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Apollo 13 - Crisis, Innovation and Sensemaking

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Abstract:

There can be few people that are unaware that Apollo 13 was on its way to the moon when an explosion caused several key systems to fail. Fortunately, the interlinked crises experienced by the Apollo 13 crew have been extensively documented. Using grounded theory techniques, we have analysed these rich data from an organisation development perspective and found that NASA's ability to respond effectively was enabled by eight interdependent capabilities that can be adopted by other organisations that need to be resilient in crisis situations.

The distinctive capabilities are: (i) active role modelling of an engineering-excellence ethos by the upper echelon, (ii) collective utilisation of standardised rigorous problem-solving methodologies, (iii) technology-enabled systemic situation awareness, (iv) extensive and forensic simulations of multiple contingencies; (v) clarity about decision ownership, (vi) aligned granular innovation capability, (vii) proof of the capability of individuals to be efficient and effective, despite adversity and (viii) a heedful group-mind.

Keywords: Apollo 13; Crisis Readiness; Role Models; Organisational Agility; Group Mind; Heedful Sensemaking;

Hey, we've got a problem here

These words, spoken by Apollo 13's Command Module Pilot, Jack Swigert, gave an intimation of serious trouble for Apollo 13 (NASA, 2020). Over the next hour the extent of the crisis began to be understood. An an oxygen tank had exploded, destroying power generation capability. The space craft was crippled. For the next four days, the astronauts and NASA's mission control organisation, fought to bring the crew back to Earth safely. This required overcoming multiple problems, many of which has not been foreseen.

The drama is well known from books, films and television programmes but less well understood is how the NASA organisation became capable of enabling the crisis to be managed successfully. It is this that we examine, focussing attention on those

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organisational attributes that can be adapted by other organisations that need to capable of dealing with crises.

There is a substantial literature on High Reliability Organisations (Leveson *et al.*, 2009), organisational resilience (Gover and Duxbury, 2018), leadership in complex systems under stress (Martínez-Córcoles, 2018), organising hazardous military initiatives (Soykan and Alberts, 2015) and crisis management (Spector, 2019). Likewise, there is an extremely large body of literature related to innovation (Tidd and Bessant, 2013). However, the role that innovation plays in the management of crises has not been extensively explored. The recent crisis related to Covid 19 has demonstrated a need for academics and practitioners to understand better the conditions that enable an organisation to utilise innovation and agility so as to be more effective in coping with crises.

Our methods

Our study examined a specific crisis event (the Apollo 13 flight) in considerable depth to assist us to understand the specific behaviours, processes and capabilities that enabled a hazardous situation to be understood and mitigated. Layder's Adaptive Theory (Layder, 1998) was our research method, as this provided a means of aligning qualitative research data to explore predetermined areas of interest (in our case this was the organisational attributes used by NASA for achieving crisis readiness that could be adopted more widely). Our orienting concepts were drawn from Organisational Sociology (Scott, 2004), Innovation Management (Tidd and Bessant, 2014), Agility Studies (Francis, 2020), Social Psychology (Weick and Roberts, 1993) and Organisation Development (Hodges, 2020). Our analytical software was NVivo 12.

We were fortunate as the Apollo 13 case has been extensively documented, most recently by a remarkable BBC World Service documentary (Fong, 2020b) that has more than five hours of recordings, including new interviews with the astronauts and many of the key people involved. In addition, we used 18 other sources of information, including NASA documentation, films, videos and oral history archive material.

We find that eight organisational attributes can be identified for which there is evidence that they could be adopted or adapted by organisations other than NASA. We acknowledge that the support for this assertion is nascent, so the list should be considered as the beginning of a conversation rather than a definitive list of the organisational attributes that can help an organisation to cope effectively with a crisis.

Organisational Attribute One: Active Role Modelling by the Upper Echelon

Robert C. Seamans Jr. was a top manager in NASA in the early days of the Apollo Program. Shortly before he died recently, he told the story (Fong, 2019) of how the decision was made as to which method would be used for the first moon shot. When Seamans joined NASA many of the top NASA executives and engineers, including Werner Von Braun, considered that the best solution would be to build a single, huge spacecraft, to be called the Nova, that would travel to the moon, land and return to Earth.

