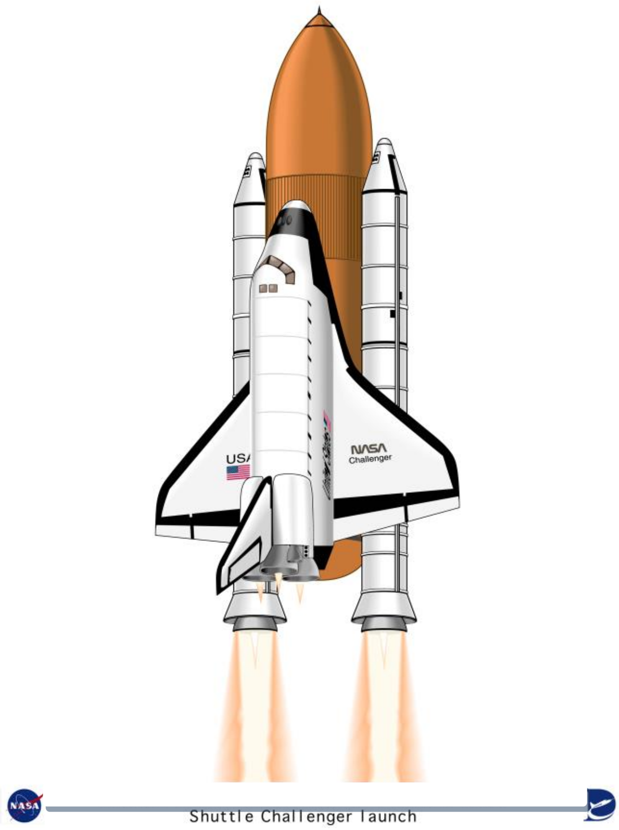
MAN 5625 – WORK & ORGANISATION BEHAVIOUR

Assignment 1:
Case Study Presentation and Report.

Q. Challenger: The Untold Story. Discuss (3000 words).



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Declaration: "I certify that I can provide a copy of the attached assignment if required" - "I certify that the attached assignment is my own work and that all material drawn from other sources has been fully acknowledged"

Signed: ………………………………….. ***Dated:*** …14th August 2009...

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INTRODUCTION

This report examines the magnitude of 'The Challenger Disaster', the spacecraft catastrophe of 1986. The importance to engineering and management fields is highlighted, this involving all great scale economic projects of which may impact society at large through seemingly minor, but great, oversights. President Reagan could not have put it a better way when:

> "The crew of the space shuttle Challenger honoured us in the way in which they lived their lives. We'll never forget them nor the last time we saw them this morning as they prepared for their journey and waved goodbye and slipped the surly bounds of Earth and touched the face of God. (As cited in Greene, 2009)

Engineering serves as the calcium of society today, and if its principles are not followed then there is little point in seeking change and innovation? Engineering continuously strengthens our pre-existing knowledge of design and, as calcium ensures healthy bones and teeth, engineering ensures a healthy and sustainable environment for humankind. This case examines the ultimate common culpability of engineering projects – inadequate communication and peer pressure influences from work associates.

The reason this topic was chosen is because communication between individuals (be it perceptive, sensemaking factors, or etc…) should be highlighted as essential elements in any engineering project in order to warrant safety, efficient distribution of resources, and thus optimization of all assets for maximum productive gain.

The historic track of space travel is not the focus of this report, instead it will examine the various perspectives taken by different key players and examine further theoretical concepts in determining an ideal way to manage all players for future like case scenarios.

STORY

CASE A – FORMAL VIEW (Julchen68, 2009)

In early 1986 the space shuttle challenger blew up soon after lift off. The cause of the explosion was a component failure. Aspects that were well known were that NASA did indeed plan on refitting the prototype orbiter 'Enterprise (OV-101)', as a second operational orbiter. However, design changes made for the first orbiter (Columbia, OV-102) would have required extensive rework and would pose severe cost implications. Because STA-099's (initial name of 'Challenger') qualification testing prevented damage, NASA found that rebuilding STA-099 as OV-099 would be less expensive than refitting 'Enterprise'.

NASA planned to refit the prototype orbiter 'Enterprise' (OV-101), used for flight testing, as the second operational orbiter. However, design changes made during construction of the first orbiter, 'Columbia' (OV-102), would have required extensive rework.

It was known that 'Challenger' (and the orbiters built after it) had fewer tiles in its Thermal Protection System than Columbia – this was not deemed to be a critical factor at the time.

