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Knowledge Transfer in Space Operations

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Abstract

One of the greatest assets that a space operations organization acquires is knowledge. Knowledge accumulates with experience: "the more of something you do, the more you learn about it and the better you get, at least up to a point" (Nicholas & Steyn, 2012) [10]. "The biggest challenge is when space operation organizations do not know that knowledge exists, what knowledge exists or do not even know how to gain access to it" (Nicholas & Steyn, 2012) [10]. Another challenge could be that the knowledge that exists is tacit, and the organization doesn't have a formal process to access it. There is always someone in the organization with experience, knowledge, and skills that can contribute to the continuous success of the organization. The experience, knowledge and skills that can also be used to create new insights. This critical knowledge is mostly wasted because there are no formal processes to capture or disseminate it – a process called Knowledge Management (KM) (Nicholas & Steyn, 2012) [10]. That knowledge is also wasted when experienced people leave the organization, new processes and technologies render current ones outdated or records and documents are lost (Nicholas & Steyn, 2012) [10]. In an organization, learning takes place when knowledge is successfully transferred from one department to another or between individuals and is used to solve problems, innovate, or even create new knowledge. The most critical aspect of Knowledge Management (KM) is Knowledge Transfer (KT) –, a method of sharing information, abilities, and ideas across different areas in your business" according to (Brown, 2019) [2]. The lack of Knowledge Management (KM) – a process of capturing knowledge, retaining it, sharing it throughout the organization or between individuals and ensuring its availability for future users, and therefore a low level of information and Knowledge Transfer (KT) as well as an organizational culture that does not support knowledge sharing and job security in space operations were identified as three of the main factors causing ineffective management of intellectual capital within the organization.

This paper focuses on how a space operations organization can manage its intellectual capital effectively, factors influencing knowledge transfer and challenges involved in implementing knowledge transfer.

Keywords: Knowledge Transfer, Organization

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1. Introduction

During project execution, installation and testing of new equipment/system, launching/tracking of a new satellite, data acquisition, mission control etc., various forms of information and experience are generated. Knowledge is being generated through all these activities within an organization, but, if this knowledge generated is not properly collected, captured, and stored in a document library/repository where everyone in the organization can access it for future use, it will be wasted. Due to this, the quality of service the organization offers to clients will adversely suffer, leading to increased costs of resources, time, and money to acquire knowledge that was once available in the organization. This knowledge that gives the organization a competitive advantage gets lost when knowledge carriers, "experienced workforce or ideas people", in the organization resign/retire/depart earth.

To enhance the comprehensive strength and international competitiveness of space operations organizations, space organizational knowledge is required. "Knowledge is a fact or condition of being aware of something. Knowledge Transfer (KT) is how organizations get the critical skills, insights, and ways of doing things from employees, who may be leaving the organization to those who are sticking around" (Carruthers, 2021) [3]. The transferred knowledge must be captured, retained, and shared throughout the organization or between individuals to ensure its availability for future users.

Surveys and interviews highlighted that the lack of Knowledge Management (KM) and, therefore, a low level of information and Knowledge Transfer (KT), organizational culture that does not support knowledge sharing, and job security in space operations were identified as three of the main factors causing ineffective management of its intellectual capital.

The purpose of this research is to explore how a space operation organization can manage its intellectual capital effectively, factors influencing knowledge transfer, and challenges involved in implementing knowledge transfer.

Knowledge Transfer (KT) can help the organization to improve innovation, collaboration and understanding in the business. According to (Brown, 2019) [2]. Knowledge Transfer (KT) can also help the business in the following ways:

- Accelerate the accumulation and dissemination of knowledge across the organization,
- Provide easy and rapid knowledge access to the team
- Eliminate time and space constraints in communications
- Stimulate associates to experience the value of sharing knowledge in providing custom-tailored service to customers
- Respect the dignity of everyone by cultivating an environment that enhances their professional development and recognizes each person as a valued member of a service-oriented team.

2. Literature Review

"Knowledge has been recognized as the primary driver of an organization's growth and competitive advantage" (Ncoyini & Cilliers, 2020) [9]. "In virtual organizations where information is exchanged more frequently the cognitive ability and knowledge sharing behaviour have enabled employees with strong knowledge sharing motivation to show passion and challenge for their work. As a result, these employees are more inclined to use innovative thinking to find a variety of solutions, ultimately exhibiting high creativity" (Jin & Suntrayuth, 2022) [7] Knowledge transfer is more than just communication, it involves the circulation of information, ideas, tasks, processes, tools, documents etc. (Brown, 2019) [2]. Knowledge transfer has more to do with identifying and harnessing team members' adaptable skills and abilities to apply information (Brown, 2019) [2]. Knowledge Transfer (KT) does its best to combine both the practical with the personal to shift team behaviour and grow their skills. When Knowledge transfer systems are in place, it helps the team in streamlining their knowledge which ensures that everyone in the team has the information they need to keep the business running smoothly**.** When coming to innovation and problem solving, a knowledge transfer system can help the organization to translate the knowledge from an idea into words, visuals, and processes that can then be shared with the team. "Researchers in knowledge management contend that a firm's competitive advantage depends on its knowledge, that is: what it knows – how it uses what it knows – and how fast it can know something new" (Goh & Swee, 2002) [4]. In 2019, De

