exactly what tools were there, what size they were, and which ones to use to go bang on this thing, makes sense to him very

quickly, versus someone who wouldn't naturally know…[how do you] figure [that] out during the interview?

Not everyone had inherent skills, though, nor was as big and dexterous as the earlier Spacewalkers. The "new" EVA program made practical changes to the tools, made them easier for everyone to handle them. The changes resulted from data collected from the real-time use of the tools in space. A participant compared the older tools to the newer tools--there were differences in size, mass, and weight in the water, but new data resulted in the NBL tools being redesigned to be more like the tools used in space. He said, "…in space this tool would have mass, but it would have no weight…manipulating it in space would be relatively easy, but manipulating in the pool, in the suit, was extremely hard…at that time, that was the gold standard...now we think, 'now that's a little ridiculous…no reason you'd have to haul a 40-pound tool in the slippery, wet glove, all of these kinds of artificialities'…we…made some neutrally buoyant tools and a whole lot of people ended up being able to do it…" Everyone benefited.

The lessons learned became data to continuously update EVA training. The changes also affected the evaluation process by making it more measureable and objective. The participants talked of having more than one or two opportunities to pass the assessment to eventually become certified for EVA on orbit. This participant remembered the skills assessment:

> ...[the assessment team] would evaluate…not using tools in an unapproved way…not doing what was going to be dangerous to themselves, or dangerous to the equipment, [not] be overly aggressive on how much they were trying to do…cut back some. And if the [assessment] inputs were very significant, we

> would have another visit later after they had had a chance to modify what they were doing and have a run or two more under their belt before we'd come at them again.

The participants knew that mastering each experience would only make it easier for the next one.

Theme 3: Participants' relevant past experiences.

Obviously, all of the participants had previous relevant experiences that qualified them for the Astronaut Corps. The researcher asked them to describe some of those experiences they could attribute to expediting their transition into the new astronaut position. Those who had been or were in the military described some of their experiences as having been very relevant. Others who had not been in the military also found relevance in their work, including one participant who had worked in a HRO and the only one who used the term "high reliability organization."

Most of the participants had some previous experience with sports or hobbies and they talked about using those experiences to help them in the training. Having been newcomers before in other organizations, they knew how to familiarize themselves in a new organization. They knew how to reach out to the new people with whom they worked, a common denominator among the participants as a factor for becoming comfortable in their new surroundings. They reached out to their ASCAN cohorts and became close to one another. They looked out for one another. They shared their perceptions, learning to trust each other. A participant said, "That's a way to have a sounding board…There's no room for egos where they [the astronauts who were

trainers] think they can just roll people over and squash them. There's too much at stake." Those relationships carried over as astronaut contemporaries.

Who Are the Spacewalkers?

The researcher knew most of the participants. She recalled most of their astronaut interviews, those whom she could remember, since it has been a few years since she had been on the Astronaut Selection Board. She remembered the humility among them, when they had been applicants being interviewed. In spite of their achievements, it appeared they took very little for granted. The humility was obvious, once again, as they participated in this study. They expressed gratitude for being in the Astronaut Corps and for the opportunity to have had the unique EVA experience. Each participant was grateful for what he/she had known when they had first been selected to the Astronaut Corps as ASCANs, but some thought that some of their cohorts had been better prepared for the new role of astronaut.

In remembering his experience as a newcomer to the Astronaut Corps, one participant expressed his viewpoint of the concept of newcomers as something we do all of our lives.

> …in life you're always going through phases where you work to get to the top, you work through school and you graduate, your first year as a freshman was really hard, but by the time you're a senior you're sort of in charge...you go to college and you're a freshman again…you get out of college, and for me I went to flight school, where you start over again, and you work your way through the squadron, then you get a new squadron…that process is…like a saw tooth, you climb the ladder, then you back over, then you climb again…that probably just

> continues through life. And, I think in the military, we do, whether you like it or not, you're assigned to a different job, you probably get more practice than a lot of the folks do, doing that, the adaptation and the integration into a new organization.

The participants repeatedly experienced the process of adjusting to the new organizational culture at each new level of training. A rigid training curriculum and the built-in support from the people at each phase of their development kept them focused. Although they had diverse backgrounds, the participants made sense of their new environment by reaching back to previous experiences, sometimes helping cohorts and contemporaries, too.

Backgrounds that became relevant experiences. Because of the nature of the astronaut position and the history of the Astronaut program, since the original seven astronauts were all military men, one might assume that military backgrounds are more relevant to the culture of the Astronaut Corps. As described by the participants, in the EVA environment, there are characteristics similar to that of a military environment, including operating and working in hazardous conditions, discipline, rigidity, as well as the ability to deal with conflict, build trust, to react to unexpected situations, and high levels of motivation and expertise. Based on the participants' comments, some of their pre-astronaut experiences included some of these characteristics, although not everyone had experienced all of them. They also did not all share the same *depth* of experiences for working in hazardous conditions. The participants provided a few examples of pre-astronaut experiences they said were relevant to their becoming familiar with the EVA environment and organizational culture.

The newcomers found that *time* was critical in this world of operations. They learned about several factors that could lead to loss of time. For example, a participant pointed out that avoiding unresolved conflicts could later result in loss of time. The discussion also referred to the importance of having the ability to handle conflict. The participant related that some of his cohorts, even after ASCAN training, could not handle disagreements very well without becoming uncomfortable. He found that his military experience had provided skills to resolve conflict, although he was aware that hurting feelings was a concern for some. "But, those of us from the military, that type of culture, we just get face to face and start to argue, but you can see others may be uncomfortable watching that or doing that…if we only have 5 minutes to figure it out, you have to have worked out a method of working confrontations that doesn't necessarily become extremely personal." Another participant, also former military, added, "…working to a time clock, space flight is operational, things have to be done in certain time frames, and there's timely decisions have to be made that have consequences. That's where the NBL training certainly comes from, an operational background, military or not, there's a timeline, there are consequences…" Safety concerns arise.

Regarding safety, the participants who had military backgrounds remembered quickly grasping its importance in the astronaut environment. A participant found many similarities in the work he had done in the military, experiences which developed the sensitivity for being proactive rather than reactive. He said, "Having been a military pilot, I think safety is preeminent…So that obviously translated, it was an easy transition…flying airplanes [and] spacewalking, there are similarities…there is a

sensitivity that you develop, you don't want to induce risk by rushing or being incomplete, you become a lot more proactive than reactive."

The skill to react quickly was another factor described by a participant. He had worked in an aircraft that had provided him with the mentality to react to possible malfunctions and looking for ways to quickly resolve an unexpected situation. He said, "...That mentality was always there, I didn't have to learn that, how to do that kind of stuff. It made the transition much easier…you just know there are some things you have to react to pretty quickly…we're ready for those and if it happens, we know, we don't just sit and talk about it, we just do what the procedure says…or injury, or whatever is going on."

Another participant, a former military, recognized certain traits he had observed in other people during his career as traits on which to build trust. He saw the same traits in his NBL and EVA teams, where so many of the people had positive attitudes, behaviors, and high levels of motivation and expertise, an environment that lent itself to building trust. He said:

> …the training process, my experience took care of getting ready to be a potential EVA, a Spacewalker, and then a flight assignment to go execute the EVA…certainly the coaching that I got from very good flight controllers, instructors, with lots of experience, as well as experienced astronauts who took the time...it's part of the natural cycle of the team, I think, the experienced folks helping the new folks…It's very much like the military where everybody is focused on a mission and accomplishing a mission…we trust each other and that's implicit…it produces a high level of trust…the training process reinforces

> that…It's a very healthy environment—there's a lot of trust…dependency, loyalty, and commitment…

Another participant said, "…to know someone is covering your back."

These participants remembered how previously working in an inherently dangerous environment had prepared them for the EVA experience. A participant, former military, compared his experience to cohorts who had not been in the military but how the ASCAN training had provided experiences others had learned in the military. He said,

> ...just working in those types of dangerous environments, where you have to have the discipline to go do that work…we had several folks who had basically just come out of graduate school, or had just worked in research labs, where on a bad day you don't get your data, and the focus and intensity of those military folks, who just kind of brought viewpoint to EVA. They seemed to be fine. We'd all been through ASCAN year by that time…

Another participant spoke about his previous career in a HRO. His former organization had looked at NASA as an example for planning a task involving safety at that company. He said:

> …at [also HRO company] there was an attempt to look at some of the examples of NASA in the way that business is done in terms of oversight and follow-up and requirements and regulations internal to the organization to help define what the structure and operations of that organization were.

Once at NASA, he had compared the high reliability organizational culture of his previous organization to NASA's and noticed less reference to *safety* in the NASA

environment, although it had certainly been present in everything he had done as an astronaut. He said,

> ...so when I came here my expectation was to see some of that, and I saw that, to a slightly lesser degree [in the EVA environment], but definitely the awareness and desire to have consideration for safety in everything that we do…That's probably what set me up and allowed me to have an open mind for that type of environment here.

Diving, whether for pleasure or for employment, was an experience that helped some of the participants in their NBL experience. A participant, a former educator, remembered his experience when he was selected as an *educator* astronaut. The educator discipline became a qualification for the astronaut program because of changing objectives of the human space flight program to provide a forum to interest children in scientific, technical, engineering, and math careers, something very relevant to the U.S. workforce. The educators who have been selected have backgrounds as educators in the math and science disciplines and are trained with the other astronauts for full integration into the program. This participant remembered:

> …coming from a non-technical background…I did have a background in [working in the water]…I had spent time doing…technical diving and working around water, working around ships and scuba diving…any part of this job that I felt I had eased into, transitioned to, doing pool training was probably by far the easiest…

The bigger challenge for this participant had been overcoming being intimidated by seemingly new challenges, "…of the things that I had to learn…just having the background working in water, not being intimidated by that piece of the pie, piece of the puzzle helped me out quite a bit…" Water activities helped the next two participants.

A participant had master scuba diver experience and found the experience useful and working in the NBL was exciting and non-threatening for him. Scuba had taught him how to work in the water. He said,

> …The point is you're in the water, you can move in different orientations, the mobility and the orientation, that's why we do the training underwater. And I think just the familiarity with all of that is what made it exciting and non-threatening to me because it was all familiar.

Water skiing was a relevant experience for this participant. The experience helped relate the body position while in the water, coordination, and getting the body to do certain things, "I'm not a professional water skier, but I have water skied before, I have snow skied before, and just try to think about how to get your body to work to do something like that, and it makes it a lot easier." Water wasn't the only environment in which the participants had gained certain skills.