A consensus was emerging that this would be the best solution but a middle-level engineer named John C. Houbolt disagreed. He believed that a totally different approach, known as Lunar Orbit Rendezvous method, was the only viable option (a small craft would descend to the moon band but need to rendezvous with an orbiting mother ship for the journey home). Later, Houbolt (Yvette Smith, 2014) wrote to Seamans, many levels above him in NASA's hierarchy, saying "somewhat as a voice in the wilderness, do we want to go to the moon or not? Why is Nova with its ponderous size simply just accepted?". Seamans' reflected later, "when I first read the letter my hackles went up and I thought I'm getting sick of this guy, he is becoming a pest… and then I thought, maybe he is right!"

Over the next few months Houbolt's argument won favour and the Lunar Orbit Rendezvous method was selected for the Apollo moon shots. The effect on NASA's organisational culture of the stance taken by Seamans, and other senior managers, was profound. Houbolt's persistence was openly honoured. Those working in NASA experienced that those in the upper echelon personally valued engineering logic above organisational status and they were willing to acknowledge that they were wrong. Almost certainly without premeditation, Seamans, and other senior leaders in NASA were actively role modelling that engineering-excellence was a superordinate organisational value that trumped hierarchy, stature and orthodoxy. Narratives that describe how NASA was organised during the Apollo Program (Grundstein and Rosholt, 1967) demonstrate that the personal values of those at the top of the organisation have a profound effect on strategy, organisational culture and (innovation, agility and mission) ambitions. Similar viewpoints are common in military organisations (Murray, Berkowitz and Lerner, 2019) that can be summarised as 'character is vitally important'.

The insight that the character and personal values of those in the upper echelon profoundly shapes how organisations cope with challenge, uncertainty, and crisis is transferable. We suggest that four initiatives are relevant. First, that those selected for leadership roles are selected because, in part, their personal values support the required identity of the organisation that they seek to lead (Hood, 2008). Second, leaders need to be informed as to how they, personally, are perceived across the organisation (Bourne, Jenkins and Parry, 2017). Third, values-based coaching should be mandatory for all those in the upper echelon (Athanasopoulou and Dopson, 2018). Lastly, top-team building should include a component of values clarification (Kets de Vries, 2011).

Organisational Attribute Two: Collective Utilisation of Standardised Rigorous Problem-Solving Methodologies

When Apollo 13's Command Module Pilot, Jack Swigert, announced that "Hey, we've got a problem here" many of those outside of NASA will have been unaware that the terminology that he was using was precise. It was mandatory in NASA to be aware of a structured approach to problem-solving known as Kepner-Tregeo training (Kepner and Tregoe, 1981). This approach (known as 'KT') describes problem-analysis as enabling "us to accurately identify, describe, analyse, and resolve a situation in *which something has gone wrong without explanation*. It gives us a methodological means to extract relevant information from a troublesome situation and set aside irrelevant, confusing information" (p.25 authors' italics).

KT training is rigorous. In the 1960s, the introductory KT course took five-days and required that trainees used customised tools on complex simulations that were extremely intellectually challenging. Advanced KT training was required several more weeks of demanding exercises, practice and discipline. KT is strongly engineering orientated and it became a collective orthodoxy in NASA as Lyndon (2008) explained in relation to the Apollo 13 crisis, observing that: "the KT process was very thoroughly used in that whole sequence of events from trying to understand what caused the problem to using decision making on how to get the astronauts back… If you go back and listen to the tapes of conversations between Houston and the Apollo 13 crew you will hear KT language used" (p. 2).

As far as is known, all of the key decision-makers in mission control during the Apollo 13 crises had been fully indoctrinated and practiced in the KT step-by-step process (Situation Appraisal - Recognize Problems - Problem Analysis - Decision Analysis - Define Standards for Solutions - Test Potential Solutions - Set Contingency Actions - Minimize Problem Effects). This breadth of commitment to the use of the KT toolkit in NASA provided a high level of intellectual standardisation. It enabled those addressing highly complex and urgent problems to work together as effective ad hoc teams with little or no preparation. Importantly, as the KT is intellectually rigorous, and strongly evidence-based, conclusions from teams had a higher probability of being reliable.