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Luca and Cano Rubio created the theoretical model for KT process evaluation based on the knowledge transfer curve, focusing on the speed of Knowledge Transfer (KT) and not necessarily on the proposed knowledge context. They have found that the capacity of an enterprise for long-term competitiveness is somewhat linked to the attributed role of KT in that given enterprise. Moreover, the authors pointed out that the efficiency of KT is maximized through the dimensions of knowledge, such as complexity, and the quality and quantity of information available for transfer (A. Grigorescu, 31 December 2021) [5]. Furthermore, Milagres and Bucharth assessed the factors influencing knowledge transfer, identifying the following: policy, inter-organizational synergy, intangible resources, behaviours, motivations, and capabilities, among others (A. Grigorescu, 31 December 2021) [5]. In essence, the future of KT is directed toward organizational performance, innovation, promotion of knowledge-intensive business processes, at the precipice of the Internet of Things—especially considering the vision of communication, energy, and logistics internet, Artificial Intelligence, Big Data, Industry 4.0, as well as environmental simulations and digital integrations (A. Grigorescu 1, 2021) [5]. The success of knowledge sharing (KS) cannot be measured without considering the culture of the environment in which the sharing takes place (Ncoyini & Cilliers, 2020) [9]. Cultural concerns, such as leadership, trust, reward, and communication, may impact negatively or positively on KS, (Ncoyini & Cilliers, 2020) [9].

2.1 How Space Operations Organization can Manage its Intellectual Capital Effectively

Knowledge management is important because it boosts the efficiency of an organization's decision-making ability (Andreev, 2022) [1]. By making sure that all employees have access to the overall expertise held within the organization, a smarter workforce is built that is more able to make quick, informed decisions, benefiting the entire company (Andreev, 2022) [1]. Organizations are the sum of their collective knowledge, and they succeed or fail based on how they capture, store, share and effectively manage that information in pursuit of business goals. When employees can access knowledge easily, they're more productive. When they can't, they are inefficient and become frustrated, So the question is: What are you doing to optimize knowledge management in your organization? (Starmind, 2022) [14]. Modern knowledge management processes enable employees to ask questions anonymously or contribute their expertise, breaking down silos and creating a living knowledge base (Starmind, 2022) [14]. When knowledge-sharing barriers are removed, employees move beyond silos and discover who else has valuable information about a topic. And when organizations connect those subject matter experts with co-workers who need their expertise, teams are empowered to challenge the status quo and find innovative solutions to unique problems (Starmind, 2022) [14].

2.2 Factors Influencing Knowledge Transfer

Demographic factors such as age, gender, education, and work experience can all affect knowledge transfer (Nuaimi & Jabeen, January 2020) [12]. Employees with shorter organisational tenure are more willing to share their knowledge, and male and female behaviour in both seeking and sharing knowledge often varies, and women are more willing to share their knowledge (Nuaimi & Jabeen, January 2020) [12].

Trust has been defined as an individual's willingness to share knowledge positively with others (Nuaimi & Jabeen, January 2020) [12]. Trust is an extremely important requirement when knowledge transfer occurs because the process can result in transferring employees from one organisation to another (Nuaimi & Jabeen, January 2020) [12]. When dealing with knowledge-based organisations, employees who demonstrate faith in their organisation are seen to take up information faster because no barriers are created by doubt (Nuaimi & Jabeen, January 2020) [12]. Trust generates and sustains exchange relationships, which helps to speed up knowledge-sharing with a high-quality output (Nuaimi & Jabeen, January 2020) [12].

Managing attitudes is mostly beyond organisations because attitudes are generally psychological conditions deeply rooted in individual personality (Nuaimi & Jabeen, January 2020) [12].

People are connected through social networks which also create positive relationships and a quick knowledge-sharing tool. Knowledge transfer that is supported by social networks has two key advantages. First, social networks are an open and inexpensive channel where people can discuss findings, resulting in the generation of new ideas through innovation (Nuaimi & Jabeen, January 2020)[12].

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The differences in beliefs, values and practices between the transferors and transferees could create barriers to knowledge transfer unless they are identified and harmonized (Hassan, et al., October 2017) [6].

Knowledge transfer is also influenced by the culture possessed by the individual and organization environment created to promote knowledge transfer where it becomes a part of organizational system (Hassan, et al., October 2017) [6]. Knowledge transfer is also influenced by established communication tools or channels set up by the organization to enhance the better practice of it besides the individual intention to deliver input to third party with the objective of adding strategic value of work process (Hassan, et al., October 2017) [6].