As a rock climber, another participant had developed mechanical reflex experience that was useful to him when he trained in the suit in the NBL and learned to work with the tether. "…There's just the whole mechanical reflex and I treat being out in a spacesuit on the truss in the pool like I'm on a cliff…you just get in the water, and you don't feel good unless you get a heightened background awareness when you're moving

around that you're not safe until you get that local tether down." Experiences like this develop not only physical but also mental skills.

The participants found that many things they had done previous to their EVA training mattered in their battle of mental and physical adjustment when they finally became qualified for EVA, the Spacewalker role. In their astronaut training, many other experiences had contributed to their success as future Spacewalkers, something all of the participants said, in spite of the different depths of experiences among the diverse group of participants. They referred to themselves as being part of a pyramid concept, they were the operators at the top of the pyramid but the other people who supported them and provided the structure from which to operate were the inside of the pyramid. Consistently, the participants gave credit and expressed appreciation for the others who had lifted them to the top of the pyramid, regardless of the depth of experience among the participants. Some of the participants were grateful others before them had cleared the path.

From the Women's Perspective

The reader should know that, although the Astronaut Corps has been inclusive of women since the 1978 selection, being a woman, an astronaut, and a Spacewalker is still a very unique combination. The women who are Spacewalkers have had their own challenges. The EVA world is a world that was initially built for men considered to be the "right stuff" in size, strength, mechanical ability, and dexterity. As in other male-dominated disciplines, some of the women have had to overcome some of these requirements; however, these appeared to also be factors for some of the male participants, thus the discussions about the inherent skill factor. Obviously, the factor is

not exclusive to women. Other factors such as mentors and role models are as important to women as they are to men.

A participant shared her experience and the importance of the other women mentors in her career path. Although accepted by her male counterparts, sometimes she had been surprised at their reaction when she did well on a particular task. She was glad she had made her career in an environment like NASA's and that other women had cleared the path for her.

> …I never had any problems, I always had female mentors in my career path prior to being here, even in college and graduate school…when I first arrived here…I had females in my command chain…I never thought it was impossible because these women did it, I can do it, too…I really never actually feel particularly as though I was biased against, I felt I just had to do my job…I feel very lucky to have worked where I did …when I first started, I was in many…meetings where I was the only female…other women had already had to field that path, when I came in [to NASA], I was accepted, I think men were surprised, I'd give a presentation and they come up afterwards and tell me that they were impressed, I'd think, "don't you expect everyone to do that job?"

In the opinion of several of the participants, male and female, all of them had been able to advance to the next levels regardless of the diverse backgrounds because of the way the training program was structured, including the curriculum and the people who supported and trained them. A participant said, "…it wasn't long—my experience was steeper and theirs [his cohorts] was more gradual, but we all got to the same point…That says a lot of things for our EVA training program…that it is able to take this

wide variety of people and smoosh them all into the same file and get a product that's the same." The training had equally qualified both military and the non-military cohorts to transition to the next level.

Theme 4: Experts build trust.

Although this study is about the EVA Team and the socialization of the Spacewalkers, the study would not be complete without including the participants' descriptions of the others on the stage of the EVA experience. The trainers provided the participants with much more than procedures and how to perform a task. By the time each participant was assigned to an EVA Team, none of them could question the trainers' expertise and skills or their loyalty and commitment. The participants found it hard to believe that these often very young trainers could have such control over the older, seemingly well-prepared trainees. In addition to the technical knowledge and skills they had imparted to the participants, the trainers had also shared their knowledge of the organizational culture with them, sometimes just by taking a few extra minutes to clarify something that wasn't in the manuals or procedures. In this type of environment, the participants focused on learning to perform the specific tasks for their EVA assignment. Each new EVA Team adds new expertise to the EVA community.

Learning from the Experts

The participants identified the experts that support the EVA program. A participant said,

> The experts around me are the divers, the people at the NBL, you've got XA, DX, the Astronaut Office, the Engineering folks, the Safety folks, all of the people who come to the NBL to help you out…The divers and the NBL people, they

> are…the ones who can see us make a mistake…You tell them, 'if you see anything, you let me know, if you see I can do something better, let me know." They have seen others do some of these tasks before…if you don't cultivate that relationship, that doesn't help.

Instructor astronauts were key to the learning, too.

The instructor astronauts (IA). Instructor astronauts are veteran Spacewalkers who have performed the EVA on orbit, some just one or two and others several times. Their experiences are integrated into the training curriculum, lessons learned that become valuable data for new training. The participants valued them as coaches and mentors because the IAs understand the newcomer's status from personal experience. They can interpret the experience to make the newcomer's specific training much easier to understand. A participant fondly remembered how his assigned mentor's personality and expertise had appealed to him and he had tried to become like that mentor, too. "He gave me great pointers, he was such an easy guy, laid back and understanding about the difficulties that we could have…a good leader, mentors, and we had lots of astronauts like that. I try and model my behavior to new astronauts as he did to me." The participant also provided a good reason for mentoring, "Mentoring is very important at the operational level, extraordinarily important...it's important to confidence, technique, development and safety. It feeds directly in the development of a safe operation."

Another participant valued an IA because the IA pointed out mistakes, which became invaluable training experiences to the participant. The participant also learned from that mentor that mistakes were allowed--to a certain degree. He said,

> You've got to have the mentor…they are the ones who infuse you with the appropriate amount of attention and fear about what you are about to do, and they are good at that…we all make mistakes and coming from someone who has made them, hearing from the experts who have made their own mistakes…You realize you could do it, too, and you realize this person had a career, afterwards. Those experts are key role models, too.

A participant remembered how IAs had worked with him during the NBL training, but some had been more motivated than others in the way they helped with the training. In either case, getting real-time critique from those who had already performed an EVA on orbit had been extremely helpful for him. He said,

> …I always felt it was good having someone there watching. It's a very physical thing you go do, it's like dancing, or doing something like that, or sports…how you do things is very important, especially that early…you're trying to develop the techniques and habits. And, there was no requirement, it just depended on the motivation of the instructor and their perspective on things…

IAs also have perspectives on capabilities.

Organizationally, it is also important to have people who are capable of recognizing the levels of abilities to enable accommodation for continued development of all its members. This participant is a very seasoned Spacewalker and IA with several EVA missions in his experience base and a product of the EVA Mafia era. He recognized the range of different abilities among the Spacewalkers, including inherent skills, and described how he had learned to distinguish the better skilled people through observation, participation, and making input to the trainers. He said,

> There are certain people who have an inherent aptitude for EVA. They tend to be people who built things, maybe from rural areas, who made their tractors and equipment work without taking them to the shop and then picking them up when they were done. They are the self-reliant type and you can tell. When you are an instructor and you've instructed a lot of people, you'd be very surprised how much you can learn quickly about how well they are going to respond…I know by how they move…touch things…handle the button, I see what they are looking at, are they noticing the right things or not. I can see it…act on that impression. You'd be surprised how quickly, if you challenge people with experiences, you're watching and participating, how quickly you will know how they will do…it's people with aptitude.

A participant remembered the evaluation process for all Spacewalkers, no matter which level they have achieved. The skills, aptitudes, and attitudes are constantly graded. Key to the evaluation process is input from all of the trainers who report to their respective representatives on the EVA Analysis Team (EVAT). A participant had been on the EVAT but continued to be evaluated in his role of IA. He described the process of the evaluation,

> …we have…the EVAT…representatives from the Astronaut Office, from the DX community, from the XA community, from the tools community, Engineering [Directorate], they all come together and watch us run a dress rehearsal…they watch how we plan to do the mission for that EVA...We get all kinds of constructive feedback on how we should do things...they will tell us that we will have to change our procedure…if they see any safety violations…they rate me,

> the roles can switch…I can be the IA one day, then…later…they'll evaluate me for my spacewalk.

The other guys on the EVA Team. It is these "other guys" who provide the elements of what is going to be evaluated. Without a doubt, the participants respected their trainers, no matter if they were IAs or divers, test directors, test conductors, medical doctors, or any of the other people who were always working with the EVA Team. They described the divers as contractors employed by Raytheon Technical Services who participated in the NBL runs for the EVA development, not only for the run itself, but also for the initial planning, pre-brief, run, and debrief. These were often very young men and women who were initially trained in the military or offshore oil industry and remained proficient because their organization maintained that standard. At some point, the training became a tradeoff—the trainers were learning, too, in their roles as EVA Team members. They, too, had career goals, just as the astronauts do. A participant said,

> …They probably want to progress…they [also] will then get assigned to a mission. That's a big deal for them, just like it is for us. Then they recycle to a new mission after the mission has flown. Most of them are fairly young, but they are really sharp and experienced …They are experts in their systems…the tools…the suit, the task that we're doing on-orbit…

The participants had noticed some of the things the trainers do to become experts. Often, the trainers would go to extremes to be able to put themselves in the same position as the trainee, so that they could see things from the trainee's perspective. A participant said,

> One of the challenges for EVA training is the trainers themselves and the EVA Team, they don't get to spend the time in the suit. They can see us doing it, some of them do get into the suit…most of them do, at least some number of times…get…in the suit…they learn by watching other people…see how other people succeed and fail and can pass on that knowledge because they saw it…

The participants were impressed by the trainers' dedication to enhancing their own training skills.

A participant commented on the dedication of one of the trainers on his EVA Team. A younger person who had just been learning the ropes had impressed him when she quickly produced a document that was needed for the training. The participant said,

> …I thought our EVA lead was very experienced and he was great, but the task person, she was very sharp…very attentive to detail…when there's lots of changes…it can be very challenging for a person to get in inputs from all of these different people, and putting it down into actually the real document …I really appreciated her…

The participants had noticed other diversity among the trainers, not just age.

The participants noted EVA teams included diversity by discipline, gender, race, and age. A participant commented that his team was comprised of men and women and found it interesting to watch those dynamics, especially the value of the learning going on among the team, sharing the experiences and viewpoints and learning from one another. He said,

> …they accumulated an incredible amount of experience in a much shorter time by doing this every day and working with all of us crewmembers in training for

> different missions…we had the rapport where they could yell at us…the instructor's opinion mattered more, and that was the end of it…you just wouldn't see that 20 years ago…they are charged with their own expertise and to pass it on to us, that's what they are trying to do…We don't even know half the time what the topic is going into the room, they've already decided what we need to know about their topic.

On the other hand, another participant had noticed that some of the newer divers and trainers could be intimidated by the astronauts.

> Some of the newer divers are intimidated by the astronauts, they are afraid to bring things out…if you cultivate that relationship…they will give you feedback. [Experts] may see the big picture, they are not in the spacesuit, they can look around and see what's going on. They may have seen someone else, another astronaut in the pool, and can suggest, try to do it like this...