Aspects that became apparently clear were that Shuttle Mission STS-51L (Challenger) was hindered by problems. Lift-off was scheduled at 3:43pm EST on the 22nd of January, 1986 – this date moved to the 23rd of Jan, then 24th of Jan due to mission delays in 61-C and finally postponed to the 25th of Jan. Bad weather caused postponed to the 27th of Jan and then further postponed to the 27th of Jan due to servicing equipment errors. There as a final delay of two hours when a hardware interface module in the launch processing system, which monitors fire detection system, failed during liquid hydrogen tanking procedures.

CASE B – NASA'S NARRATIVE VIEW (Julchen68, 2009)

NASA called Roger Boisjoly but spoke with his colleague Arnold Thompson. NASA wanted to determine if Morton Thiokol had any concerns regarding the SRBs during a very cold launch (i.e. expected 18 deg. F, which is below freezing point).

After consulting with Morton Thiokol Larry (NASA employee) responds using wording along the lines of "for God's sake, we have been flying for 4 years with these joints, you're generating new launch criteria. Think about this, think about your data!"

Larry then seeks George's opinion. George says he is 'appalled' with Morton Thiokol, but he would not go against a contractor, and hence couldn't recommend a launch.

CASE C – MORTON THIOKOL'S NARRATIVE VIEW (Julchen68, 2009)

Morton Thiokol Engineers convince staff that there is a potential problem.

The Morton Thiokol Engineers have "45 minutes to prepare for the most important technical meeting of the careers" (urgency).

Never before had a company tried to stand-up, and stop, a launch flight (manned or unmanned).

Morton Thiokol Engineers are initially confident of being able to stop the launch – Roger, Arnold, Larry, George, Gerald, Joe and Robert, are all at the teleconference meeting.

Morton Thiokol Engineers present their data and information, and explain why they want to stop the launch in the teleconference with NASA. The real problem is that there is no quantitative information to predict how 'O' rings will react to the predicted cold temperatures during the launch, but qualitatively they expect there to be more 'blow-by'.

Joe undermined the position of the Morton Thiokol Engineers.

Morton Thiokol goes Offline in the Teleconference – after much debate to consult engineers once again. Morton Thiokol was doing everything in its power to 'fudge' results in order to appease NASA. Private conversations ensue and the engineers start to change their minds.

Arnold tries to intervene in the private discussion between the Morton Thiokol Managers, but Gerald indicated that he was not welcome by using a 'grim' look.

Roger then attempts to intervene by screaming at the managers to look at the data again – he received the same treatment as Arnold.

Gerald then calls a vote on recommending a launch.

- Joe responds "I think it's alright".

Gerald then prompts Robert by saying" you have to take off your engineering hat and put on your management hat".

- Robert nods indicating he supports the launch decision.

MOTIVATION

"The movement of workers to act in a desired manner has always consumed the thoughts of managers. In many ways, this goal has been reached through incentive programs, corporate pep talks, and other types of conditional administrative policy." (Tietjen and Myers, 1998, p. 226)

The spacecraft Challenger was launched through pretences of what was deemed rational. Challenger was known to have poorer thermal insulation, but the fact remained that staff were under stress to perform within deadlines, and within budget, thus a series of oversights were made. The immense pressure from NASA, on Morton Thiokol's engineers was seen to affect as Gerald finally attacks Robert's credibility by saying that he ought to see the 'management' side of things, this in detriment to the engineering side. Robert, in turn, was probably motivated through prospects of:

- recognition;
- achievement;
- possibility of growth;
- advancement;
- responsibility; and the
- work itself.

The fact remains (unmentioned in the case study) that the spacecraft launch had been delayed for months. It can be assumed/guessed that Robert was eager to get the project back into schedule so that he could pursue with work so as to accomplish his own self-motivated desires. Pressure could have also been generated by his superiors who undoubtedly would have pushed the project forward due to their own self-motivating agendas.

It was well noted that NASA could have cancelled the project at any time, although there was intense political pressure surrounding the launch which motivated engineers and management to act irrationally. The main forces motivating the launch were:

- Teacher of Space was on board.
- Already wasted one good launch opportunity because a faulty door handle could not be removed.
- Public image "takes a beating" with each further delay.

Motivation for the launch to proceed derives from the degree of stakeholder involvement. It is human nature to pursue goals that promote satisfaction, and the public deemed the launch to be a symbol of American might as well as a progress towards scientific discovery.

NASA is under constant heavy pressure to accomplish more and better with less (Julchen68, 2009). Key questions that may have been asked in deciding on the final launch procedure would have been:

- Do the benefits outweigh the risks?
- Do we meet requirements but not much more?
- Do we feel it is a good decision?