The insight that a shared, embedded and relevant intellectual tool-kit for problem solving assists key actors to cope with crises is transferable, and facilitates the development of a collective intelligence (McHugh *et al.*, 2016). We suggest that three initiatives are relevant. First, select a standardised problem-solving toolkit that is appropriate for the types of crises situations that can occur in the organisation (van Aken and Berends, 2018). Second, ensure that mandatory training is provided for those who could be key actors in challenging or crisis situations (Hošková-Mayerováa, 2016). Third, require that the logic of the selected problem-solving toolkit is required routinely as problems are being addressed, so that the use of the method becomes 'second-nature' (Rouleau, 2005).

Organisational Attribute Three: Technology-Enabled Systemic Situation Awareness

"After the explosion, Aldrich (Arnold D. Aldrich later became the Director of the Space Shuttle Program) had moved into the spacecraft analysis, or SPAN, room, located across from mission control. The SPAN room was fitted out with more consoles and acted as a bridge between the flight controllers and the army of engineers who had actually designed and built the spacecraft. 'In there were supervisors like me and executives from the engineering organizations in NASA and the manufacturers, and this group would sit together and monitor the flights,' says Aldrich. The SPAN room had come into being because 'we learned during Mercury that we wanted immediate access to the manufacturers, that we needed clear and unfiltered data very rapidly', says Kranz (Flight Director)".

This quotation from Stephen Cass' comments (2005b, p. 3) provides an excellent description of the challenges of the Apollo 13 flight provides a glimpse into the degree to which information was shared extensively, in real-time and ready to be interrogated for specialist purposes. Not only was this important for decision-making purposes. It had two other functions. The sustaining of collective consciousness (discussed further in Organisational Attribute Eight) and facilitation of mutual adjustment, meaning that individuals were able to see where help was needed and act autonomously to provide it. From accounts written at the time it seems that within one hour almost all of those who could contribute to solving the spacecraft's problems had been contacted.

In the influential book, 'Power to the Edge: Command, Control in the Information Age' that had been written for military planners, the authors, Alberts & Hayes, (2003) state that: "during the undertaking of the mission, those involved need to make sense of the situation and orchestrate the means to respond in a timely manner. These functions are performed iteratively with the means being adjusted dynamically in response to changes in the situation and/or command intent. Making sense of the situation is inherently dynamic" (p.16-17). This could have been a description of how NASA reacted to the crisis on Apollo 13 but, crucially, the technologies and processes were not only in place, they were up-and-running enabling the entire support system to become aware of the situation and monitor changes.

The insight that an accessible, real-time, reliable, information sharing network that enables potential actors to adapt to crises is transferable (Gillespie, 2017). We suggest that three initiatives are relevant. First, form a team to undertake an inquiry into how the organisation dealt with a recent systemic challenge and to take evidence from those who could have helped as to what information they could access (McFillen *et al.*, 2013). Second, find examples of other organisations with similar operations and compare and contrast their information sharing network with yours (de Castro and Frazzon, 2017). Lastly, identify a systemic risk that could affect your organisation and simulate how your organisation's information sharing network could cope with the challenge (Huang, 2015) (see Attribute Four, below, for further suggestions on this recommendation).

Organisational Attribute Four: Extensive and Forensic Simulations of Multiple Contingencies

"in the run-up to the Apollo 10 mission, the flight controllers and astronauts had been thrown a curveball during a simulation. 'The simulation guys failed those fuel cells at almost the same spot,' as when Apollo 13's oxygen tank exploded in real life, remembers James ("Jim") Hannigan, the lunar module branch chief, 'It was uncanny'… At the time, the simulation was rejected as unrealistic, and it was soon forgotten by most. NASA 'didn't consider that an authentic failure case', because it involved the simultaneous failure of so many systems, explains Hannigan. But the simulation nagged at the lunar module controllers. They had been caught unprepared and a crew had died, albeit only virtually. 'You lose a crew, even in a simulation, and it's doom,' says Hannigan. He tasked his deputy, Donald Puddy, to form a team to come up with a set of lifeboat procedures that would work, even with a crippled command module in the mix. 'Bob Legler was one of the key guys' on that team, recalls Hannigan. As part of his work, Legler "figured out how to reverse the power flow, so it could go from the LM back to CSM," through the umbilicals, says Hannigan. "That had never been done. Nothing had been designed to do that." Reversing the power flow was a trick that would ultimately be critical to the final stages of Apollo 13's return to Earth" (Cass, 2005a, p. 3).