2.3 Challenges Involved in Implementing Knowledge Transfer

"One of the biggest challenges in KT is, if the knowledge possessor does not know how to transfer knowledge to recipients, then this leads to decrease in the efficiency and effectiveness of knowledge transfer" (Nidhra & Yanamadala, May 2012) [11]. For example, if the knowledge holder is not able to specify correctly and communicate precisely what they want to transfer, then this leads to misinterpretation and distortion in knowledge transfer. Moreover, if the knowledge sender does have a sufficient capability to transfer knowledge but the knowledge receiver does not fully understand the transferred knowledge, that makes transferring knowledge more difficult (Nidhra & Yanamadala, May 2012)[11]. Cultural barriers negatively affect face-to face interaction, communication, and collaboration (Kroll, et al., 2016) [8]. Knowledge sources may not be trustworthy, and trust affects cooperative learning (Kroll, et al., 2016) [8].

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3. Material and Methods

This study was survey research. The survey questionnaire was distributed to a target population of 56 staff members, recorded a 70% male response and 30% female response, making up a response rate of 66.1% using equation (1).
The distribution of the sample is detailed in the table below:

Table 1: Descriptive characteristic sample

	Gender		Age					Site Location			Designation					Work Experience				
	F	M	21-29	30-39	40-49	50-59	60+	Pretoria	Hbk	Hermanus	Technician / Specialist	Lead / Supervisor	Manager	Executive (MD etc.)	Other	0-5	5-10	10-20	20-30	30+
Number	11	26	5	11	13	5	3	9	27	1	17	4	8	2	6	7	4	11	10	5
Percentage	30%	70%	14%	30%	35%	14%	8%	24%	73%	3%	46%	11%	22%	5%	16%	19%	11%	30%	27%	14%

3.1 Survey Objectives

The objective of the survey was to collect data from target population within different divisions of the South African National Space Agency (SANSA) to explore how space operations can manage its intellectual capital effectively, factors influencing knowledge transfer and challenges involved in implementing knowledge transfer.

3.2 Research Instrument

Research instruments used were surveys and interviews. Questionnaire in this study was designed based on past experiences of some of the workforce in the organization and by collecting information from literature on factors influencing knowledge transfer.

3.3 Data Administration and Collection

The data sources used to test the exploratory study came from contacts located in different divisions in the organization. Qualitative and quantitative data was collected through surveys and interviews. Interviews were conducted where respondents were all in one room, research questions were posed to them, and they responded by writing down their answers.

3.4 Data Analysis Method

Data was analysed using content analysis where themes/categories/concepts were extracted from the data received.
Insights functionality in Microsoft Forms was also used to categorize qualitative data. Though this system automatically allocated data categories, all categorized data was reviewed to confirm accuracy.

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4. Theory and Calculation

The response rate was based on the number of responses received versus surveys sent.

4.1 Equation numbers

$$\text{Response Rate} = \text{Survey returned} / \text{Surveys sent} * 100 \quad (1)$$

$$= 37 / 56 * 100$$

$$\text{Response Rate} = 66.1\%$$

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5. Results

A survey questionnaire was distributed to a sample population of fifty sixth (56) participants in different divisions within SANSA and 37 returned. 70% male and 30% female making up a response rate of 66.1% using equation (1). This is because the target population was from technical and project environment where female population is less. Surveys were sent to 15 females and 11 responded while 41 males were surveyed and only 26 responded. If the survey questionnaire was distributed to the entire organization the number of female responses was going to be very high. Eight (8) members of the staff were interviewed (Focus groups) at South African National Space Agency (SANSA) Hartebeeshoek (HBK) site.

Overall, 35% of the participants were between the ages of 40-49, 30% between the ages of 30-39, 14% between the ages of 50-59 and 13% between the ages of 21-29 and only 8% between the ages of 60 years or older. 73% of the participants are from HBK, followed by 24% from Pretoria as well as 3% from Hermanus. The participants are from Engineering, Operations and Maintenance (EOM), Portfolio Management (PM) as well as Earth Observation (EO) divisions within SANSA comprising of technicians/specialist (46%), lead/supervisors (11%), managers (22%) as well as executives (5%) and other (16%) with work experience ranging from 0-5 (19%), 5-10 (11%), 10-20 (30%), 20-30 (27%), 30+ (13%) years.