His point was that it was important to build relationships with the trainers. They could offer many perspectives on how to master a skill because they had the benefit of observing what worked for others and could pass that along.

They care. These participants remembered how the trainers were very caring. They displayed a great desire to do well, were proud of their roles. Every task they performed was critical to the success of the planned activity. Although some of the participants initially felt discomfort not knowing how well to trust the trainers, that didn't last long because it was obvious that the trainers took their jobs very seriously. A participant said,

What they are doing is very important to them and you could almost get wrapped up in the comfort, if that were a blanket, that person cares so much about what they do, and they like what they do, they give their personal selves to it…I put a lot more trust in them than I do [in] myself…

Another participant noticed who among the trainers were the minor and major players. He said,

… there's personalities out there, some are team minors…some are kind of intense, but you can tell if you step out of yourself for a moment…watch them do their job…they care about what they are doing, not because you're great, but because they care about what they are doing …I put more stock and faith in that, than any emotion that they might just be doing this for us.

Those who are consistently where knowledge is emerging do learn and do pass it along to others, as long as those others are willing to listen, not under estimating the value of what others can teach. A participant said,

…although some don't always realize it and some people do it automatically, this environment, and life in general is an environment, in which you can learn from everybody. Everybody can teach you something, it doesn't matter what you do, it doesn't matter who you are. This is certainly especially true in the EVA world…

Learning from Others in the EVA World

The EVA world is an environment in which just being together begins to teach others. A participant said,

It's just an example of those who are not necessarily in a teaching role, but have corporate knowledge to share, that we all learn from…We have specific

instructors, we have opportunities for people to come in and watch us and evaluate us…can comment and provide some input at the debrief after...

Each new EVA team derived the benefits of what others had learned.

Theme 5: An organizational culture of collaboration. .

The term "EVA team" refers to the multi-organizational team that forms when a flight crew is named and the mission includes EVA tasks, tasks that will be performed during a spacewalk. This is what the participants had worked for, getting both a space flight and an EVA assignment. A participant described the greater team from which each EVA team evolved. He referred to that team as the EVA community, the small, tight-knit group that was comprised of design engineers, flight controllers, trainers, the crew, and the EVA project office. These were the organizations responsible for building and managing the EVA operations. When an EVA team had been established, it was because an EVA task had been assigned to a space flight. During the Shuttle era, EVAs were initially scheduled for a few flights, then on more flights, in preparation for the new era of the "Wall of EVA." It took about 100 EVAs to build the ISS, to accommodate the permanent present of humans in space. According to the participants, with the end of the Shuttle program, the role of EVAs will be primarily for ISS maintenance.

Establishing an EVA Team

For the EVA team members, getting assigned to an EVA team was an accomplishment, not only for the Spacewalkers who performed the EVA, but also for the trainers who were assigned to the team. A participant remembered how deserving his EVA team trainers had been:,

> Most of them are fairly young…they are really sharp and experienced…they make sure that we know every little piece of hardware that we're touching or interfacing with…we train and train…when we get up there [in space] it's all second nature, almost. They are experts in their systems…

The Spacewalkers, as the operators for the assigned EVAs on a mission, were always involved in the planning and implementation of their missions and EVA task-related decision making. Other team members were also involved. A participant said:

> …You have to be [involved]…it's [the task] going to be used during the job and you can't rely upon somebody else to develop techniques and procedures and know where a foot restraint needs to be or where a handrail needs to be, that kind of stuff. Where it's a unique mission kind of thing, you need to be the one who is there because you're the one who will ultimately have to do the task.

Some of the people assigned to new teams had previously worked together—that's an advantage because trust and confidence have previously been established among the members of the new teams. Oftentimes, they were the same people who had provided the participants with new skills and the knowledge of the organizational culture when they were newcomers in the different levels of their training.

For the participants, organizational culture seemed to be defined by their understanding of how communications were handled, who were the role models, what were the team norms, what was the philosophy on mistakes, what were the taboos, and how would the team deal with the unexpected? One other element of the EVA team culture was the final peak experience, the spacewalk. This experience was unique to the Spacewalkers who had already performed the spacewalk, they could describe it, and the

future Spacewalker could anticipate the experience. For the other EVA team members—the trainers, director, etc.--who couldn't be out in the on-orbit experience, they had invested their own time and effort. Therefore, the collaborative event became their success, too. The participants shared experiences in their EVA teams and identified characteristics the researcher identified as factors of the organizational culture of the EVA teams.

Building the EVA, a Collaborative Event

Each EVA team "builds the EVA" and develops, tests, and produces the training plans for the specific EVA tasks to be performed on orbit. A participant said, "Then together we write the next draft, you do that a couple of times…after three to four times of that, you actually got it right…you execute the right one in the pool one or two times…you're ready to go fly it in space." Another participant said, "those people are the experts… help us in our training… identify the areas of concern…design the plans that train us, the multiple events in the Neutral Buoyancy Lab leading up to a space mission." The participants described Spacewalkers as just one part of the team. They referred to each EVA team as a pyramid, with the Spacewalker as the operator at the top and many others inside building the EVA along with the EVA team. A participant said,

> … recognizing that you're at the top of the pyramid, you have the mission control team…the folks in the EVA branch…in robotics, the flight director, the Capcoms…work with those guys in preparation for the mission…they're just a little bit broader part of the spear, all of the other people underneath, all over NASA…the country…the world."

Among those people, the participants remembered role models who had been there for them as they had trained.

Identifying the role models. During their many hours with the trainers, the participants had learned about the unwritten or unexpressed factors of the EVA world. They learned them through their relationships, observations, and by reaching out to those to whom they could best relate for guidance. According to the participants, these role models pointed out or told them things that weren't in the manuals, or that other trainers might not have pointed out, or that could only be explained by someone who had actually performed the EVA on-orbit.

The role models ranged in levels in experience or notoriety. A participant remembered ASCAN class leaders who had become role models, even though class leaders had no formal authority over their classmates. But, class leaders were undergoing the same newcomer experiences and could ease discomforts very easily just from talking about experiences. A participant said, "…George Zamka [astronaut now in management role]…was very honest and I think very open about his experiences here…he established credibility very quickly…wasn't guarded with me." Another participant had a hero and a role model in one of the original 16 astronauts, someone very committed to the space program, even though he had already retired from the NASA workforce. He said, "One of my biggest heroes is John Young. John did it right. And he put his heart and soul into it." For another participant, role models were the veteran Spacewalkers, those who were experts because they had performed EVA more than one time.

> The experienced EV1's [EVA lead on a space flight] or experienced EVA crew members…they pass along things they know…like Jerry Ross, Joe Tanner, Dave

> Wolf… they've [not only] got such amazing experience but also the hubris to be able to pass it on without an air of superiority…you can begin to think you can do things on board.

Others modeled leadership and personal investment.

The participants appreciated the demonstrated leadership and the personal investment of knowledge that role models made in them. A participant remembered,

> …Dave Wolf was kind of the archetype, somebody that went out there and did it and did it right…There were also some of the instructor astronauts who helped me by demonstrating hands-on and led me through. Joe Tanner…Mike Massimino…They were both almost personally invested in imparting as much knowledge…embodied you, 'I'm here to teach you to succeed as best you can'…

For some of the participants, the relationships they formed with their role models were ongoing.

Building Relationships

The participants spoke about the closeness that had developed among the members of their respective EVA teams, not just with their role models, but also with the divers, the mission control room operators and directors, the ground crew during the missions, and their IAs. Everyone had clearly defined goals, working in timelines in spite of schedule slips and changes in the plans.

Time is a critical factor. The participants talked about timelines and how much they impacted the outcome of a project or mission. A timeline always dictated the task, especially during the Shuttle and early ISS eras, when the Shuttle's return to Earth made the schedule critical. But, although the timeline could impact the schedule, being able to

speak out was also important, in spite of time limitations. All of the trainees were instructed to identify any issues because unresolved issues could have greater consequences on orbit. A participant said, "I think there's a tendency to always be looking over your shoulder for the timeline…if you have an opinion, you need to state what it is, just do it with respect…On our crew we always had a rule, if you didn't agree with something, you absolutely spoke up and you just did it with respect, so that people wouldn't rush or wing it after all of the things we'd worked on…" The participants learned that communication was very important in the EVA team culture.

Learning the language, the specifics of communication. Several of the participants described the uniqueness of the communication required throughout their EVA training and tasks and the signals that were derived from that communication. When the EVA team communicated, the members of the team were not the only ones included in that conversation; there were also "back room" teams assigned to the mission. Everyone was listening. Words, sounds, pauses, all began to take a special meaning for the team. Communication was part of the culture the participants had to learn. The participants talked about critical words, unspoken words, no sounds or talking, time lapses in the communication. They had specific significance to situational awareness.

The participants learned that communication in space also had specific meaning. No sounds or no talking from a Spacewalker were a form of communication that meant something to the others on the EVA team. A participant provided an example of when interpretation of the signals could mean the focused Spacewalker was too busy to talk, therefore, also impacting his/her situational awareness. He said,

> …they start making certain sounds or no sounds at all…they stop talking…they become so focused on what they are doing, they don't talk, they really have to focus...they no longer…communicate and it's interesting how it works… [then] the second thing is that your situational awareness has dropped off…that's how I know that the situational awareness is down because they are not communicating anymore. When you start seeing that, then I know that the person is getting tired…

Another participant said everyone on the EVA team had to continuously be able to hear what the Spacewalkers were doing. He said,

> The communication between each other is a continuous thing and in the training, if you haven't said something for 3 minutes, people are wondering what you are doing. And even if they are seeing what you are doing, they want to hear what you think you're doing.

As a procedure, each EVA team would establish the language for conversation so that everyone had the same interpretation.

Discussing beforehand how the team would communicate in certain situations made it easy to avoid long conversations and wasting time during the practice or the EVA on orbit. A participant said, "In a spacewalk there are no long conversations, we have only precise and few words…So, if you say you have a *tear* [tāre]—that word, it's a big deal, you have to be very specific about what you say…We have already talked about that and figured out all of the steps that we'd take to get that going and what to do next…We don't have to discuss them anymore." The EVA team members know that

understanding and adopting unique communication techniques is an important responsibility for everyone.