Of all of the processes that enabled solutions to be found to the problems that beset Apollo 13, simulations of the type described above were essential. They were designed to be authentic, just as were used to train pilots in flight simulators (Lee, 2017). All of the actors participated, including astronauts in authentic settings and intensive reviews were conducted after each iteration. The simulations had the vital function of facilitating collective learning (Lau, Lee and Chung, 2019). Also, importantly, simulations provided opportunities to identify precise targets for innovation when there was time to undertake innovation initiatives (NASA managers took the view that as little innovation as possible should be taken during an actual flight as the chances of error were too great). The case example described above shows that, in NASA, failures in simulations led to substantial resources being allocated to find solutions. This readiness to act on evidence from simulation failures proved to be critical to the ability of Mission Control to find effective, and often proven, answers to extremely complex problems in highly time constrained contingencies.

The insight that extensive and forensic simulations of multiple contingencies increases the capacity to respond effectively to crises is transferable (Sterman, 2014). We suggest that four initiatives are relevant. First, identify and rank systemic risks in terms of likely consequences (Tavares, Da Silva and De Souza, 2019). Second, find pertinent existing simulations (if available) and test them as prototypes (Quillinan *et al.*, 2009). Third, establish a simulation-orientated learning programme that, over time, addresses possible high-impact failures (Straus *et al.*, 2019). Lastly, rigorously check that failures in simulations have led to remedial improvements (Antonacopoulou *et al.*, 2019).

Organisational Attribute Five: Clarity about Decision Ownership

"The flight director probably has the simplest mission job description in all America, Kranz (Flight Director on the Apollo 13 Mission) told Spectrum. 'It's only one sentence long: 'The flight director may take any action necessary for crew safety and mission success.' The only way for NASA to overrule a flight director during a mission was to fire him on the spot. The rule vesting ultimate authority in the flight director during a mission was on the books thanks to Chris Kraft, who founded mission control as NASA's first flight director and who was deputy director of the Manned Spacecraft Center during Apollo 13. He had written the rule following an incident during the Mercury program when Kraft, as flight director, had been second-guessed by management. This time, as the crisis unfolded, no one had any doubts as to who was in charge" (Cass, 2005a, p. 4).

A major concern in NASA was to achieve clarity about who owns which decisions, how decision-makers should interrelate with each other and how decision-making ownership should flex in the circumstances of the moment. The issue is complex, as has been shown by experiments using different decision-making models in military scenarios (Alberts, 2015) which have demonstrated that factors such as the nature of the task, the degree of requirement for intra-operability and the depth of trust between lead actors result in decision-making models needing to be contingent. In the Apollo 13 case NASA's aim was to routinise decision-making by developing flight manuals that specified what and how needed to be done in pre-defined circumstances, using a model that Mintzberg (Mintzberg and Waters, 1983) described as a professional bureaucracy. After the explosion, so many contingencies developed that went outside the pre-prepared flight manuals that a different organisational modality was required. These were targeted adhocracies (Waterman Jr., 1992), that had short-cycle decision rights and were aligned by standardised investigation problem-solving processes and by accumulated practices, developed largely in simulations, that had become encapsulated through mutual adjustment and become a property of the collective mind.

The insight that clarity about decision ownership is essential for an organisation to be able to respond effectively to crises is transferable, indeed it has been known for millennia (Tzu, 1981). Less well understood is how changes in the nature of challenges, and of technologies to manage information flows, affect decision-making stratagems. For these reasons we suggest that three initiatives are relevant. First, identify a significant incident in which the organisation failed to make prudent, timely and effective decisions to deal with an unexpected challenge or crisis and undertake an inquire to discover what could have been done what would have been more effective (Alberts *et al.*, 2014). Second, arrange for senior managers to become aware of recent experiments and assessments or effective decision-making using modern technologies (Marchau *et al.*, 2019). Lastly, ask for input from across the organisation as to what could be done to improve decision-making (Church, 2017).

