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ANTHROPOTECHNOLOGICAL PERSPECTIVE IN ADOPTING VIRTUAL REALITY TRAINING TOOL TECHNOLOGY TRANSFER IN MALAYSIA AEROSPACE INDUSTRY

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ABSTRACT

The modern technology constructed by developed societies is always in great demand by developing societies who are trying to soar towards technological advancement. However, in the transfer of technology, many mistakes were made by both contributor and the receiver of the technology due to failing to observe the cultural variables in the societies and the local context. This paper analyses the theory of anthropotechnology with focus on sociotechnical aspect, based on the case study of Virtual Reality System for Training in Aerospace Manufacturing (VIRISTAM). This project involves a cross-cultural technology transfer between France and Malaysia, which have different working culture and level of technological ability. The aim of this paper is to analyses the sociotechnical block especially in terms of communication, which could have big impact on the integration of the technology into the social context. This research is using semi-structured interviews, direct observation and focus group with 20 respondents in total, as the methodological approach to collect the data needed.

This paper concludes that it is almost rare that a method developed in one company can be transferred and applied elsewhere without any intervention. Anthropotechnology helps in tailoring the system of the technology by taking into account the sociotechnical block; sociocultural, cognitive ability, and the organizational culture. This paper also proposes a model that illustrates how an organization could succeed in creating innovation while keeping along with their sociotechnical perspective.

Keywords: anthropotechnology, sociotechnical, technology transfer, virtual reality, culture, Malaysia

INTRODUCTION

Globalisation has significantly impacted the industrial landscape, compelling multinational companies to adapt to new markets and regions. One prominent aspect of globalization is delocalization, where companies transfer their operations and technologies from developed countries to less developed ones. This process not only involves the physical relocation of facilities but also necessitates the transfer of technology, skills, and knowledge. Such transfers are critical as they enable recipient countries to access advanced technologies, fostering local development and integration into the global economy. Delocalization and technology transfer, however, come with challenges. According to Shahnavaz (2000), the recipient country must adapt the transferred technology to fit its local context, which includes understanding the industrial systems, cultural norms, technical capabilities, and socioeconomic conditions. Failure to adapt can lead to high rates of injuries and accidents, low work quality, and reduced productivity. Therefore, a thorough anthropotechnological analysis is essential to ensure successful technology adaptation.

Case Study: Airbus' Virtual Reality (VR) Technology Transfer to Malaysia

This paper examines the case of Airbus' VR training platform transfer to Malaysia, an example of delocalization driven by globalization forces. Airbus, a leading multinational aerospace company, has initiated the transfer of its VR technology from its headquarters in France to Composites Technology Research Malaysia (CTRM) in Melaka. This transfer is part of a broader strategy to enhance local capabilities and integrate Malaysia into the global aerospace supply chain. The VR training platform project, managed by the VIRISTAM research consortium, exemplifies the complexities of technology transfer. The consortium includes local and global companies, as well as Malaysian public universities, collaborating to develop a VR training tool for aerospace manufacturing technicians. The technology encompasses equipment, skills, and knowledge, and its transfer involves design, capacity, and material aspects.

In this context, the theory of anthropotechnology is applied to address the challenges posed by introducing new technology into a different environment. Additionally, the sociotechnical systems approach plays a critical role in this transfer by ensuring that the social and technical elements are integrated harmoniously. This involves considering the work practices, organizational culture, and social dynamics of the local plant to align the VR training tools effectively with the local workforce's needs. The sociotechnical system theory emphasizes that technology must be adapted not only technically but also socially to enhance efficiency and well-being. This case study not only highlights the process of delocalization but also underscores the importance of adapting transferred technology to local conditions to achieve successful integration and productivity improvements. By involving local engineers in the adaptation process and ensuring that the technology meets their specific needs and work conditions, the project promotes sustainable technology integration, skill development, and long-term productivity.

LITERATURE REVIEW

The industrial and economic development of a country is heavily reliant on technology transfer activities, which are particularly vital for less developed countries that rely on the influx of advanced technologies from more developed nations. Technology transfer involves not only the movement of physical equipment but also the transfer of associated knowledge and skills. This combination of equipment and knowledge enables the recipient to enhance efficiency and productivity, and develop their own technological capabilities (Kumar et al. 1999; Rahman Hamdan, Mohamad Syazli & Mohamed 2018). Technology, broadly defined, consists of both tangible and intangible components. The tangible elements include tools, machinery, blueprints, techniques, and processes, while the intangible aspects encompass knowledge in areas such as production, marketing, management, labor, and quality control (Kumar et al. 1999). These components are essential for achieving specific outcomes, solving problems, and completing tasks through the application of particular skills and knowledge (Lan & Young 2002).

When technology is transferred from one geographical or physical location to another, the embedded knowledge is also disseminated. This inseparability of technology and knowledge underscores the importance of effective technology transfer processes, which serve as mechanisms for translating technological capabilities developed through research and development into new or improved productivity functions (Bozeman 2000). For example, Malaysia has strategically used technology transfer to elevate its status from a developing nation to a participant in high-value-added activities (Rahman Hamdan, Mohamad Syazli &

Mohamed 2018). The local context plays a critical role in the success of technology transfer. As Derakhshani (2019) and Van Gigch (2010) suggest, the transfer must align with the local conditions for effective absorption by the receiving country. This includes adapting to local industrial systems, cultural norms, technical capabilities, and socioeconomic conditions. The process of technology transfer is thus closely linked with knowledge transfer, as both technical knowledge and the ability to master and develop new products independently are crucial for the receiving country's development (Chesnais 2010; Gibson & Rogers 1994).