Every Member has Responsibilities

Designing an EVA was defined by the participants as the technical design, the procedures required, anything relevant to the item or procedure that is the purpose for performing the spacewalk. It could be to install new equipment or to integrate a new component to the spacecraft, or to check a previously installed component by a previous EVA team. When the EVA was designed, the assigned Spacewalkers and NBL team members would repeatedly practice the task in the NBL. Each time there was an NBL run for the EVA task, the team would include veteran Spacewalkers who would also "suit up" for the NBL to mentor the trainees. There were also the divers, the test conductor, the test director, the medical doctors, and the others who were standing by, observing, and/or learning. Each individual on the team was proficient in his/her own discipline to ensure there were no accidents or fatalities and to know when to take action if an emergency occurred. A participant remembered,

> You have interactions from everybody, from the divers, then the tool divers…test conductors that control the facility while you are underwater, and they have the overall responsibility for the safety of you and all of the divers…lots of different levels and…it's the test director, and…the test conductor is the EVA task lead…he's running the specific…EVA that you are practicing.

The participants remembered how some of these same people had made an impact when they, the participants, were first newcomers.

Any team member was expected to be able to fully contribute to the success of the team by the time the participants were assigned to an EVA team. In other words, other than the specific EVA task for the assigned flight, the members of the team would have learned all of the general procedures for conducting an EVA. This participant emphasized the trainee's role on the team and how important it was for each member to know his/her responsibility as members of the team. He said,

> Everybody knows to be prepared and well-rested…It's just like everything else, in space flight, the astronauts are a very small part of the pie, a highly visible part of it, but it's still one of thousands, from the person who built the EVA tool, to the one who got trained, so everybody knows that at the basic level. And, unless you're slacking, you're able to build the team up. It's standard stuff to the way you want to be treated.

It's also a good way to avoid making mistakes.

Perspectives on mistakes. The participants talked about the mistakes they had made or seen made when they were trainees, but the mistakes decreased with experience. By the time they were assigned to an EVA team, they had learned that although mistakes should be avoided, the culture accepted that mistakes would occur and that they could be overcome without affecting a career. The participants discussed how they had learned to deal with mistakes.

To avoid making mistakes, this participant talked about the importance of the Spacewalkers' ability to "check their egos at the door" to ensure that they were listening to what the trainers, the other members of the EVA team, were saying to them. And, admitting mistakes built credibility among the team members. He said,

> As far as the EVA crew members, when they are able to, maybe some at the very start and others along the way, where they check their ego at the door…they have the humility to enjoy the run, take on suggestions…you'll either execute, or "here's why I was doing this," "oh, okay."…that's the buy-in for that person…to be brutally honest, especially with yourself…you're the only one in that position with that point of view, you are able to admit to your errors…then builds credibility for you with the others…

A participant discussed the discipline in the training process and how the process was reviewed to try to fix a mistake. Paying attention to mistakes fostered a culture of discipline among the teams and the individuals. "…when there is an error or a fault in the process, it's identified, people aren't ostracized for it, somebody's working on it, they make a mistake, it's recognized as a mistake and they're not punished for it. We look at the overall process to try to fix the mistake…"

On the other hand, for some participants, the potential for making mistakes added to their stress levels because of their concern for potential consequences. There was so much at stake that not "screwing up" became a goal for the individual EVA team members, not just for him/herself. This participant worried about how a mistake could impact all of the hard work that others had done to get him to his spacewalk. He did not want to make a mistake because so many people were depending on him to do well. And, he knew space was the real thing, no longer just a practice run.

> In the pool the piece of equipment is just a plastic square, it doesn't look authentic…then you get out in space and it's this very shiny, polished thing, where you can tell it's worth a million dollars or however much it is…it just ups

> your nerves—not anxiety…and you think, "here it is, this is the real day and I don't want to screw up!"

They also worried about reputations.

The participants indicated they knew their reputations would not suffer after just one or two mistakes. But, avoiding repeated offenses was important, even if they were unintentional. Mistakes could even be made if a person was too focused. A participant said,

> …Throughout the training they are always thinking about having you do the safety tether, it's a priority. For every run, not only what you do and how well you do that task, your reputation is on the line. That's an overly dramatic praise because a reputation is never destroyed by one mistake or a couple of mistakes…if you have repeated offenses or if you have a repeated success, then you destroy or build your reputation.

Repeated mistakes could also lead to questioning someone's aptitudes.

When an individual did repeatedly make mistakes, even after being given several opportunities to correct the mistake, a participant said then it was time to take a look at the aptitudes or inabilities of the trainee. He said,

> There are high consequences for making mistakes, but everybody makes mistakes now and then…If it's something that is repeated over and over again because of aptitude or inability to work in the environment for whatever reason, then that's grounds for finally getting to the point where you conclude somebody is not qualified to do it.

The participants understood the importance for the EVA team members to acknowledge and learn from their mistakes to prevent greater consequences for the individual or the mission. They were constantly reminded that untethering was a very serious mistake, for example.

As newcomers, the participants had been unaware of some of the things that were considered "taboo," but being untethered became very apparent early in the training as a clear violation of safety and possible grounds for exclusion from an EVA team. Untethered was defined by the participants as not being connected to the vehicle, either in the NBL or on orbit from the ISS. A participant remembered what he had learned about being untethered. He said,

> … most of those taboos, at least the real ones, have to do with safety and the priorities that are safety related, tethered being a big one. You never go untethered. And you always have redundancy in your tethering. If you're having to move, you come off one tether and you go to another, you have the interim tether in between, where you ensure your tether to the Station, and then you install your new one before you release the old one…

This was a rule that was repeatedly stressed to them. Breaking this rule could easily label someone as a dysfunctional team member for not being in tune with the team's ongoing focus on this safety concern.

Occasionally, an EVA team could become dysfunctional because of a team member. This participant described how people enjoyed working on the EVA teams, but the norm, from his perspective, was that dysfunctional team members did not stay long on the team. He said,

> I think the kind of people working on EVA [do] like working on a team. You are dependent on each other's performance, so it's not tolerated to have dysfunctional elements in the team. The team excises them, but they usually excise themselves—they quit…Sometimes it's personal, this is very demanding…it's not the right moment in a person's life. When we are engaged on a team that is this consuming, that can happen.

Excising oneself was a form of commitment to the team, according to the participant.

The EVA Team Members are Committed

Participants said the commitment demonstrated by their respective EVA teams was characteristic of the NASA culture and the respect people had for one another was earned through loyalty to the mission. A participant cited an example he had witnessed on his team.

> …the fact that we would listen to instructors that are 20 years younger than us…I'd give the same respect to someone who is 30 years older than me…when we do what they tell us and we do our best, and they see us doing that, trying to implement what they told us, it's definitely that give and take and that respect. People have to earn that respect…And, because of that, they are willing to listen to us, too.

A participant said respect was, "things my parents taught me."

Participants talked about the interdependency of the EVA team members and decisions were often reached through debate just among themselves and the supporting organizations. From working together and knowing one another they had learned to

negotiate and to make decisions quickly. Occasionally, however, external influences did alter plans and decisions.

External Influences

Although each EVA team was very self-contained,, external factors did occur and sometimes impacted a team's preparations and training. A participant referred to requirements handed down by NASA Headquarters or a programmatic entity. He said,

> …later in the game, without time to practice it, we're getting pressured to change it because of programmatic requirement emphases, priorities changing at the programmatic level…the EVA Team, not the crew…will take that…they'll say, "this is what we think we should do, this is what the crew thinks we should do"…It's always changing a little bit and there's always a discussion and thoughts about it, and they [outside factors] have the constant interaction to evolve…

No effort was wasted by the EVA teams, regardless of the impact. All outcomes resulted in data that resulted in lessons learned for the future, including for working with the international teams.

Learning with the International Teams

Some of the participants shared very interesting experiences about their participation with the Russian EVA teams. The participants had lived in the Mir, the earlier Russian space station that preceded the ISS, some had launched to the ISS as crew members in the Russian spacecraft Soyuz, others in the U.S. Space Shuttle. The discussions provided perspectives of newcomers working in an environment one would assume would be very different from the U.S. program. The observations were good data to be applied to the U.S. program as it changes to what the participants seemed to believe

will be a more simplified approach, the approach the Russians have kept almost throughout the history of their space program. The researcher did not discuss the data in this report, although it has potential for a future study based on a comparison to Russian perspectives on safety, training, and dealing with the unexpected.

Dealing with the Unexpected

The unexpected is always a concern; therefore, training for dealing with the unexpected was included in every Spacewalker's training curriculum. They refer to it as contingency training. One concern was space debris since it is always present. But it's small enough that it has not yet done any damage to either the Spacewalkers or the ISS. A few instances of other unexpected events had occurred, however, but had been resolved. The participants' contingency training had prepared them for those instances in which the Shuttle or ISS crews had been surprised. The contingency training applied to all of the members of the flight crew, not just the Spacewalkers. But the Spacewalkers did develop the plan for their specific roles.

Know the plan. According to this participant, knowing the plan well was the foundation for dealing with the unexpected so that

> …in case Plan A does not work, Plan B is not as difficult to develop because the EVA Team will have a place from which to begin—Plan A. You have to have the knowledge to be able to operate nominally, and, knowledge of the system, that's the base that you work on and then an aptitude to be able to apply that outside of your expected experience base. Given all of the nominal environments, you can do it…

But a participant said that was true as long as everyone did not start creating new procedures.

Don't want to create new procedures. The unexpected presents new factors, the need for new judgment and creating new procedures when there are already procedures. This participant did not think it was good for the Spacewalker to all of a sudden begin to create new procedures. He said,

> …with the unexpected, then you are off that sheet, then you are presented with using judgment and creating, we don't want to create. As astronauts, as operators, like the pilot, you don't want to create new procedures…you want to execute perfectly within the experience base…we press the limits.

He further stated that the EVA and flight crews were already experiencing the unexpected, based on the way the program has evolved. He said, "We've built things that have never been built, we go further out, on the Space Station, for longer times, doing new procedures and we do reach the unexpected—new metabolic rate levels, different, handling all new tools and equipment…" The participants described two unexpected events that created new learning for everyone, the ammonia pump module failure and the loss of a bag of tools.

When the failure of the ISS ammonia pump module occurred, it resulted in the potential for a dangerous ammonia leak that created great concern. The failure also caused half of the ISS power to fail. The situation was extremely hazardous and took more than one mission to completely repair. The ammonia was not the normal product that we find at home; instead it is a very powerful concentrate of ammonia. According to a participant, ammonia is the most toxic substance onboard. It is dangerous to the

Spacewalkers and to the astronauts in the ISS, if the Spacewalkers return to the interior of the ISS and carry any amount of it back into the ISS.