Organisational Attribute Six: Aligned Granular Innovation Capability

"The command module was built by North American and had a square (lithium-hydroxide for removing CO2 from the atmosphere) canister. The LM was built by Grumman Aircraft and that had round canisters and so they wouldn't fit (the LM's air purification system). (Fong) These are two state-of-the-art spacecraft worth billions of dollars but there is a tiny difference in the design of their life support systems. For Apollo 13 this is what it comes down to. The shape of a hole. A feature so seemingly unimportant that even detail-obsessed NASA hadn't thought through its implications: but now it threatens the astronauts' lives. There were no plans for this eventuality. To rescue the mission NASA would have to indulge in a rare feat of pure improvisation. NASA had learned to be wary of creativity and inventiveness in the heat of the moment. Knowing that plans hatched in the midst of battle often harboured hidden flaws. But it had no choice. In mission control another team of engineers splits off to take on the problem. Astronaut Tony England is assigned to the group and recalls 'They could only use what was in the LM to build an adapter) so that all this stuff on the table and they were taping it together to see whether it was going to work. It was a makeshift deal. We had cardboard, duck tape and we actually had a sock that we stuffed in to fill up a hole… it had to be airtight and durable.…' (Fong) Dozens of people were involved. Equipment is shuttled backwards and forwards across the country on specially chartered flights (Fong, 2020a).

This extract from a recent BBC podcast series, presented by Kevin Fong, provides important insights into how NASA managed innovation. Fong explained that the essence of NASA had been determined by the mission defined by President Kennedy and, importantly, it had been given the resources and political momentum to complete its mission. It is revealing to re-examine the original speech to understand better the nature of NASA's mission.

President Kennedy' speech on September 12, 1962 included these words: "man, in his quest for knowledge and progress, is determined and cannot be deterred. The exploration of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay behind in the race for space… In short, our leadership in science and in industry, our hopes for peace and security, our obligations to ourselves as well as others, all require us to make this effort, to solve these mysteries, to solve them for the good of all men, and to become the world's leading space-faring nation… We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too" (NASA, 2012).

The chief goal, defined by Kennedy, was for the USA to acquire and sustain "leadership in science and in industry" by achieving the feat of putting Americans on the moon. It is not an exaggeration to state that this required entering a new technological paradigm (Harris, 1992). Innovation would be required in every dimension of endeavour, from space medicine to computer-controls. The focus of this vast, multidimensional innovation effort was to become able, reliably, to put men on the moon which was a flight, similar in some ways to that of an aircraft. Those involved in aircraft development, for example in Lockheed's skunkworks (May, 2003), knew that novelty was both progressive and dangerous and so developed a managerial philosophy that adopted (probably unconsciously) the principle of 'checks and balances' (Hamilton and Madison, 1788), meaning that critical evaluation was as significant as invention.

The capability to be both bold and critical in engineering needs to be highly detailed. Examples of topics that need to be mastered include design of a switch that will operate reliably in a vacuum, a process for ensuring a correct flow of fuel during a burn or the design of computer memories that are capable of withstanding cosmic ray burst. World-class expertise is needed and this requires specialist, or granular, innovation capability that is managed using checks and balances. However, granularity promotes organisational silos (Cilliers and Greyvenstein, 2012) that can be dysfunctional for systemic integration. Hence, alignment of innovation initiatives is essential. A careful and dynamic balance between integration and differentiation is a managerial imperative (Lawrence and Lorsch, 1967).

The insight that aligned granular innovation capability is essential for an organisation to be able to respond effectively to crises is transferable. In crises there will be unpredicted events, such as the inability of the astronauts on Apollo 13 to use available lithium-hydroxide canisters in a different life-support system from their intended use. Such problems require dedicated granular teams with specialist expertise and resource availability. we suggest that two initiatives are relevant. First, to practice forming ad hoc granular teams to address simulated problems (Jacobsson and Hällgren, 2016) and second, to give those with system-wide responsibilities the opportunity to practice managing alignment and instilling appropriate checks and balances (Campbell, Whitehead and Finkelstein, 2009).