The facets examined show that motivation criteria may lead to distorting perceptions so as to justify the current means to an end. When organizations start re-evaluating their options, as above, it becomes clear that the need to excel (in relations to motivation prospects) may in fact cast a blurred shadow over the common sense of rationality. Personal desires, ambitions, and goals may then be pursued in selfishness – without concern to the overall consequences.

Morton Thiokol did not take a 'selfish' approach in practice. Morton engineers sought to advise NASA of the limitations of the spacecraft given sound logic. It can be said that Morton was acting out self-pride, a concern for the welfare of others, and reputation – these can be said to have been Morton's motivating factors. As a result Morton engineers insisted that the process had to be maintained and upgraded in order to launch Challenger while observing the required conditions – something NASA was unwilling to invest in or waste more time on (refer to: Julchen68, 2009).

NASA decided that before spending more money on an apparent not fully identified situation it needed to address the public pressure for a launch and economic feasibility of delaying it further. NASA 'could' have addressed, and stimulated, the following motivating factors in its entirety amongst all its employees:

- "Doing something worthwhile – a goal.
- Doing one's share – participation.
- Counting for something – recognition.
- Knowing what is going on – communication.
- Getting a decent living – fair wages.

- Preparing for the future – learning.
- Doing things together – teamwork.
- Being challenged – innovation." (Rabey, 2001)

[The above list is by no means an exhaustive evaluation, and motivation theories will be further briefed further below]

Morton Thiokol's engineers ought to have been determined from the start to be doing their job, and they should not have succumbed to management pressures by forfeiting engineering reasoning and logic. It then becomes each organization's duties, amongst top management, to warrant that recruitment of its professional staff align with more noble and altruistic motivation methods. This becomes essential in order to keep staff in check and warrant that such engineering catastrophes to not reoccur.

"The five basic sources of motivation are; extrinsic/instrumental rewards, external self-concept, internal self-concept, goal internalization, and intrinsic self-concept." (Leonard, Beauvais, & Scholl, 1999)

There is a number of motivation theories that may explain the comportment of the individuals in the case study illustrated. Listed below is a quick summary of them – they will not be discussed in detail:

Hertzberg

Hygiene factors (conditions, pay, status, security, company policies)
Motivating factors (achievement, recognition, opportunity/management, interest in the job).

McClelland

Need to achieve
Most v outcome v success
Necessity of feedback

McGregor

Theory X
Theory Y

Mayo

Hawthorne effect
Importance of treatment
Social collaboration

Maslow

Physiological
Safety
Affiliation
Self-esteem
Self-actualisation

Drucker

Money

Llkhart

Exploitive-authoritative
Behavioural-authoritative
Consultative
Participative group

Taylor

Scientific management

(Ref. Post graduate diploma in management and leadership)

Argyle

- Bureaucratic pyramidal
- Humanist/democratic

Aldefer

- Achievement
- Affiliation
- Power
- Independence
- Self-esteem
- Security

Goal-setting

- Specification
- Challenging
- Acceptance
- Feedback

Addressing factors (i.e. Hero, slogan, ceremony, stories, culture gap, symbols, and etc…)

(Ref. Post graduate diploma in management and leadership)

PERSONALITY AND IDENTITY

“When an engineer can reproduce a bug they get excited because it means they can be sure to fix it.

When a manager can reproduce a bug they get annoyed because it means they keep running into it.”

The joke above does indeed relate individual problems that are all too prominent in workplaces, that is, each person is liable to think a different way. In our case study, the key players consisted of managers and engineers (this is outlined in the appendix under the table ‘Main Characters’). Engineers, in general, are largely responsible for all duties to the project whereas managers generally only tend to coordinate people to do work. Unfortunately managers often tend to coordinate too passionately which in turn can influence the engineers’ sound reasoning to a great extent. Unfortunately, in this case example, by the time most Morton Thiokol engineers gather towards their final decision most engineer’s minds were already biased by management and pressures from NASA. In the incident a NASA key representative, Jud, is quoted as saying, “anybody against the launch should have spoken up, otherwise they agree to launch”. Jud also emphasized that Morton Thiokol had 6 months to prepare for this potential outcome, but instead they left it to the final hours.

The core self-evaluation model posits that people make fundamental assessments about themselves concerning worthiness, competence, and capabilities that can affect one’s performance, behaviour, and attitudes at work (Judge, Erez, and Bono, 1998 as cited in Keller, 2007, p. 13). Self-esteem is a significant trait that ought to have been examined in the YouTube Challenger video. Roger and Arnold, for instance, are extremely confident on being able to stop the launch initially. However, it became apparent that those two individuals had an external locus of control thus believing that the factors were outside their control. Larry (NASA employee) showed to be very assertive, and probably had an internal locus of control, but this in itself can lead to catastrophe as the individual believed in himself so much that he overlooked key statistical data that proved him to the contrary.