A participant (a rookie Spacewalker) and the another Spacewalker on this team, a veteran Spacewalker, performed the initial repairs on the disabled ammonia pump module. This was something neither had expected to be doing, since they had trained for other EVA tasks. The magnitude of the task was such that the rookie Spacewalker had been initially concerned with being able to perform the critical EVA. The participant remembered the experience,

> …there was no Shuttle docked or anything…we had this ammonia pump fail…half the Station power went down…had all of the elements of a risky EVA because it was time critical…we had only two people that could go out in the space suit and do this repair…if the other pump failed before we could get out there, we were going to lose power to the entire Space Station…we had leaks of ammonia, and it's the most toxic substance that we have onboard…

The rookie Spacewalker had trained for another specific EVA task, the first EVA on orbit for this rookie; therefore, the rookie thought the unexpected event required an EVA that was way above the rookie's level of skills. The rookie also thought about the expectations others would have of this first-time Spacewalker, but there was no choice but to proceed. The rookie remembered being really in tune with the situation while performing the EVA, applying the knowledge and skills gained from training and performed not one, but three previously unplanned EVAs. The two Spacewalkers successfully completed their phase of the repairs.

> I went out there…was more in tune with globally everything I had to do …I was focused on it being my first time out there…I couldn't forget to do my transition adaptation because I knew there was a timeline…people were expecting me to do this…but nobody expected anything other than [what we had prepared for], that's what I think is a strong point in the way we prepare people.

The rookie—no longer a rookie after *that* spacewalk--attributed those abilities to perform the unexpected EVAs to the training and the trainers.

Another unexpected incident had occurred during a different spaceflight. Although the incident had taken some new plans to resolve the situation, the crew had been able to continue to do the EVA tasks, in spite of the resulting shortage of tools. A participant noted that although the situation was resolved, for the rest of the world, it had appeared to be a big event, something that, unfortunately, didn't reflect well on NASA. He remembered,

> …we lost a tool bag…Half of our tools for the spacewalk were in this bag, and it goes floating away right at the beginning of the spacewalk…We saw the thing floating away…We hadn't started the spacewalk yet, we had 6 hours ahead of us with trying to get done with all of these tasks, with now only half of the tools.

Fortunately, the situation had not been a real emergency, it had just been something unexpected that had to be quickly resolved.

> [We] came up with a great plan, sent it down to mission control, we beat them to the punch, which is unusual…we were going to share tools…put them in a central location…go back and forth…We didn't have any real major emergency. That

was a bummer…everybody in the world knew about it. It brought a lot of attention to NASA.

Most folks remember that one, the participant had thought.

The loss of tools provided lessons learned. A participant said,

…We did a good job, just with that rough spot…when we got back…debriefed…came up with all of these procedures…It didn't hurt anybody, or anything, and that's the kind we like. We can't plan for everything…we certainly have the mentality that things aren't going to go well all of the time, even though you plan them…

More fearful for some of the participants was the thought of dealing with an injury.

For the participants, the thought of dealing with an injury while in space is a terrifying thought. A participant said,

You don't know where this is going to happen. You haven't trained panicking back to the airlock for every stage of the EVA, you've done it twice in your training flow with that person…with a real hit and a real injury, you would be hurrying…the chance of making a mistake with tethers is very significant…the chance of someone being emotionally affected by the event…is pretty significant…the lack of assistance in packing the airlock and closing the hatch, is [a problem]…

According to a participant, there wasn't training that had completely prepared them for that situation.

The participants' training provided them the knowledge and understanding of all of the components that are part of their training plan and they have used that knowledge

and understanding to identify and implement a resolution. Some of the participants said that in the history of the EVA program, no unexpected event nor its impact have gone unresolved. A participant said that the grace of God had also helped.

The Ultimate Peak Experience—the Spacewalk

For the participants, being on an EVA team had been a goal accomplished, but finally being able to perform the EVA on orbit made worthwhile all of the long, excruciating training and waiting for an assignment. The spacewalk was the ultimate experience. This was a unique experience that only a few had had, with every experience contributing to the preparation of the future Spacewalkers. Once the crew was in flight, the long-awaited exit didn't happen right away, but the Spacewalkers knew the exit was worth waiting a little while longer. Unfortunately, there was no training for the actual exit from spacecraft—it had to be a real-time experience and it was complex. The new Spacewalker had new factors to consider in space, including the equipment floating in the airlock, something it didn't do in the NBL. There was also the preparation for exit itself, preparing the tools, checking the hatch for leaks. Just prior to the actual beginning of the EVA, there was studying the procedures, preparing the suits, and on the actual day, there was getting in the suit, checking the EMU, going through pre-breathe for washing the nitrogen out of the blood to prevent the bends. That's at least another 3 hours of preparation before the exit.

The walk began with an exit from the spacecraft's airlock to the hatch, the Spacewalker's door into space. A participant described the final step,

> …going in the airlock and going through the procedures to make sure that the hatches that you're closing behind you aren't leaking, so you can take the air out of the airlock, put it back in so you can open up the outside hatch.

Finally, it was time to egress.

The participants shared their experience of the first time they opened the hatch and stepped into space, their introduction to a brand new environment, and immediately began to make sense of the surroundings, then went to work. The participants referred to "muscle memory," the process of remembering all of the training they had experienced for the spacewalk. When the Spacewalker stepped outside of the hatch, the EVA included a 10-15-minute step called the translation adaptation. The following participant described it,

> …we…have [the]…translation adaptation…[a] window [of time] for people who are new to the space environment, moving in the suit, feeling what the differences are, what it takes to manipulate or move the suit in different orientations...it's a very small amount of time, and then you're expected to do a 6.5-hour EVA…we know what to expect from the ground calling up…it becomes muscle memory…you automatically know what comes next.

There was little time to relish the moment because the EVA clock was ticking.

Each participant had a memorable experience of his/her first moment out of the hatch into outer space, but with different reactions. Some remembered feeling all alone, just two people out in the infinity of space. Others remembered they really weren't alone, they knew there were others close by—the other flight crew members in the space vehicle, the other EVA team members on the ground, and the back room people in

Mission Control Center, to name a few. In spite of the short experience, these participants described their experience, that moment in time.

A participant was not too sure whether to let go or not once he was outside of the hatch. Other participants had experienced the same thing--"the grip"--and not being sure of what would happen if they let go.

> …I think I found out that I was ready for my spacewalk when I opened the hatch…I grabbed on, still inside, reached out, grabbed on with my hands, pulled myself out, and then I was sort of stuck there with both hands attached, looking around, thinking, "I don't know if I should let go, or if I should move, or what's going to happen"…That first moment, it's a very odd instance…

"Thou shalt not untether" was in the muscle memory.

Another participant enjoyed the scenery as he exited the hatch. The training had prepared him and made the experience feel familiar.

> It felt like I already had the t-shirt. It wasn't like déjà vu, the visual reaction was, "This is all very familiar…I've never done this before, why do I have this feeling of terra cognita?"…I remember just stepping out of the hatch…it was a gorgeous summer afternoon over the Amazon jungle in South America…I could see all of the way down to the Amazon River. I could see all of the estuaries that were flowing into it and the puffy clouds…here is this beautiful summer afternoon, a wonderful day to go out and do a spacewalk…

The participants' experiences as Spacewalkers were not only about their work. They also knew how to compartmentalize as they worked and participated in their personal lives with the families they too often left behind. The researcher thought the

following participants expressed the feelings that most likely the others felt, from their professional and personal perspectives.

> The stuff I take away from the EVA, the thing I love most is the physical and mental challenge, so personally, that's what I love the most…I think about how fragile this planet is that God put us on, and then to be in a small subset of people who have gone out in a personal spacecraft [the space suit]. When you're out there and you look through a window, you get a pretty good view. But, out there you have that fishbowl of the EVA HUT [Hard Upper Torso of the suit] and every bit of your senses, your visual senses, seeing the beauty of the Earth, I have been blessed to have had that opportunity…

This participant remembered that compartmentalizing had helped him when a special event was going on back at home at the same time as his EVA. He had experienced an extra special moment during the course of his EVA on orbit.

> …my wife gave birth to our daughter after [my] doing my spacewalk, first in my life, doing the things I was trained for, and my daughter was born while I was "in space." I'm thankful for my [military service] and NASA training, I was able to compartmentalize, and just go do that, but there was one point where I was in the middle of a task, ready to go back, and get on top…I went back to the part [of the ISS] where now there's no truss or other stuff…And, I got up, there were two extension arms and I… had my left arm on it…it was the strangest moment of peace and quiet, the whole thing, it conjured this image where I'm on this boat with the ocean underneath…like I had my hand on the tiller of the boat, and I was

going along in this moment of peace, just taking in the beauty of that…I wondered if my daughter was being born…

Some of the participants said they would perform another EVA any time. Others said it was time for them to leave, to let the younger people enjoy the same experiences they'd had. Others said that just being a part of NASA had been a peak experience.

Learning from One Another

Overall, the participants described the focus of the EVA Team training as their preparation for a mission and a spacewalk; but, they were not the only ones getting trained. The trainers were also building on their skills. Their organizations continuously ensured the trainers' skills were being enhanced by their interactions with the trainees. A participant said about his EVA team, "it wasn't just the…EVA crew members or even the…Shuttle crew members, it was always all of these wonderful people that make up this pyramid around you…a lot of the information came from them, but once in a while…they [the trainers] were learning from us, too…" The trainers learned from observing and talking to the veteran Spacewalkers as they mentored the new trainees. The team members met for debriefs, inherent to the culture of the organization, where the team members, according to a participant, planned, argued, innovated, and learned from one other. The learning was then recycled to future training development and future EVA teams.

Summary of the Chapter

All of the 20 participants in this study made contributions to the data about the socialization they experienced as they integrated into the high reliability organizational culture of the EVA teams. By understanding their technical roles, the participants had

also become familiar through not only their past experiences but also the experiences of others who had gone far beyond just doing their jobs, as they informally had added to the socialization processes of the newcomers. The five major themes described in this chapter indicated the EVA team was structured so that the high reliability organizational culture was defined in the environmental context as the participants work in the facilities and with the other members of the supporting teams, including the EVA team members once the astronaut was finally assigned to a space flight and an EVA. Although the researcher was not sure that the EVA teams recognized or identified themselves as a HRO, the data well supported the five hallmark characteristics of a HRO, based on the descriptions of the organizational culture, the environment, and the backgrounds of the individuals who represented the EVA teams as participants in this study. The individual members of the EVA teams, as described by the participants in the study, were committed to their work because of the environment in which they worked, their individual relevant experiences, their drive, and the relationships they formed with one another. They participated in the organizational culture not only through the mentoring and training they received, but also by adding new learning to the organizational culture from their own experiences and involvement as members of their respective teams.

The findings in this chapter were supported by the data from the participant interviews, by the observations, documentation, and the artifacts that comprised the EVA program environment. As recommended by Creswell (2003), the researcher triangulated the data among the different sources of information, participants reviewed the draft of their respective interview data for accuracy, and the researcher consistently checked her biases to ensure increased trustworthiness of the study.