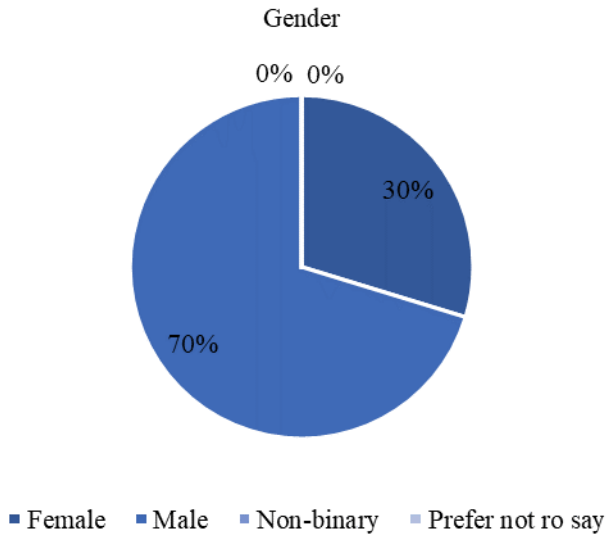

Figure 1: Gender comparison

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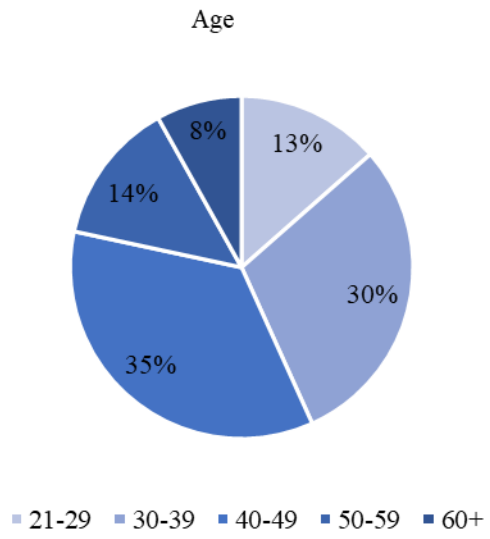

Figure 2: Age comparison

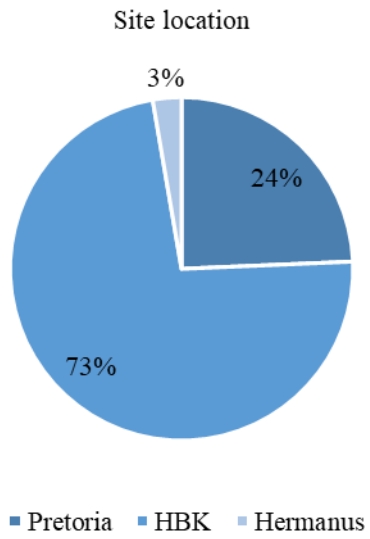

Figure 3: Site location

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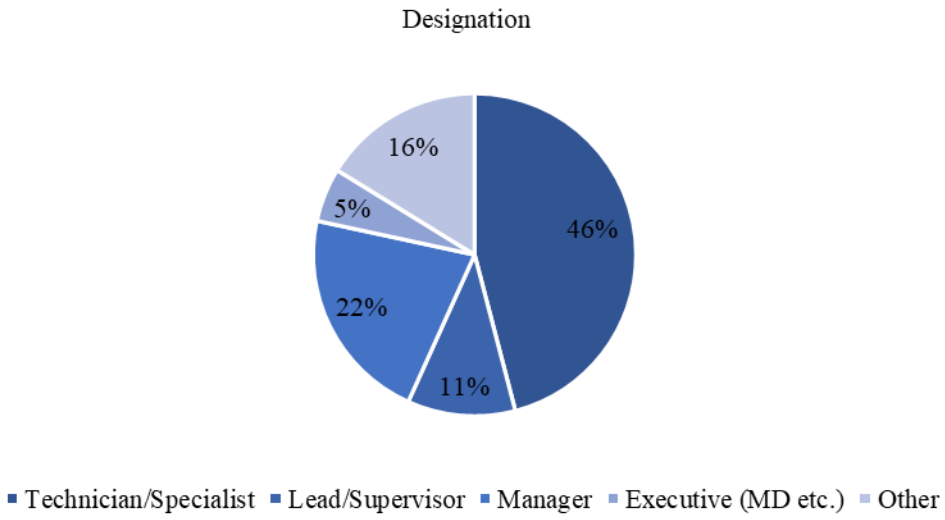

Figure 4: Designation

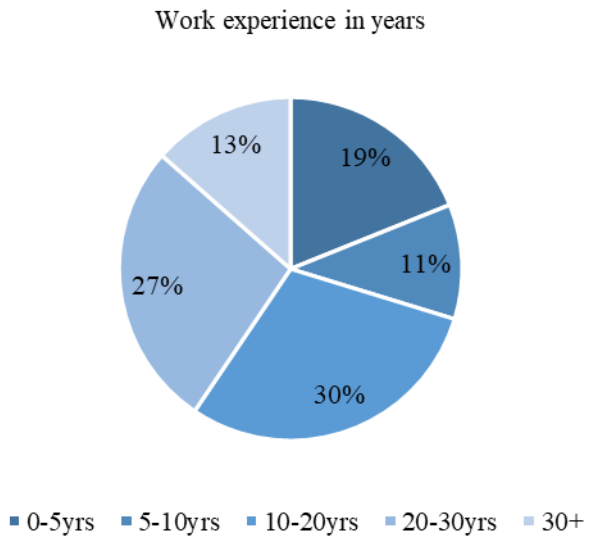

Figure 5: Work experience in years

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Questionnaire #1: Do you understand what knowledge transfer is?