Individuals with an internal locus of control do perform better than people who do not believe they are in control of their lives – this can be supported by examining narcissistic behaviour versus effectiveness (Edith Cowan University, 2009). The ability to deal in ambiguous or unclear situations can enhance self-competence, but dismissing key data when presented on front of you is inexcusable, and indeed NASA ought to have been just as liable as Morton Thiokol for their failure to work on the issue and instead resorting to peer pressure.

IDENTITY

Corporate identity is the articulation of what an organisation is, what it stands for, what it does and how it goes about its business (Topalian, 2003). On that note, we know that NASA identity is not only guided to improving space research, but its also a symbol of hope to many and a symbol of American might – that is, they will argue through any length in order to fulfil deadlines so that it does not lose interest by its key stakeholders. Morton Thiokol is a team that is focused on technical aspects of building propulsion systems, tanks, and even generators – they indeed have a philosophy of being able to adhere to technical required specifications so that no harm will come to the users of their products – hence, precision! So what went wrong? Well, a mistake in engineering design was found, and within time, however, management pressures from within NASA and Morton Thiokol engineers pushed forward a launch that should not otherwise have been mandated.

There are constant pressures nowadays to constantly raise performance, in the face of global competition to achieve targets. In turn, trial and error (as was the case with NASA) leads to restructuring as companies learn, and reinvent new ways in which to optimize efficiency by all parties involved. The Challenger scenario may indeed have happened more by chance than incompetency, but from it engineers have learnt to be more patient and precise when it comes to giving a complete system check before launch (Julchen68, 2009).

Normally it takes years for new identities to be formed within organizations, and there may be a number of emotional responses at an early stage – on the long run the normalizing and setting-in of corporate identity ought to lead to greater loyalty and growth amongst all departments. When a common culture is developed there is said to be less internal conflict within an organization, this equates to greater loyalty.

PERCEPTION AND SENSEMAKING

Perception is a process of intuitive judgement and it is a process by which apprehension by means of the mind or of senses occurs in order to interpret the world around us. An enactive view of perception suggests that perception works to understand the world rather than maintain the representation of the world.

Perception levels can be varied, and accordingly; "The person perceiving concentrates on the task and keeps watch on symbols, reference marks, intention, experience, and changes involving both inside and outside circumstances" (Barat, 2007, p. 339). Perception is a means of organizing patterns and meaning into a coherent whole. (Krueger, 2005, p. 1403)

Sense-making refers to the process of which an individual creates comprehension of a subject in order to interpret the world around them through use of sensory information. Like perception, sense-making also varies from person to person, however, sense-making is more dependant on past life experiences and different inherit physiological differences than perception is. Sense-making is what people do in order to decide how to act in the situations they encounter (Jensen, 2009, p. 103).

"Sense-making = situation awareness + understanding" – (Jensen, 2009, p. 104).

Sense-making spans a set of activities that begins with developing situation awareness and ends with preparing for action. Starting to prepare for action implies a decision on what action to prepare for.

In relations to the Challenger case scenario, it ought to be mentioned that Jud believed the right engineering decision was made with the data that was available – he was relying on his accrued perception over the years of his experiences and his sense-making capabilities in order to come across that conclusion. Roger, in turn, had a good gut feeling that the Challenger mission would not go right, this after the meeting. In fact he admitted that he knew, when he went home that night, that there was a good chance that seven astronauts would die the very next day.

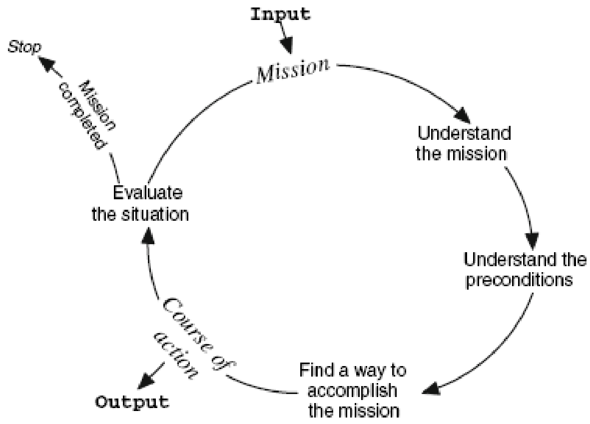

Figure 1: The functions of sense-making (Jensen, 2009)

The usage of language throughout the whole Challenger ordeal also shaped decisions from both sides. When Joe uses the words 'I guess' he undermines the analytical decision of not to launch – this is perceived by NASA that indeed the flight could launch as schedule since there was no determinacy in speech.