Chapter 5: Conclusions and Recommendations

Overview

The purpose of the research was to understand the socialization processes of the high reliability organizational culture of the NASA EVA teams. The one-on-one interviews provided an excellent forum in which the participants could reflect on experiences in their socialization processes as newcomers as they became members of the organizations through several phases of their journey from ASCANs to members of the EVA teams to prepare them to become Spacewalkers. The 20 participants described the social tactics and techniques that bonded them to the organization and strengthened their desire and motivation to carry out the mission by understanding the roles of the organizations involved, the hazardous environment in which they worked, the relevance of their previous experiences, and the lessons they learned from others.

This case study examined the research question: What are the socialization processes in the high reliability organizational culture of the Extravehicular Activity (EVA) teams at the NASA Johnson Space Center? The following two sub-questions provided the researcher with discussion opportunity.

(1) What are the formal socialization elements?

(2) What are the informal socialization elements?

The major themes that emerged from this study provided for the researcher an understanding of the formal and informal socialization processes experienced by the participants in the Astronaut

program and the EVA teams. This chapter includes the following sections: overview, conclusions and theoretical implications, summary of the conclusions, implications for practice, recommendations for future research, and concluding remarks.

Conclusions and Theoretical Implications

The researcher's overarching conclusions drawn from this study was that the organization provided a strong foundation for the participants from a *technical* perspective to become socialized into the culture of high reliability that began with their selection into the Astronaut program and continued through their assignment to an EVA team. The results further suggested two other contributors to successful socialization of the participants into the high reliability organizational culture of the EVA teams: (a) the participants' continued desire to succeed; and, (b) the ongoing mentoring and coaching they received from others throughout each stage of their development from ASCAN to Spacewalker. The results are supported by literature relevant to the discussions.

The four conclusions reached from this study derived from the five major themes and sub-themes previously identified in Chapter 4.

Conclusion 1. The high reliability organizational culture of the EVA teams provided structure that supported both the organization's and the participant's expectations.

The participants described an organizational context rooted in history and technical success. There was rigidity in everything they did, from the beginning of their training as ASCANs through the training in the EVA team. For the participants, the organizational culture was based somewhat on their own understanding and the stories they had heard about the history of the Spacewalker program. In accordance with Schein

(1992), the founders of this organization had the greatest impact on its cultural beginnings. The major influence for the initial EVA team concept was in the roots of the moonwalker era of the Apollo program. Schutz (cited in Wagner, 1970) referred to the system of knowledge that newcomers see, sometimes it's incoherent, inconsistent, and unclear. According to the stories the participants heard, the "founding fathers" of the EVA program were rooted in what is now the Mission Operations Directorate, the Astronaut Office, and the EVA Project Office, and was established post-Apollo era. Knowing these stories, the participants were motivated to follow in the giant footsteps of the people they had heard about.

Weick (1987) placed great emphasis on the value of an organizational culture in which its people share stories. The story tellers are reliable substitutes for trial and error, avoiding learning failure. The participants had heard stories or worked with the EVA Mafia, the second major influence in the organizational context of the EVA Team of the early Shuttle era. Schutz (cited in Wagner, 1970) referred to this type of influence as accepted standards of the community that had been handed down by "ancestors, teachers, and authorities as an unquestioned and unquestionable guide in all of the situations which normally occur within the social world" (p. 81). As Spacewalkers, the EVA Mafia had a legendary reputation within the norms and mores they had established. Kurtz (2003) referred to culturally derived decisions as a hindrance to effective decision making. For the participants, it appeared the taken-for-granted assumptions that had evolved from the organizational culture of the EVA Mafia had perhaps suppressed further innovation. Kurtz said, "the general success of these norms and mores contributes to their legitimacy, providing reinforcement for veteran employees, who teach them to new employees as the

correct way to perceive, think, and feel about problems the organization frequently encounters" (p. 306). Eventually, program requirements and the demographics of the Astronaut Corps mandated changes that would allow all of the astronauts into the EVA program. The qualifications remained the same, but there were more opportunities to practice more and correct mistakes. The astronauts were pleased with the changes and the opportunities for EVA participation.

According to Levinson (1965) the concept of reciprocation defined man's (employee's) relationship with the organization. Employees also have expectations from their work and the relationship can become extremely deep for them. The reciprocals are growth, power, self-esteem, innovation, and the need for inclusion. Schutz (cited in Wagner, 1970) states, "…the social world into which man is born and within which he has to find his bearings is experienced by him as a tight knit web of social relationships, of systems of signs and symbols with their particular meaning structure, of institutionalized forms of social organization, of systems of status and prestige" (p. 80). In the case of the participants, expectations were met for both the organization and themselves.

Conclusion 2. Formal and informal socialization processes supported the norms and values of the inherent safety culture of the EVA teams.

Pidgeon (1991) identified safety culture as "the constructed system of meanings through which a given people or group understand the hazards of the world" (p. 132). The participants learned what was important and real and that situations could easily become a matter of life or death, not only to themselves, but also to their cohorts, their trainers, and the priceless hardware in which they worked. Pidgeon also defined safety

culture as being "created and recreated as members of it repeatedly behave in ways that seem to them to be the natural, obvious, and unquestionable ways of acting, and as such will serve to construct a particular version of risk, danger, and safety" (p. 132). Several of the participants said the training had prepared them so well the Spacewalk was almost second nature when it finally happened.

The experiences described by the participants were consistent with the literature on high reliability organizations. The following are comments the participants made about the safety philosophy they experienced. For example, their comments were consistent with the literature on HROs, including Weick and Sutcliffe's (2001) five hallmark characteristics of a HRO, organizations that "persistently have less than their fair share of accidents" (p. 10). The following are short definitions for each of the hallmarks, participants' comments that described their understanding of the high reliability organizational culture of the EVA teams, and literature that supported the organization's processes of socialization.

*(1) Preoccupation with failure—"*Even though high reliability organizations are noteworthy because they avoid disasters, they do not gloat over this fact" (p. 10). A participant expressed his perspective of the overall philosophy of safety in NASA and the EVA program and its discipline and accountability. He said,

> Just thinking through the different elements…the people that work in spacewalk disciplines are very disciplined themselves…they care about what they are doing. This is a generalization I make about the NASA team often, but it specifically applies to those who work in EVA, they are devoted to doing the mission and doing it successfully …attention is in the details…they are generally individually

> very disciplined people …collectively, in the way we have organized the system, it instills discipline…there is accountability with each other for that discipline…if an individual lacks attention to detail in some area…it's identified, talked about, and addressed almost immediately.

(2) *Reluctance to simplify interpretations*—"HROs take deliberate steps to create more complete and nuanced pictures. They simplify less and see more. Knowing that the world they face is complex, unstable, unknowable, and unpredictable, they position themselves to see as much as possible" (p. 11). Each level of training builds upon the preceding level to give the Spacewalker the total picture of the situation. A participant provided his description of the training and the complexity involved with the processes.

> It entails understanding the equipment, the suit in particular…the tools…other equipment that we use…you want to have a good understanding to operate it, to not break it, to use it the way it's designed, to understand the redundancy in the systems, to understand the signature if something goes wrong, or to be able to identify what it is if it does go wrong… [to] respond correctly…that's a big component of the training. In other words, understand the suit…we spend a lot of time learning the systems of the spacesuit…we learn how to operate in the spacesuit...every detail from climbing in the suit…checking the suit out…getting ready to go in the airlock…getting in the airlock…letting all the air out of the airlock…opening the hatch…going outside, every step of the EVA is trained with attention to detail in every step of the way, tethered all of the time…you're going in the right direction all of the time…you don't lose tools and bags of

> equipment…you lose a lot of points if you lose something…it's always attention to detail in the operation.

(3) *Sensitivity to operations*—"points to the ongoing concern with the unexpected. This is an area where HROs distinguish themselves. They are attentive to the front line, where the real work gets done. When people have well developed situational awareness, they can make the continuous adjustments that prevent errors from accumulating and enlarging" (p. 13). The participants talked about the importance of situational awareness when the Spacewalkers are on orbit, sometimes for as long as 6-7 hours. Because they train together for so long before they actually go into space, the team of Spacewalkers begins to develop signals they recognize from one another as a way to communicate without saying too much. It's important to recognize the signals.

> The first thing that drops off is your communication because you're working away, and the second thing is that your situational awareness has dropped off because there's no communicating...then I know that the person is getting tired.…we don't just say things like, "can you take a break?" [in case a reporter is listening]. Instead, "can you clean up your tools or tethers?"…you always want to make sure that the tether is pristine, no knots or snarls, so it's always a fine thing to do…even if it's good, it's something the EVA guy can do and say…It's a little break, maybe for 5 minutes…you don't have to say, "I'm taking a breather."

(4) *Commitment to resilience*—"HROs develop capabilities to detect, contain, and bounce back from those inevitable errors that are part of an undeterminate world. The signature of an HRO is not that it is error-free, but that errors don't disable it; HROs put a premium on experts; personnel with deep experience, training" (p. 14). In Chapter 4, the

researcher included the participants' experiences with two recent unexpected on-orbit events. Although a challenge for some of the EVA Team, both situations were resolved without additional consequences to the mission or the EVA Team. The experiences demonstrated the ability of the EVA Team to deal with the unexpected and provided lessons for future training development. Part of the strategy of the EVA program is to train EVA teams so that they can "swap out" if necessary. A participant described a situation in which EVA crews were successfully swapped between the Shuttle and ISS, because of a contingent EVA that had to be performed on a solar array on the ISS.

(5) *Deference to expertise*—"HROs cultivate diversity…it helps them do more With the complexities they spot…decisions are made on the front line, and authority migrates to the people with the most expertise, regardless of their rank" (p. 16). The participants made several comments about the diversity among the trainers, how some of them were very young, yet sharp and experienced. More impressive was the participants' willingness to listen to the trainers, no matter how much younger the trainer is or how much higher rank the astronaut had been in his/her pre-astronaut position. The participants also reported that when they were assigned to a flight crew and the mission had an EVA to perform, the assigned Spacewalkers were part of the team that would build the EVA. This means the Spacewalkers are involved in the design, the planning, the training, and the implementation of the EVA on orbit. In keeping with the "front-line" philosophy and to ensure any EMU problems are taken care of right away, a representative from the contractor company is also part of the ground team. A participant said,

> …they have kept us safe from EMU problems for many years--for 30 years, perfect record. There are things that have gone wrong with the suit, but never endangered somebody's life…that's the reason that we are safe, it's due to those guys. And, us, we monitor the EVA system, mainly the XA and the contractor team that processes the suit…they do a tremendous job and it's due to them.