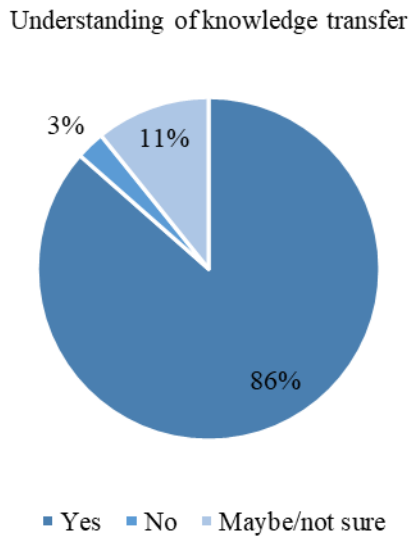

Figure 6: Understanding of knowledge transfer

Questionnaire #2: Do you think that organizational knowledge has adequately been shared with you?

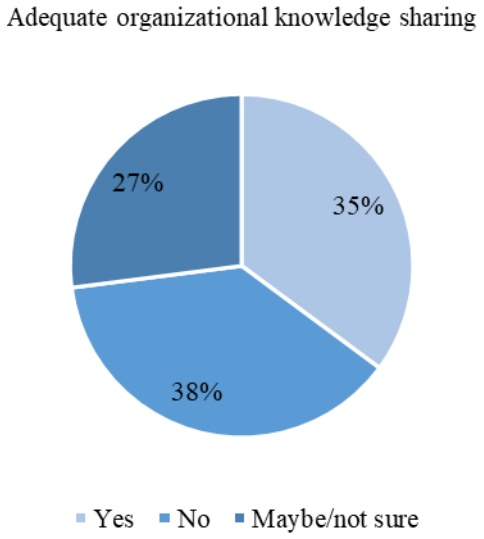

Figure 7: Organizational knowledge shared

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Questionnaire #3: Do you think the knowledge shared with you is sufficient for you to excel in your job?

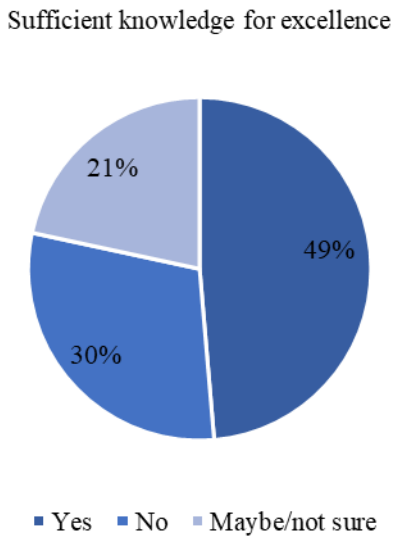

Figure 8: Sufficiency of the knowledge shared

Findings indicated that 86% of the workforce understand what knowledge transfer is, 11% are not sure what it is and 3% don't understand what knowledge transfer is. 38% of the participants highlighted that knowledge of the organization has not yet adequately been shared with them, 35% confirm that yes it has been shared with them and 27% are not sure. 49% of the participants stated that the knowledge they have is sufficient for them to excel in their jobs, and indicated that most of the knowledge they have, they did not acquire it from the organization but had to scramble to find it elsewhere all by themselves. 30% of the participants said no, the knowledge they have is not sufficient for them to excel in their jobs and 22% said they are not sure.

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Questionnaire #4: What do you think are factors influencing knowledge transfer?