It was also perceived by NASA that the odds of a malfunction occurring at the last minute were pretty phenomenal – this in particular point to failure of 'O' rings due to cold temperatures, it just seemed ludicrous (Julchen68, 2009). Furthermore, Larry was insinuating to Morton Thiokol that 'they' were going to be held liable for the whole event in case the newly acquired data turned to be not pertaining to reality, "C'mon you are screwing up my launch schedule". Morton Thiokol 'perceived' this as an attack on their competency, and if NASA was backing this statement up then 'maybe', they (Morton Thiokol), are wrong after all! (Julchen68, 2009)

To conclude, the concept of perception can be greatly enhanced on by the implementation of technologies (hence, enactive) whereas sense-making is a process undertaken by which to understand conditions and enact upon them through a suitable intuitive/thought course of action.

CONCLUSION AND RECOMMENDATIONS

This essay covered some work and organizational behaviour aspects that directly affected the Challenger spacecraft disaster. There were several key players in the decision making side of things in this case study, however, a broad approach highlighting the story mainly from NASA's and Morton Thiokol's perspective was taken, and from it we were able to highlight certain aspects and mechanisms by which motivated individuals to perform the way they did and how they could improve from such learning.

There were strong political forces that motivated the project to proceed despite it proving unfeasible. Employees from both companies ought to have been better educated in dealing under peer pressure, and there was room for perfectionist determination amongst employees. If individuals were stronger mentally, and adhered to a proactive organization culture, then maybe the flight would have been delayed and the problem found and fixed. Unfortunately the notion of corporate identity sometimes takes place from the representation of a few who are not fit for the job.

A key aspect covered in the Appendix was the concept of learning. Learning is an ongoing process, and in this case it ought to be cyclical also. The process of getting information was right, however, it can be said that the information only came too late – given the previous safe launches it was deemed that this information was then erroneous. In dealing with learning, perception and sense-making come into question – these concepts take control from within individual's and very rarely can be easily changed, and more often than not requires time in order to progress to better reasoning.

The usage of language between engineers, managers, and staff also played one of the biggest roles in giving the clearance for the Challenger launch. The majority of personnel were not accustomed in working in 'red-alert' scenarios – these situations don't occur often. Every individual was responding in accordance to the best interests behind his supporting organization. NASA did not want to lose on money and any future funding because of a potential 'systems-check' procedure. The space aviation industry learnt much from this case study.

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Part 2 – http://www.youtube.com/watch?v=-H3NfqP9438
Part 3 – http://www.youtube.com/view_play_list?p=4C1AA8E6119D8167&playnext=1&playnext_from=PL&v=3nMG_a6u_aI
Part 4 – http://www.youtube.com/watch?v=81O9E9PJLA0&feature=PlayList&p=0C4BB92A4D0311C1&index=3
Part 5 – http://www.youtube.com/watch?v=81O9E9PJLA0&feature=PlayList&p=0C4BB92A4D0311C1&index=3
Part 6 – http://www.youtube.com/watch?v=7V2f-c5vlqQ&feature=PlayList&p=0C4BB92A4D0311C1&index=5
Part 7 – http://www.youtube.com/watch?v=sYTjAYQ4cJU&feature=PlayList&p=0C4BB92A4D0311C1&index=6
Part 8 –http://www.youtube.com/watch?v=nkNoeJ47a_A&feature=PlayList&p=0C4BB92A4D0311C1&index=7
Part 9 – http://www.youtube.com/watch?v=2im9W340qCU&feature=PlayList&p=0C4BB92A4D0311C1&index=8
Part 10 – http://www.youtube.com/watch?v=wtQI-KbFubc&feature=PlayList&p=0C4BB92A4D0311C1&index=9

APPENDIX

MAIN CHARACTERS

Main characters in video, 'Challenger: The Untold Story', in order of appearance:

Table 1: Main Characters - Challenger, The Untold Story (Julchen68, 2009)

Name:	Organization	Department	Title	Responsibility	Location
Roger Boisjoly	Morton Thiokol	Engineering.	Engineer.	#1 'O' ring specialist.	
Arnold Thompson	Morton Thiokol	Engineering.	Engineer.	#2 'O' ring specialist.	
Larry Molloy	NASA	Kennedy Space Centre.	Manager of the SRB project.	Launches.	Kennedy Space Centre.
George Hardy	NASA	Marsh Space Flight Centre.	Deputy Director of Science & Engineering.	Rocket and engine systems.	Alabama.
Gerald Mason	Morton Thiokol	Management.	Senior Vice President.	Highest rank Morton Thiokol person at meeting.	
Joe Kilminster	Morton Thiokol	Management.	Vice President of Space Booster Program.	2nd Highest rank Morton Thiokol person at meeting.	
Robert Lund	Morton Thiokol	Management / Engineer?	Vice President of Engineering.	3rd Highest rank Morton Thiokol person at meeting.	
Jud Lovingood	NASA	Engineering?	NASA Engineer.		