Organisational Attribute Seven: Proof of the Capability of Individuals to be Efficient and Effective, Despite Adversity

"Confidence was part of the bedrock upon which mission control was built. When prospective controllers joined NASA, often fresh out of college, they started out by being sent to contractors to collect blueprints and documents. They then digested those into information that mission controllers could use during a mission, such as the wiring diagrams that the lunar module controllers had used to figure out how to power up the Aquarius. After that, the proto-flight controllers started participating in simulations. The principal problem NASA had with these neophytes was "one of self-confidence," explains Kranz. "We really worked to develop the confidence of the controllers so they could stand up and make these real-time decisions. Some people, no matter how hard we worked, never developed the confidence necessary for the job." Those not suited for mission control were generally washed out within a year" (Cass, 2005b, p. 2).

During NASA's huge expansion of personnel in the early 1960s there was often a short selection process, with young people being hired from their CV alone and without an interview (Fong, 2020b). Most recruits were from the hard sciences, having studied subjects like mathematics, engineering, physics. All these skills were needed in a rapidly growing NASA but for those that would deal with possible problems or crises, such as mission controllers, the capacity to function in highly stressful situations was essential. This was tested in simulations and only those that thrived would be selected for these demanding roles.

Those with mission-specific decision power, in particular the Flight Director, could be in a position that many would find totally overwhelming. Fong (2020a) reports that the lead Flight Director for the Apollo 13 mission was "Eugene Francis Kranz ('Gene', the Flight Director). He was an ex-marine. He was always a pumped up guy. He hardly ever sat down. He passed the floor. He was that intense. We playfully called him the Prussian General. Gene was a very serious hard-working disciplinarian. And he was good. Could be pretty tough. That was OK. We needed that sometimes. He is a one of a kind guy." The fact that Kranz had been a military officer is significant as the armed forces are one of the few fields of employment that regard 'grit' or 'hardiness' as a core personality requirement (Von Culin, Tsukayama and Duckworth, 2014).

Francis (2020) writing about organisational agility, an essential component of effective crisis management, states that: "leadership in agile organisations requires a depth of character. This somewhat unfashionable insight is central to understanding the attributes of the elite leadership group that is ever-present in successful agile enterprises… Acquiring individuals with grit for key roles in an organisation is more than a task for specialists in human resource management, as it is a strategic act. It is remarkable just how far world-class agile enterprises will go to seek, find, motivate and honour individuals with the combination of advanced technical prowess and personal grit. Not everyone possesses an inner commitment to pursue aspirational goals with unstoppable zeal and diligence. Interestingly, people with grit do not necessarily demonstrate superior talent; rather superior diligence, confidence to be proactive and enough humility to be a team player".

The insight that the proven capability of individuals to be efficient and effective, despite aversity, is essential for an organisation to be able to respond effectively to crises is transferable. Put simply, in crises the required quality of leadership is greater. Hence, we suggest that three initiatives are relevant. First, those that will be leaders in crisis situations need specialised training to help them to gain the required mind-sets and skill-sets (Von Culin, Tsukayama and Duckworth, 2014). Second, ways need to be found to test whether possible leaders have the personal resilience to cope constructively with highly stressful situations (Murray, Berkowitz and Lerner, 2019). Lastly, 360-degree feedback needs to be available to facilitate reflective learning (Schön, 1983).

Organisational Attribute Eight: A Heedful Group-Mind

"The first astronaut assigned to Grumman was Fred Haise, who would eventually use the knowledge gained by his deep involvement in the Lunar Module program to get his crippled spacecraft home when Apollo 13 used the module as a lifeboat. His intimate understanding of the LM and its inner workings went a long way toward saving his crew. When he first arrived at the Grumman plant, Haise was on a walk-through of the LM assembly area when he pulled one of the Grumman executives aside to make a request. The man looked surprised, saying something to the effect of, "Mr. Haise, hundreds of people are working on the LM!" Haise was undeterred ... and later that day, he placed himself at the head of a line that snaked through the plant and well outside the door and beyond. He wanted to shake the hand of every single person who was working on the Lunar Module, and he did. It was a brilliant way to get the builders of this complex, fragile machine onto his team. None of them ever forgot this simple gesture - they built a perfect flying machine for 'Fred' (Pyle, 2014, p. 96).