Weick (1987) described the role of the operator and how it is not necessary to control the operator if the individual has been provided a culture of reliability, including preparing for the unexpected. The participants discovered that, although training objectives were well defined, the "how" was not always clear and they struggled with doing things the correct way. They had expected and knew about the challenges of the NBL training, but the extreme requirements were somewhat shocking to some of them. This is in accordance with Louis (1980), who referred to the "surprise, contrast, and change" (p. 226) that newcomers will experience when they first join a new organization. This is where the role of the trainers and mentors became key, to help the participants "facilitate sensing making…encourage appreciation of the local culture and acquisition of a setting-specific interpretation scheme ultimately facilitate adaptation to the new setting and progress through the stages of socialization" (p. 245). The availability and willingness of the experts to become mentors and role models were key factors in the socialization of the organizational culture of the EVA Team.

Conclusion 3: The participants' drive to become Spacewalkers was influenced by past experiences, self-efficacy, and the relationships they formed.

According to Barnard (1968), a function of the organization is to ensure that individuals are available to provide the services required by the organization. He states:

> Membership, nominal adherence, is merely the starting point; and the minimum contributions which can be conceived as enabling retention of such connection would generally be insufficient for the survival of active or productive organization…every organization to survive must deliberately attend to the maintenance and growth of its authority to do the things necessary for coordination, effectiveness, and efficiency …This…depends upon its appeal to persons who are already related to the organization (p. 230).

For the participants, selection to the Astronaut Corps was quite an accomplishment, since they were a handful selected from among the hundreds of others who had also met the criteria. They brought with them what Barnard said organizations should provide, an environment concerned with increasing the quality of its citizenry, "securing loyalty, reliability, responsibility, enthusiasm, quality of efforts, output" (p. 230). Organizations that set challenging goals are committed to them and invest high levels of effort and know how to recover from failure, do well with employees who do the same.

Argyris and Schön (1974) in their study of theory in practice noted that, things become more complicated when the individual enters an environment in which the "professionals" have created "artifacts that are shaped by both the requirements of a task environment, in Simon's (1969) terms (as cited in Argyris & Schön, 1974), and by materials whose properties constrain the creator's ability to respond to requirements" (p. 149). Professions create techniques. There are (1) first-order techniques as the arts and skills that comprise professional practice, and (2) second-order techniques that are needed to create the setting required by the institution in which the first-order techniques will

function. That being the case, in relation to others, "the professional's knowledge of the structured environments, his certification to practice in them, his ability to understand the language spoken in them and to negotiate in them constitute a great part of his technical expertise and authority" (p. 150). The participants brought highly-qualified relevant skills and experiences, but assimilating them into the new environment would take more than just the skills.

Overall, the participants discovered an environment described by Argyris and Schön (1974) as second-order techniques, including:

> …formal, structured interactions among professionals...; rules governing the procedures to be followed…; sharp role differentiation, spelling out what is expected of professionals…; the breakdown of activities into component parts that are standardized, uniform, and measurable; and the control of environment so that variables can be altered in limited and sequential ways…the outputs can be expected after certain first-order techniques are applied" (p. 151).

In addition to their skills, the participants also brought the self-efficacy that had already projected them to their new level of achievement and would project them to the next level.

Several of the participants were tested by the tremendous challenges they encountered as they advanced through each level of their training. The participants talked about embarrassment, reputations, mistakes, and other factors that indicated that their perceived confidence would wane in the self-efficacy that [apparently] was a strong driver for their desire to succeed (Bandura, 1977). When they became ASCANs, it was as if they were back to the end of the line as they all began their cohort training at the

same starting line. For some, recalling cognitive functions helped. In all cases, they invested high levels of effort to attain their goals, not only for themselves, but also because of their reputation with their peers and the desire to please the people who were training them. They had time to learn, to "get it right," yet each time they were unsuccessful in learning a new skill, the drive to succeed became stronger. They were encouraged by others to ask for help, some hesitated; but, soon they all learned that asking for help was appropriate, especially since there were others who had the knowledge gained from repeated experience. Lesser skills were overcome; they were required for the next level.

Zimmerman and Bandura (1994) attributed the treatment of lesser skills to the "belief in one's self-regulatory efficacy—which determines how well subskills are enlisted, orchestrated and sustained…an important contributor to the belief in attainment efficacy that governs behavioral accomplishments" (p. 38). They also said that beliefs in subskills and how well they will be put into practice would depend on the pursuits being subserved. In addition to their pursuit of successfully achieving their goals, the participants seemed to pursue praising the efforts and support of their trainers, mentors, and coaches. It had been important to them to please these people, not only for evaluation purposes, but also because their trainers were so committed to the newcomers that the participants had not wanted to disappoint them. According to Bandura (1977), efficacy beliefs affect thought processes, "the level and persistency of motivation, and affective states, all of which are important contributors to the types of performances that are realized" (p. 39). Apparently, the affective state in self-efficacy is an element that drives one to care about others feelings, too.

Conclusion 4: The EVA teams create trust because of the collaborative nature of the organizational culture that enables individuals to participate and contribute.

According to Kurtz (2003), in larger, more complex organizations in which subcultures and inter-organizational systems exist, trust is harder to achieve. This was not the case for the participants. Perhaps that's because the EVA community is a closed-knit community, although comprised of three major organizations with support from several other organizations. Eventually, the different actors in the EVA community would cross paths again as teams formed for new training requirements, thus decreasing the need to begin new relationships each time a team was formed. Everyone knew the values because the members of the teams spend so much time together. The values in the organization were tight and well-defined so that disruption did not occur when crises episodes occur, supporting Schulman's (1993) finding that when the operators are properly socialized they can negotiate unexpected situations based on trust and credibility that had been gained through their socialization process. For the Spacewalkers, trust was a key factor that augmented the safety factor because as operators of the EVA itself, they could focus on the immediate task at hand without worrying about others' roles.

Once assigned to an EVA team, the participants remembered how their confidence was had been augmented by the people who had worked with them as mentors and coaches, the trainers and the veteran Spacewalkers who took them through the training, step by step. They had learned that little things could get them into trouble very fast. In accordance with Schein's (1968) findings in his study of newcomers, eventually, the participants began the reaffirmation of the norms from the mentors and coaches, as well as by different communication channels, the role models among key

people, and the procedures, debriefs, and instructions. At the level of EVA Team members, they had already gained their knowledge from the others, "the structure, goals, history, traditions, rituals, myths, language, and politics of the organization, the group or work unit, such as, the personalities, interests, attitudes…the use of resources, and finally personal change relating to identity, self-image, and motivation" (Ardst, Jansen, & van der Velde, 2001, p. 159).

The many others on the team had also learned their respective roles and knew what to do, most likely through assimilation within their own disciplines and from their own organizations, training, and mentors. The divers and other trainers knew how to accommodate the suits with padding and other neutrally buoyant materials to make the suit fit better. They had learned that by working with the Spacewalkers who had already been into space and knew where some of the discomforts in the suits needed to be alleviated. The participants had also learned to master the suit through the conversations and examples provided by the divers and other trainers, especially the veteran Spacewalkers. The veteran Spacewalkers were either formally assigned to work with the newcomers or just wanted to share their knowledge, as others had done with them. The people were part of the system and another resource that was there for the taking.

Katz (1978) talked about the consequences of the lack of maintenance by the organization. He talked about the social system of the organization and how, if not properly maintained, individual members of the social system could decide to leave it. Leaving, in this sense, could include not only a physical actual departure, but also a departure from acceptable behavior. For the participants, the changes in the evaluation process, the mentoring, and the coaching were real signals that the organization wanted

them to improve and succeed. Their technical skills had brought them to the program, but it was the social system of the organization and the relationships built among the members of the organization that made work quite as unique as it was for these participants. For those participants who had left or were planning to leave, they knew it would be hard to top this experience. For those who will stay, they will simply give back what they received.

Summary of the Conclusions

The data made two contributions that evolved from the study. The data: (1) defined for the researcher the formal and informal socialization processes experienced by the participants; and, (2) identified organizational factors that required re-evaluation because of the changing demographics of the Astronaut Corps, thus constantly requiring adjustment to the organizational culture of the EVA teams.

The *first* contribution was relevant to the study because it demonstrated how in spite of extensive formal training, individuals sought and derived great benefits by being indoctrinated into the norms and values of the organizations in which they sought membership. There were too many unspoken norms and values that were understood much quicker by the newcomers because others who had already had the experiences readily shared their knowledge. Feelings of belonging affected attitude and the desire to give back to the mission and helped the newcomers meet their professional and personal expectations of their roles as they became Spacewalkers.

The *second* contribution emerged because the participants clearly indicated the demographics of the Astronaut Corps had been a factor in making changes to the EVA program, including making it more inclusive of astronauts who were not built or were as

dexterous for the space suit as the legendary EVA Mafia had been. Generations who come after the "founding fathers" of an organization begin to change within a few succeeding generations, for example, with the inclusion of non-military men into the Astronaut Corps, came scientists who were not pilots. Program requirements necessitated larger numbers of Spacewalkers. Since the Astronaut Corps by that time was inclusive of women and minorities, how can you then not use all of the work force in the organization? Diversity of any kind requires the organization to make necessary adjustments. And, according to the participants, new programmatic requirements are occurring. These will require even more changes to the EVA team's practices.

Implications for Practice

Based on the interview data, the researcher identified three implications for practice. The *first* implication for practice is the need to continue assessing formal socialization processes, also known as training, and their effectiveness in socializing newcomers. In the case of the astronauts/Spacewalkers, socialization was generally referred to as the formal "training," and the participants appeared to be well entrenched in the training. They also spoke of the importance of communication and the "special" language that had evolved throughout the life of the program. Changes made to the EVA program as a result of new programmatic requirements and a changing work force appeared to be well known to the participants because they had participated in those changes. When external factors did occur, the well-defined mission and the collaborative and cohesive organizational culture of the EVA teams took little time to realign to accommodate changes. The EVA teams, based on the researcher's findings, were a model of structured and well-planned activities with a well-trained work force that left nothing

to chance and with little disruption from external factors, practicing what they preach in dealing with the unexpected—know the plan.