FULL DRAFT CASE STUDY

CASE A – FORMAL VIEW

On the 28th of January of 1986 at 11:38am the 25th space flight was launched at the Kennedy Space Centre in Florida – this being the spacecraft 'Challenger'. This flight was supposed to mark a stepping stone in space flight history as the first civilian was scheduled to fly to space, however, an O-ring seal on the right solid rocket booster (SRB) failed, this due to a variety of factors, primarily due to abnormally cold temperatures. As a result of this failure a plume of flame leaked out of the SRB and impinged on both the external fuel tank (ET) and SRB aft attachment strut of the vessel. The vessel's trajectory path rotated out of the normal flight profile and because of this the entire vehicle assembly broke apart due to aerodynamic loads – 'Challenger' exploded 73 seconds into the launch, killing the entire crew.

Aspects that were well known were that NASA did indeed plan on refitting the prototype orbiter 'Enterprise (OV-101)', as a second operational orbiter. However, design changes made for the first orbiter (Columbia, OV-102) would have required extensive rework and would pose severe cost implications. Because STA-099's (initial name of 'Challenger') qualification testing prevented damage, NASA found that rebuilding STA-099 as OV-099 would be less expensive than refitting 'Enterprise'.

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It was known that 'Challenger' (and the orbiters built after it) had fewer tiles in its Thermal Protection System than Columbia – this was not deemed to be a critical factor at the time.

Aspects that became apparently clear were that Shuttle Mission STS-51L (Challenger) was hindered by problems. Lift-off was scheduled at 3:43pm EST on the 22nd of January, 1986 – this date moved to the 23rd of Jan, then 24th of Jan due to mission delays in 61-C and finally postponed to the 25th of Jan. Bad weather caused postponed to the 27th of Jan and then further postponed to the 27th of Jan due to servicing equipment errors. There as a final delay of two hours when a hardware interface module in the launch processing system, which monitors fire detection system, failed during liquid hydrogen tanking procedures.

CASE B – NASA'S NARRATIVE VIEW

- NASA called Roger Boisjoly but spoke with his colleague Arnold Thompson. NASA wanted to determine if Morton Thiokol had any concerns regarding the SRBs during a very cold launch (i.e. expected 18 deg. F, which is below freezing point).
    - Why did NASA make this call? Because they knew there could be a potential problem with the launch temperature!!!

- After consulting with Morton Thiokol Larry (NASA employee) responds using wording along the lines of "for God's sake, we have been flying for 4 years with these joints, your generating new launch criteria. Think about this, think about your data!"
    - Morton Thiokol interpret the message as 'metaphorical buzz words' for "c'mon you (Morton Thiokol) are screwing up my (NASA's) launch schedule".

- Larry then seeks George's opinion. George says he is 'appalled' with Morton Thiokol, but he would not go against a contractor, and hence couldn't recommend a launch.
    - George's opinion was significant because he was a very highly recognized Engineer / Manager on the program.
    - The word 'appalled' was a "killer" because the next multi-million dollar contract with Morton Thiokol was still under negotiation. This word put intense pressure on the Morton Thiokol Management.

CASE C – MORTON THIOKOL'S NARRATIVE VIEW

- Morton Thiokol Engineers (i.e. Roger and Arnold, and a few others) successfully raise their concerns with Management, and convince them that there is a potential problem.

- A teleconference between Morton Thiokol and NASA is arranged.

- The Morton Thiokol Engineers have "45 minutes to prepare for the most important technical meeting of the careers".

- Never before had a company tried to stand-up, and stop, a launch flight (manned or unmanned).
  - The 1st time (i.e. never before) for any potential engineering action is often very difficult, because there is no precedent upon which you can base your argument.

- Morton Thiokol Engineers (i.e. Roger & Arnold) are initially confident of being able to stop the launch when arriving at the teleconference meeting, because they believed that NASA would not go against a Contractor's recommendation.

- Roger, Arnold, Larry, George, Gerald, Joe and Robert are all at the teleconference meeting.