The Grumman Aircraft Engineering Corporation, later Grumman Aerospace Corporation, was a main contractor for NASA. They had won the contract to develop the Lunar Module (LM), which required multiple forms of radical innovation. NASA's astronauts and mission controllers needed to understand how the LM functioned in great depth, so many NASA people, including Fred Haise, the intended lunar module pilot on Apollo 13 mission, worked closely with Grumman. The incident described above, when Haise shook the hand of everyone working on the development of the LM, led to the Gramman engineers considering their task as helping Haise to undertake his dangerous task with the best possible equipment. They had Haise in mind as they did their work.

In the 1980s the US Office of Naval Research helped to fund a five-year study of air operations aboard Nimitz class carriers. These had been described as ‘a million accidents waiting to happen’ (Wilson, 1986, p. 21). Weick and Roberts (1993), reported on the Nimitz research and observed that “almost none of them do… The explanation we wish to explore is that organizations concerned with reliability enact aggregate mental processes that are more fully developed than those found in organizations concerned with efficiency” (p. 357). The researchers concluded that people working on aircraft carriers “act heedfully when they act more or less carefully, critically, consistently, purposefully, attentively, studiously, vigilantly, conscientiously, pertinaciously” (p. 361) and this orientation to collective sensemaking is key to understanding why complex hazards can be managed effectively. Weick and Roberts conclude that “a well-developed organization mind, capable of reliable performance is thoroughly social. It is built of ongoing interrelating and dense interrelations. Thus, interpersonal skills are not a luxury in high-reliability systems. They are a necessity. These skills enable people to represent and subordinate themselves to communities of practice. As people move toward individualism and fewer interconnections, organization mind is simplified and soon becomes indistinguishable from individual mind. With this change comes heightened vulnerability to accidents… With more development of social skills goes more development of organization mind and heightened understanding of environments” (p. 378).

NASA had developed a similar heedful group mind and they had succeeded in extending this into the support ecosystem, incorporating contractors like Grumman. When disaster struck Apollo 13 people rushed to help. It has been estimated that several thousand individuals made a contribution, many who volunteered and proposed ways of helping. The many accounts of how crises were mitigated (Fong, 2020b) describe multiple acts of heedful endeavour. Other priorities were postponed. A phrase from the days of sailing ships in distress “all hands to the pumps” captures the commitment to undertake effective action.

The insight that a heedful group mind helps to enable an organisation to respond effectively to crises is transferable. Unlike managerial initiatives that focus on processes and performance, this requires focusing on the emotional and social life of the organisation. We suggest that three initiatives are relevant. First, those in the upper echelon of an organisation study the role of heedful interaction as a modality of sensemaking and formulate leadership initiatives to encourage its development (Weick, Sutcliffe and Obstfeld, 2005). Second, those responsible for organisation development devise experiential activities that raise consciousness as to the importance of mutual heedful interaction (Solansky and Stringer, 2019). Lastly, recognition is given to incidents where people react heedfully, to promote this attribute as a honoured cultural meme (Drew and Wallis, 2014).

Concluding Remarks

The ways that NASA responded to the crises that occurred during the Apollo 13 mission demonstrates the critical importance of building an organisation that is able and willing to act intelligently, decisively and quickly. The organisational attributes that enabled this to occur were not invented when the crisis struck. Rather, they had been developed over time enabling NASA to be agile in action, innovative in solution finding, cohesive in culture, motivating a talent-rich elite organisation, rigorous in practice and quintessentially human in respecting honourable endeavour. It will be important to undertake further research in this area, so as to deepen our knowledge of the leadership and managerial actions required to enable organisations to respond effectively to crises and test the eight organisational attributes model outlined in this paper.

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