The *second* implication for practice is the need to better identify and formally define those informal processes that are so important to the socialization of the newcomers. The participants described the informal processes and how important they were to them in making the technical training easier and, in many cases, friendlier. Perhaps a more formal attempt should be made to capture those informal processes so that they are integrated into the training. Based on the participants' comments, sometimes they had wished for a more defined approach to some of those "unwritten" practices rather than base that help on relationships they had to form, although those relationships sometimes became as important as the training. Too often organizations cannot recreate the magic of earlier generations who seemed to do things "just right" and that is because no one captured what those generations had to offer. The EVA teams, based on the researcher's findings, were a model of collaboration based not only on mission objectives, but also on respect and dignity that were an outcome of the trust that developed among the team members, priceless outcomes in any organization.

The *third* implication for practice is the need to pay close attention to what the participants have said. So often, data collected from individuals becomes temporarily important then ends up on a shelf with other data collected for some other need, as could be the future of this study. Although the participants maintained positive statements about the future, there were a few concerns about how long the people in any organization remain confident when there are so many unknowns. There were concerns about qualifying *every* astronaut for the EVA program and how everyone would overcome the

inherent challenges in the training, especially when not everyone selected will have the benefit of inherent skills. All of the participants believed that NASA would remain an organization, but there was uncertainty about human space flight and the impact of the loss of expertise through attrition because of termination of work tasks. Although there was understanding that NASA is a geo-political organization, there was also the hope that NASA's accomplishments meant much more than that for this country and the world.

Recommendations for Future Research

The researcher proposes four research implications from the insight gained from the study: (a) a multi-level study of the teams that comprise the EVA teams and how they are prepared as trainers; (b) a qualitative case study of the socialization experiences of other high reliability operations, for example, an off-shore oil rig operators; (c) a follow-up study of the Spacewalkers in a few years to compare the future EVA program to its status at the time of this study (recommended by a couple of participants); and, (d) research best practices in other high reliability organizational cultures to determine how the human resources development communities can better provide formal and informal socialization processes for newcomers to more readily integrate them into the organizational culture, no matter the business of the organization.

A multi-level study of the teams that comprise the EVA teams would provide a better understanding as to how all of the members are socialized, not just the Spacewalkers. The EVA teams appeared to be strong, but did the other team members receive as much attention as the Spacewalkers? If not, where does all of the dedication and desire to do well come from?

A qualitative case study of the socialization experiences of the operators of off-shore oil rig teams would most likely find similar experiences to those of the EVA teams, since oil rig teams most likely have high reliability organizational cultures. Oil riggers are operators, too, in an environment that are quite hazardous. Does the responsibility match the preparation?

A couple of participants suggested a follow-up study to this researcher's study. They were curious as to the impact current changes will create for the EVA team environment as it enters a new era of programmatic requirements and demographic changes in the workforce. This study could be either a qualitative, quantitative, or mixed methods study since there is data that tracks the progress of the trainees for comparison of earlier and current training for Spacewalkers.

For a qualitative case study to research best practices of socialization in high reliability organizations, data could be used to develop better training for employees in HROs, focusing on building *collaborative* teams versus just team building.

Concluding Remarks

In this chapter, the themes and conclusions were related to the relevant literature, including socialization, organizational culture, safety culture, and HROs. The researcher's interest in socialization in organizational cultures derived from her own experiences as a newcomer several times throughout her career, even when she first joined NASA in 1964. She was 19 years old, just out of high school, a well-skilled clerk-stenographer, freshly naturalized as a U.S. citizen, after being raised very Mexican by her parents. Going to NASA was a complete culture shock to her, yet she acclimated to the culture, most likely because of her refusal to be intimidated by circumstances, but also

because mentors and coaches "adopted" her whether she asked them to or not. Years later as JSC Director of Equal Opportunity programs, a senior staff position, she determined that a lack of proper socialization among the JSC workforce could be the reason why employees sometimes described their perceptions as discrimination and exclusion as JSC employees. Most of these people had great skills and had been proud to join NASA, but had been left on their own once they had joined the JSC workforce. They made mistakes that either ended their careers at JSC by going out the door, or worse yet, by being tucked away in some organization far from the person's initial expectations.

For purposes of this study, the researcher's interest in the study of socialization in the high reliability organizational culture of the EVA teams was triggered by the findings of the CAIB, including that NASA's organizational and safety cultures were broken. The finding was a generalization; the CAIB did not separate out all of the other operations and teams within NASA that fell far from that finding. The EVA teams are a good example of highly technical work that is conducted in very hazardous conditions, yet they have consistently done something right because in their history, according to the participants, no loss of human life has occurred during the training or during a mission. The researcher wanted to know what the EVA teams had done to maintain such a standard. She found the culture to be concerned, not just with the hardware, but most definitely about the people. The systems and people collaborated because there was a well-defined task to do, roles and responsibilities were well defined, expectations were well-defined and measured, and there was a reward at the end that was worth the effort and wait. The EVA teams fits the definition provided by the Great Place to Work

Institute, where employees “trust the people they work for, have pride in what they do, and enjoy the people they work with” (p. 13) (Chalofsky, 2010).

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Appendix A

E-Mail Note Inviting Participation in the Study

From: estellagillette@hotmail.com
To: estellagillette@hotmail.com (distribution)
CC: janet.l.kavandi@nasa.gov; peggy.a.whitson@nasa.gov
Subject: Request for your participation as a subject for—"A Case Study of Socialization in an Organization Characterized as a High-Reliability Organization: NASA's Extravehicular Activity Team, the Spacewalkers of the Astronaut Corps"
Date: Mon, 26 Sep 2011 01:48:04 -0500

Hello,
I am Estella Gillette, now retired from JSC, but I hope you remember me from either my working with you in the Astronaut Office or as a member of the Astronaut Selection Board, when I was JSC Director of Equal Opportunity Programs. Before I retired, I entered a doctoral program at the George Washington University (GWU) in the Human and Organizational Learning Department. Now I'm finally writing the dissertation and I have to finish by May 2012 to meet the requirements for the Doctorate in Education from GWU. I am contacting you to request your participation in the study to provide the data for the study for the dissertation.

I am the Principal Investigator (PI) and my Dissertation Chair Dr. Neal Chalofsky, professor at the George Washington University, is the Co-Investigator. As the PI, I will be conducting this qualitative case study. As a member of the EVA team, past or present, you are one of 21 persons who will comprise the study, should you agree to participate. All the persons whom I am contacting are currently in the JSC work force. The JSC Committee for the Protection of Human Subjects (CPHS) has approved the request for this study and has requested that I contact you directly. The CPHS has provided the approved Informed Consent Form, which is attached.

The purpose of the study is to understand your experience as a member of the EVA team--the Spacewalkers--and your socialization into the EVA team's organizational culture of safety in a high-reliability organization like NASA/JSC, not only through the training you received, but also from what you learned from others who were involved in preparing you for your first spacewalk. The study will require 1.5 hours of your time for the first interview and another 1.0 hour for a follow-up interview for clarification of any of the data collected during the interview and to allow you the opportunity to review my interpretation of the data you provided. The interview will consist of two main questions as well as a few additional sub-questions. The full set of questions is included in the attached Informed Consent Form. The main questions are:

1. What are the elements of the safety training for the Spacewalkers?
2. What is involved in the development of the EVA Team?

I would like to meet with you for the initial interview some time during the weeks of October 10, October 24, or October 31—remember, that's for the 1.5 hours for the first interview. Barring any major delays, I would schedule your second interview within 2-3 weeks of the first interview.
I have reserved the Green Room (131) in Building 2N, Public Affairs Office building and will contact you to make the appointment as soon as you notify me that you will participate in this study. I will ask you now, that if you do agree to participate in the study, you will have read the attached Informed Consent Form and be prepared to ask questions when we meet or to send me questions prior to the meeting. At the time of the first meeting, I will ask you to sign the Informed Consent Form prior to our beginning the interview. If you think that I should notify anyone else in your chain of command to provide him/her with the information about this study, please let me know whom I should call. I will cc Flight Crew Ops Director Janet Kavandi and

Astronaut Office Chief Peggy Whitson so that they are informed of my request for your participation, as well.

If you have any questions, please call me at 281-488-5960 or cell phone 281-772-6860. Thank you so much for your consideration to this request. Although I cannot offer any compensation for your time, I want you to know that I will be gratefully appreciative for your "priceless" time. I am really excited about the study. To my knowledge, no one else has conducted this type of study. Understanding why the EVA team has been so successful in the performance of its EVA missions will make a great contribution to the literature about the organizational and safety cultures at JSC and can be shared with other organizations characterized as high reliability organizations and largely depend on individual and team performance for the success of the mission.

Please let me hear from you, whether or not you can participate. But, I really hope you will agree to participate. Thanks!

Appendix B

Consent Form

CONSENT TO BE A PART OF A RESEARCH STUDY

Excerpt from: NASA Institutional Review Board (IRB) Committee for the Protection of Human Subjects (CPHS)—Signature page

15. RECORD of INFORMATION PROVIDED

15.1 Your signature in the next section means that you have received copies of all of the following documents:

- This NASA IRB CPHS "Consent to be Part of a Research Study" document;
- Video, Audio, and Photo Consent;
- Other (specify): _____

16. SIGNATURES

Research Subject:

I understand the information printed on this form. I have discussed this study, its risks and potential benefits, and my other choices with _____. My questions so far have been answered. I understand that if I have more questions or concerns about the study or my participation as a research subject, I may contact the study team. I understand that I will receive a copy of this form at the time I sign it and later upon request.

Signature of Subject: _____ Date: _____

Name (Print legal name): _____

Video, Audio, and Photo:

I understand that this study will utilize video and/or still photography to analyze study results and I consent for the use of these materials.

_____I accept

_____I do not accept

Signature: _____

Principal Investigator (or Designee):

I have given this subject information about this study. I believe this to be accurate and complete. The subject has indicated that he or she understands the nature of the risks and benefits of participating in this study.

Name: _____ Title: _____

Signature: _____ Date: _____

Witness (optional):

I observed the above subject sign this consent document.

Name: _____

Signature: _____ Date: _____

Appendix C

Interview Protocol

The following are the two main questions and sub-questions that will support the framework of the study.

1. What are the elements of the safety training for the Spacewalkers.
    a. What does the general orientation include?
    b. What does your safety training entail?
    c. Where are the interactions of the teams, members of the other teams besides the EVA Team members?
    d. Who provides your safety training once you have been assigned to a specific mission?
    e. Who are the experts around you?
    f. Who were some of the key role models around you?

2. What is involved in the development of the EVA Team?
    a. When does the team start developing?
    b. How did you determine what were the norms and principles of the team?
    c. What were some "upending experiences" (those deliberately planned or accidentally created circumstances) that made the team members become closer?
    d. What were some of the "taboos" you learned from others?
    e. How can you tell when the team members have built commitment and loyalty to the team?
    f. How did others let you know you were ready for the Spacewalk?