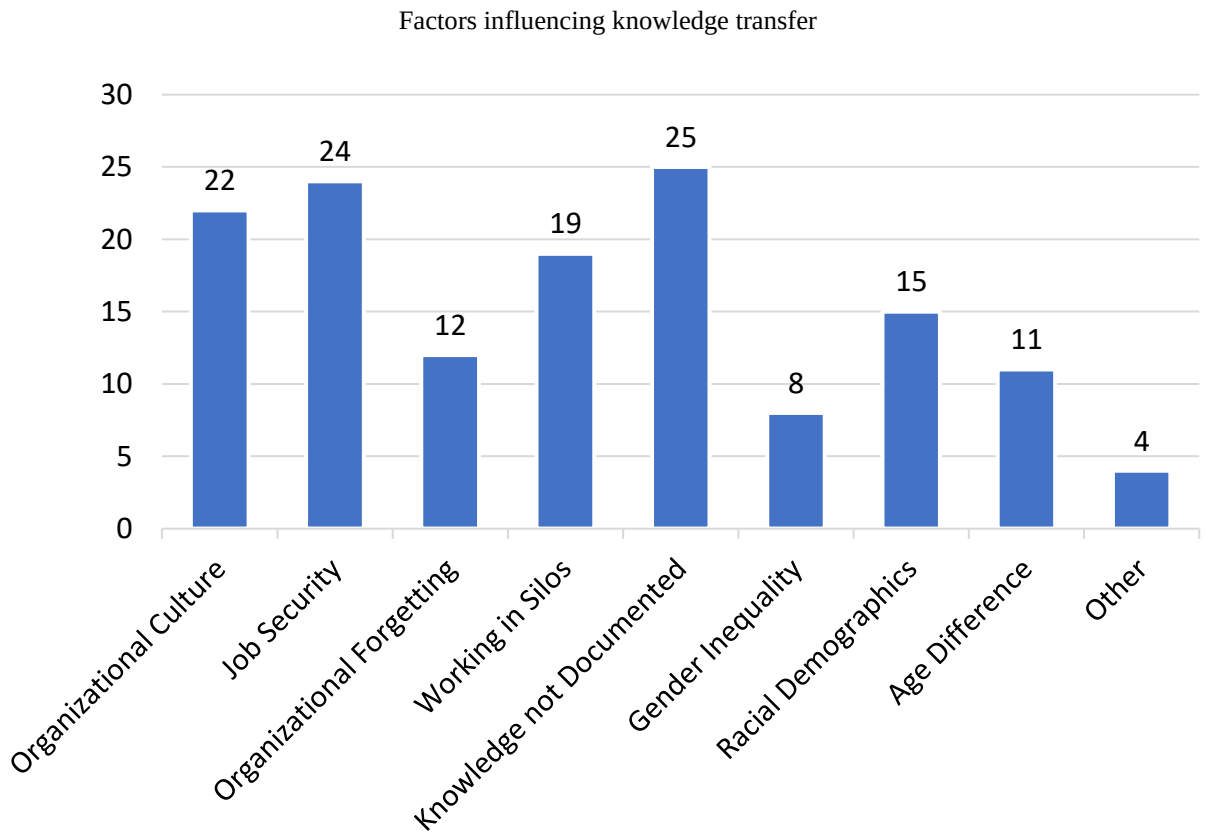

Figure 9: Factors influencing knowledge Transfer

The results of the survey and interviews indicated that organizational culture, job security, as well as knowledge not being documented were rated as one of the highest factors influencing knowledge transfer in SANSA Space Operations.

Results also highlighted that the culture of the organization does not encourage knowledge sharing and certain staff might not be willing to share/transfer knowledge or might provide incorrect information as a form of sabotage to safeguard their jobs because of fear of being replaced by younger candidates, so lack of trust and resistance can be foreseen as challenges anticipated in implementing knowledge transfer.

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Table 2: Summary of responses

Questionnaires	Summary of responses	comments
What do you think should be done to enhance knowledge transfer in the organization?	38% of the responses stated that knowledge must first be identified, captured, documented, and regularly updated. Provide ways to share that knowledge and then share it with the rest of the teams in the organization. Personal development, social and experiential learning must be encouraged. Ways to share knowledge must be provided. Training and skill transfer should be mandatory. Management must enforce teamwork. Identify what knowledge needs to be transferred and plan knowledge sharing on different organization levels. Ensure that there is trust amongst senior staff so that knowledge sharing does not lead to job insecurity and explain how knowledge sharing can reduce workload for senior staff as they can properly delegate. Other Responses includes: • Encourage a culture of mentors and coaches. • Seniors staff should be open to learn new ways from junior staff. • Structure of the organization should change. e.g., how technical and ops work is slowly making the organization irrelevant to the industry. • Challenge and change the culture of the organization. The culture of the organization must change to encourage knowledge sharing through social interaction. That way tacit knowledge can easily be extracted. • Introduce more skill transfer programmes. More skills transfer programmes should be introduced, training and skill transfer should be mandatory. Updated manuals, drawings, check sheets, workflows, processes, procedures must be easily accessible.	Proper documentation of explicit and tacit knowledge is key.

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	• Rewards and recognition of experienced knowledge carriers. Reward and recognize experiences workforce i.e., your "knowledge carriers" to encourage and motivate them to share their tacit knowledge. Raise more awareness on the importance of knowledge sharing and explain how knowledge sharing can reduce workload for senior staff as they can properly delegate. • Ensure that there is trust among teams so that knowledge sharing does not lead to job insecurity. Rotate jobs among peers to encourage teamwork.	
What challenges do you anticipate in implementing knowledge transfer?	19% of the responses indicated that knowledge hoarding to safeguard jobs because of fear of being replaced by younger candidates is anticipated as one of the challenges in implementing knowledge transfer. Unwillingness to share knowledge came out as the biggest challenge to implement knowledge transfer. There will be a lot of resistance as some of the team members may not be willing to share their knowledge to safeguard their jobs. There will be no access to critical information since Knowledge is not documented. According to Nuaimi and Jabeen, "trust is an extremely important requirement when knowledge transfer occurs" so lack of trust is seen as a challenge to implement knowledge transfer in the organization. Some of the responses indicated that: • Resistance to change and to document learnings and lack of support from management is foreseen as other challenges in implementing knowledge transfer. • Lack of trust, respect, unity, and willingness to participate from the team. • Formulating and documenting the knowledge to be transferred. • Lack of understanding on how to capture tacit knowledge as it is a challenge capturing tangible knowledge currently.	Understanding the importance of knowledge sharing and raising awareness and the lack thereof and the impact on the organization is important.