- Morton Thiokol Engineers present their data and information, and explain why they want to stop the launch in the teleconference with NASA. The real problem is that there is no quantitative information to predict how 'O' rings will react to the predicted cold temperatures during the launch, but qualitatively they expect there to be more 'blow-by'.

- Critically, Joe used the words "I guess we can't launch due to the expected temperatures". The use of the word 'guess' showed that he was not confident in, or doubted, what he was saying to NASA. It also undermined the position of the Morton Thiokol Engineers.

- Morton Thiokol goes Offline in the Teleconference – after much debate to consult engineers once again. Morton Thiokol was doing everything in its power to 'fudge' results in order to appease NASA.

- Within the off-line caucus, which was much longer in duration than originally intended, the Morton Thiokol Managers begin to ignore the Engineers and hold private conversations. The duration of their talks was an indication to the Morton Thiokol Engineers that they were starting to change their minds, and would recommend a launch regardless of the Engineers' opinions.

- Arnold tries to intervene in the private discussion between the Morton Thiokol Managers, but Gerald indicated that he was not welcome by using a 'grim' look.
    - Arnold then decided that there was nothing more that he could do about it.

- Roger then attempts to intervene by screaming at the Managers to look at the data again.
    - He received the same treatment (i.e. grim looks) from the Morton Thiokol Managers.
    - Roger believed that he was very close to "completely loosing it".

- Gerald then calls a vote on recommending a launch.
    - Joe responds "I think it's alright".

- Gerald then prompts Robert by saying" you have to take off your Engineering hat and put on your Management hat".
    - Robert nods indicating he supports the launch decision.

LEARNING

There are a variety of methods that individuals and organizations may use to learn. Zuber-Skerritt (2002) identifies that the following common elements are common to learning:

- Learning by doing;
- experiential learning;
- reflecting on practice;
- being open;
- sharing ideas;
- collaborating;
- synergy;
- learning to learn;
- life-long learning; and
- learning in the workplace.

In the case study it was evident that destructive learning was taking place during the general meetings. Morton Thiokol engineers were being open with NASA staff about their concerns and doubts about the launch. However, instead of collaborating it seemed that Morton Thiokol engineers were taking an accommodative approach and thus succumbing to NASA's ideas. It was only at conclusion of the whole scenario that both parties were able to reflect on practice and that positive synergies developed.

On a different note, the concept of 'action learning' relates that learners themselves develop on the job by experiencing problems first hand and learning from the implemented changes or reactions. In the Challenger scenario there is not one person that could not have learned from this incident. George, as an individual, learnt that despite holding a senior position that he should never let his guard down, and in effect always be ready for last minute changes. Larry, and the NASA staff, ought to have been patient with the new findings and they should not have instigated the sheer pressure for launch given advice from Morton Thiokol, the real experts on the matter. The case study has been well narrated, and it can be seen quite clearly at who was responsible for each action.

Later in the YouTube video documentary (Julchen68, 2009), Arnold admits in hindsight that maybe he should have screamed louder! He seems to acknowledge that his obligation does not end with informing his managers. It is quite probable that Arnold, along with all of the affiliated people, learned a valuable lesson indeed.

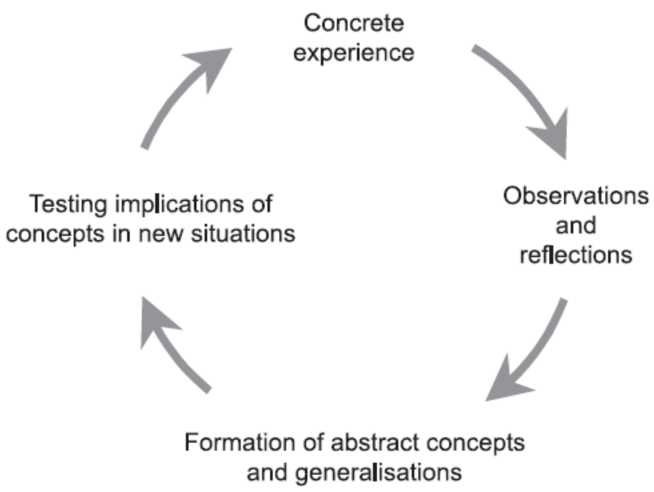

Figure 2: Kolb's experiential learning model (Zuber-Skerritt, 2002)

Kolb's experiential learning model, illustrated above, indicate that learning can only take place from observations and reflection. Morton Thiokol engineers had the knowledge that the O-rings would not sustain such cold temperatures, however, they had never learnt from concrete experience in order to justify their decisions. Had not Morton engineers approached NASA with their generalisations prior to the incident it is plausible that NASA would never have ascertained the cause of the disaster after the incident. As a result testing procedures have become more rigid when it comes to the space industry (Julchen68, 2009), and a greater reliance on empirical data is now common practice.