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	• Lack of sincere leadership or commitment from management. • Getting a buy in from staff capable of transferring knowledge. • Lessons not learned and lack of function recognition. • Working in Silos and bullying. • Lack of time to transfer knowledge. • Giving incorrect information as a form of sabotage.	
What knowledge transfer systems can be implemented in space operations/activities to translate tacit knowledge from individuals into words, visuals, and processes, that can then be shared with the team?	27% of the responses stated that the organization should motivate the staff to participate in knowledge sharing. The organization must identify, collect, capture, store, share and apply knowledge then measure results. Better talent management and formally allocating more time, funds, and resources to stimulate knowledge generation and sharing. Other responses include: • Extract tacit knowledge by assigning one/two personnel to work with the experienced knowledge carriers and document every activity and save it on cloud. • Create and document all audio, videos of trainings, presentations, detailed manuals and block diagrams, engineering drawings, test reports, workflows, and store on Microsoft Teams. • Develop and centralize all training policies, processes, and procedures for all business operations. • Experienced and knowledgeable staff must work with other team members to offer skills training and show them how to perform a particular task. • Bi-weekly or monthly Site Boards at the entrances or across site. Use TV screens to visualize project progress including challenges as well as interviews with project members.	Documentation of processes, procedures, and workflows on how to identify, collect, capture, store and share tacit knowledge is required.

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	• Training and skills transfer should be mandatory, personal development, social and experiential learning must be encouraged. • Knowledge should be properly managed, and a document repository must be accessible to everyone in the organization. • Encourage a culture of mentors, coaches etc.	
How can space operations manage its intellectual property/capital effectively i.e., knowledge?	43% of the responses suggested that knowledge transfer must be enforced. Implement well thought out systems to capture tacit knowledge and document it for future use. Documenting and complying with quality management standards and practices should be non-negotiable for all staff members. • Manage knowledge effectively and comply with quality management standards and practices. • Train and develop staff regularly and measure performance. • Design and implement well thought out systems, processes, and procedures to extract and capture tacit knowledge and enforce knowledge transfer while motivating staff to transfer their knowledge. Other respondents mentioned that knowledge sharing, and teamwork should be encouraged.	SANSA must first identify critical knowledge that exists within the organization and find ways to extract/collect it, store if for future use to keep the business running. Implement a plan to transfer it to individuals or the organization. Clear succession plan must be in place and ensure duplicate capacity to avoid single point of failure.
Which existing systems/platforms can SANSA use effectively as knowledge base tools?	19% of the respondents mentioned that a system that can store the acquired knowledge and is accessible to staff members such as Ms Teams and upgrade SANSA hbk-tsupport maintenance system to generate job cards and give staff members access to previous work done and how it was done would be helpful. Other respondents mentioned that: • Custom made system for SANSA that will allow for a creation of a secure information database for employees and training must be provided to staff on	Microsoft Teams is accessible by all staff members at SANSA and uses SharePoint as its own data base. M-files is a new document management software that can also be used but will require licenses for each staff member and not all staff members are familiar with the software so proper training will be required.

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	how to use that system • SharePoint and M-files can also be utilized as a knowledge base tool	

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6. Discussion

One of the primary reasons influencing Knowledge Transfer (KT) negatively is knowledge hoarding due to job safeguarding or demotivated "knowledge carriers/ideas people". The root cause of these includes low morale, lack of career growth, and uncertainty of the SANSA new business model.

Critical knowledge and solutions to problems are created, but not documented and made available to others who could apply it in future and use it to create new knowledge. Therefore, mistakes are repeated, solutions are re-invented which leads to organizational forgetting.

Launch support/tracking a satellite requires few equipment configurations and antenna testing before the launch/pass. As an example, if a satellite is tracked daily, one needs to perform equipment configuration activities, e.g. LANDSAT-8 is tracked daily at SANSA Space Operations, activities such as updating and loading TLE's on the antenna server, checking alarms on the antenna, scheduling the pass are performed in the morning, few minutes before AOS, load configurations for the channels on AVTECH 1 & 2 and enable, at AOS, transmission from the satellite, check signal lock, monitor signal throughout the pass. At LOS, disable and load the file on the USGS server. These procedures are done repeatedly to the point where one can adapt and apply their knowledge. Tracking a new satellite that requires new equipment configurations, processes, and procedures, that information should be readily available and accessible to the team to gain new knowledge, and once memorized, they will be able to access that knowledge at any time without the original source. The original source i.e., new check lists, procedures, lessons learned etc. must be documented and stored for future use to avoid organizational forgetting.

The organizational culture does not encourage knowledge sharing and social interaction. Some of the respondents during the interviews highlighted that age difference, racial demographics as well as gender inequalities are barriers to knowledge transfer as individuals work in silos. Additionally, people are comfortable with doing things a certain way and do not want to change or think out of the box. As a result, challenging the status quo becomes a dreadful exercise. This becomes a problem to the younger, vibrant team coming into the organization.