NASA and Morton Thiokol had the opportunity to learn from their errors and oversights. Before launches scale models are made and tested on a variety of scenarios. Further also, metallurgical data, as well as physical and chemical data on composites ought to provide sufficient data before a launch takes place – this learning derives from concrete experience. Morton Thiokol in fact already had an understanding of the problem before it occurred, but the fact that it wasn't noticed until the last minute show a lack of competency.

With the advances of computation iteration tests, launches nowadays can all be digitally confirmed simultaneously to scale temperature readings – technology facilitates learning. In all, organization learning occurs at the individual, group, intergroup and organization levels (Falconer, 2006, p.142). Learning can occur when errors are detected, corrected, or when the intended action has a positive outcome.

Models concerning effective learning are usually based on experiential, cyclic and/or iterative nature (Falconer, 2006, p. 143). Effective communication systems are essential in all types of learning, and indeed the process loop can even be repeated twice to warrant integrity in learning – repetition and scrutinizing is the key.

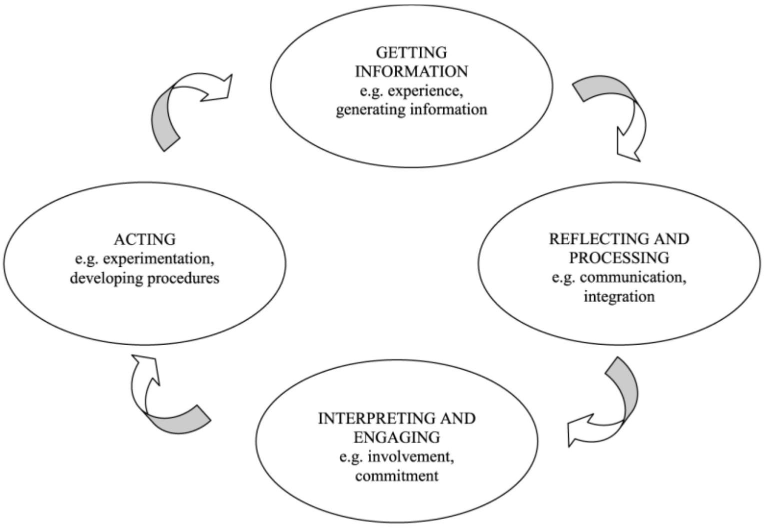

Figure 3: Cyclic construct model of organization learning (Falconer, 2006)

The model above emphasises that learning is an engaging process, and that participation is of greater importance than the actual acquisition of information. Neither the individuals nor the organization as an individual learn (Ortenblad, 2001). It can be said that only the individuals' directly relating to the Challenger scenario actually learned, and that in many ways the organizations themselves never learnt. This is not the case for NASA at least – NASA implements a rigorous testing procedure before every launch – given the potential costs with a failed launch it becomes more feasible to spend several million dollars more in order to conduct routine inspection prior launch.

THINGS TO DO TO STIMULATE MOTIVATION (Rabey, 2001)

Doing something worthwhile – a goal. ``My work is interesting and varied. I am part of a team. We understand why the work is important and the standards set are reasonable."

Doing one's share – participation. ``Others in my group depend on me. My ideas are listened to. The boss discusses things with us."

Counting for something – recognition. ``They recognise me as a person and for what I can do. I get credit for good work and help when in trouble. I feel part of the group. We are a team."

Knowing what is going on – communication. `` I know how I am doing, where I fit, what is going on and why. Changes are discussed in advance with us and our ideas are sought."

Getting a decent living – fair wages. ``My pay seems right for the skill, conditions and importance for the job and for the effort I put out in relation to that of others."

Preparing for the future – learning. ``I am encouraged to develop new skills and to acquire new knowledge. I can see stepping-stones along which I can advance."

Doing things together – teamwork. ``We know the target. We know the score. We take pride in being a team that achieves results."

Being challenged – innovation. `` I am encouraged to explore new ideas and to find improvements to present practices, knowing that initiative will be given due recognition."

SUPPORTIVE

The following hypotheses concerning individual characteristics can be examined:

- "Hypothesis 1. Self-esteem will positively predict job performance.
- Hypothesis 2. An internal locus of control will positively predict job performance.
- Hypothesis 3. Need for clarify will negatively predict job performance.
- Hypothesis 4. An innovative orientation on the KAI (Kirton's Adaptation-Innovation Inventory) will positively predict job performance.
- Hypothesis 5. Job involvement will positively predict job performance." (Keller, 2007)