Resistance due to job security is anticipated as the greatest challenge in implementing knowledge transfer. Lack of trust among peers, management and teams on the ground poses a great challenge as well. Knowledge carriers must be willing to transfer their knowledge to the team and the team must also be willing to learn and participate.

Poor communication would be a challenge, as the right information should flow to the right people using right channels. Language barrier could also pose a challenge as information must be well received and understood by all members of the team. Having a straightforward system for communication and collaboration is key.

Teamwork should be encouraged in the organization. Discrimination – management not treating the staff equally and bullying – can also be a challenge in knowledge sharing among peers.

Respondents also stated the following as challenges:

- Formulating the knowledge to be transferred
- Making sure that all positions are taken seriously and not undermined.
- Teams not willing to develop themselves, always using "It's not my job" as an excuse.
- Putting a price tag on every activity they are requested to perform.
- Buy in from knowledgeable individuals to share knowledge,
- Document learnings and expertise.
- More awareness not being raised on the importance of knowledge transfer/sharing in the organization and how the lack thereof will impact the organization.
- Perceived lack of support from management.

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7. Conclusions

Documentation of tacit knowledge is key. The organization should create activities that encourage knowledge sharing by reserving time throughout the week and having weekly learnings round-up/regular retrospective meetings with the employees/full team so everyone can share and contribute knowledge, what they learned that week or an interesting resource they found, what went well, issues and potential improvements., that way it becomes a habit.

Implement an intelligence platform that can provide access to real-time knowledge and expertise [13] (Starmind, 2022). Clear Intellectual Property (IP) policies on management of space project as well as effective plan on how to manage IP must be in place.

Teamwork and knowledge transfer should be enforced across and throughout the organization, senior management and executives must lead by example. Knowledge must first be identified in the organization. Processes and steps on how to identify knowledge in the organization, among individuals or teams must be in place. Once knowledge has been identified, identify what knowledge needs to be transferred and develop a knowledge transfer plan.

Proper ways to collect, capture and store knowledge in a document repository that is user friendly, and is easily accessible by everyone in the organization for future use should also be in place.

Always ensure duplicative capacity for the transfer of knowledge and avoid single point of failure.

Train the team to be creative and allow them to experiment so that they can be able to retain and absorb knowledge. Encourage skills transfer through on-the-job learning experience. Design tasks that require cross-functional collaboration to force individuals and teams away from silo mentality so that they can start to learn and communicate horizontally.

Thorough process of extracting the tacit knowledge from individuals must be developed and enforced while consistently creating positive interventions and opportunities, for the individuals to share their knowledge and skills. Knowledge transfer should be part of the KPAs and KPIs.

Incentivise the knowledge carriers "ideas people" and create opportunities and job promotion to motivate them so that they can feel free to transfer their knowledge to the younger teams.
Introduce incentive-based rewards for teams not individuals to encourage teamwork. Create a need for team building. Introduce activities that will build trust and support amongst the team to boost morale and establish trust among the team.

A knowledge transfer plan should be developed to identify knowledge carriers, motivate them to share their knowledge by giving them platforms in meetings and regular forums and implement a fast and easy way to share knowledge through simple tools such as organization's network drive, share point portal and Microsoft Teams.

Offer training of the knowledge base tool and hands-on training as well as videos for the team to familiarize themselves with the tool. Set targets and expected outcomes, measure and monitor progress and give feedback regularly at the end of each task, whether positive or negative.

Increase autonomy by bringing more challenging work that requires intense variety of skills to apply knowledge and allow the team/individual to make their own independent decisions on how to carry out their job activities and offer support.

Allow a little bit of tolerance by allowing the team/individuals to take risks and make their own decisions.

Offer incentives to encourage the workforce to be innovative and offer advancement for experienced workforce as a form of career growth. Skill assessment needs to be regularly monitored and those identified as more skilled need to be placed in suitable roles.

Encourage a culture of mentors, coaches, and sponsors. Mentorship programs and job shadowing as well as clear succession planning must be in place.

Seniors in the organization must be open to learn new ways of doing things from juniors.

The organization should get rid of unfavourable culture elements and create organizational culture that encourages knowledge sharing through interpersonal relations/social interaction. Job rotation among peers should also be encouraged.

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For a space operations (SO) focused organization to manage its knowledge effectively, well thought out systems, processes, procedures to capture tacit knowledge should be implemented. Skills programme that has targets and expected outcomes to provide skills training by assigning one or two persons to work with a particular individual who is more experienced to extract that information/tacit knowledge from the years of experience that was gained by that individual as a form of mentorship.

Custom tools must be developed specifically for the specific environment and building on the maintenance system to capture and store knowledge so that it can be readily accessible to all individuals in the organization for later use or create new knowledge using knowledge base tools such as Microsoft teams designed in such a way that is secure and it can also store and protect sensitive company information.

Well designed and the implementation of systems, processes, procedures, to capture, organize, centralise, disseminate, and effectively use to improve overall quality of the products and services delivered by the space operations division would be the goal to enforce Knowledge Transfer (KT). Scarce skills produced by space operations organizations must be retained to keep the space technology industry running.

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