Malaysia's Technology Transfer and Development Efforts

Technological progress has become a crucial component of Malaysia's economic development. As a developing nation, Malaysia has aspired to match the technological competitiveness of many developed countries (Perkins, Rasiah & Woo 2017). Notably, Malaysia possesses the capacity to independently develop and innovate new technologies (Economic Planning Unit 2021). The country steered its technological advancement with the introduction of the First National Science and Technology Policy (NSTP) in 1985, focusing on promoting scientific and technological self-reliance to accelerate socioeconomic growth. Subsequent initiatives, such as the Fifth Malaysia Plan (1986-1990) and the First Industrial Master Plan in 1986, along with the Action Plan for Industrial Development in 1990, aimed to enhance science and technology capabilities and address structural weaknesses in national industrial development (Ministry of International Trade and Industry 2022). The pursuit of technological capability aligns with Malaysia's goal to achieve full development by 2020; however, the country's industries encounter formidable obstacles in advancing their technological capabilities and elevating the nation's economic status. The Malaysia Education Blueprint 2015-2025 underscores the importance of collaboration between universities and industry, yet disparities exist between the output from universities and industry expectations (Azmi, Hashim & Yusoff 2018). Moreover, industrial linkages within the manufacturing sector, particularly between SMEs and larger enterprises, remain notably low (Malaysia Productivity Corporation [MPC] 2017).

Challenges in Localizing Foreign Technologies

Technological and knowledge transfer are critical components for economic development and industrial competitiveness, particularly in developing countries. Malaysia's journey towards leveraging these components reveals numerous challenges and strategic responses. The Global Competitiveness Report 2023 indicates that Malaysia struggles with the capacity to produce, absorb, and utilize the latest technologies. This deficiency is a significant barrier to achieving high-growth and development goals. Local firms often lack the necessary involvement in technological activities, limiting their ability to generate indigenous technology (Rajah 2010; Suzana 2013). Further compounding these issues are weaknesses within Malaysia's domestic industries, such as insufficient supporting industries, over-reliance on external innovation sources, and a limited pool of skilled knowledge workers (Matsuyama 2009). These factors collectively hinder the effective transfer and localization of high technology.

Managerial and workforce-related constraints also pose significant challenges. Burhanuddin et al. (2019) highlight issues such as incompetent managerial skills, inadequate capital investment, a shortage of skilled workforce, and limited access to industrial experts. These constraints significantly hamper the ability of Small and Medium Enterprises (SMEs) in Malaysia to adopt new technologies. Additionally, due to the high costs and time required to develop and produce necessary technologies domestically, Malaysia often resorts to importing technology (Lim 2020). While this approach accelerates the utilization of advanced science and technology, it also perpetuates dependence on foreign innovation. To address these challenges, several strategies have been proposed and implemented. Enhancing managerial and workforce competencies is crucial, as identified by Burhanuddin et al. (2019). Training programs aimed at improving managerial skills and technical expertise can significantly enhance the absorptive capacity of local firms. Strengthening the ecosystem of supporting industries is also essential for fostering a conducive environment for high technology transfer. Investment in infrastructure, incentives for local suppliers, and collaboration with international firms can help build a robust industrial base. Encouraging homegrown innovation through increased R&D investments and supportive policies can reduce dependence on external technologies. Besides, initiatives to stimulate local research institutions and universities to collaborate with industries can bridge the gap between research and practical applications.

Strategic partnerships play a pivotal role in successful technology transfer. The transfer of VR technology from Airbus to the local plant CTRM, where local engineers were supervised by Airbus engineers, illustrates the importance of such partnerships. These partnerships provide the necessary oversight and expertise to achieve desired outcomes and customized training programs that address specific local needs can also enhance the mastery and independent development of transferred technologies. Understanding and integrating the local context is vital for the success of technology transfer. Policies and strategies that align with local cultural, economic, and social dynamics can foster sustainable development and ensure the transferred technology is effectively absorbed and utilized. The challenges faced by Malaysia in technological and knowledge transfer are multifaceted, involving infrastructural, managerial, and workforce-related issues. However, through strategic initiatives such as enhancing managerial skills, developing supporting industries, fostering indigenous innovation, forming strategic partnerships, and leveraging the local context, Malaysia can overcome these obstacles. Effective technology and knowledge transfer are crucial for Malaysia's industrial and economic advancement, ensuring sustainable integration into the global economy.

METHODOLOGY

This research applied qualitative methodology. Researcher resorted into three different approaches in collecting data. First, semi-structured interviews were conducted which consisted of 20 respondents. The main objective of the interviews was to track the background and the socialization path of respondents. All the participants are filtered into ten items; name, age, gender, ethnicity, position, hometown, social class, socialization path, cultural capital and economic capital. The cultural capital, representing non-economic resources that facilitate social mobility, is typically benchmarked by educational attainment, participation in cultural activities, and familiarity with cultural references. Economic capital, which refers to financial resources and assets, is commonly benchmarked by income level, ownership of assets, and employment status. Social class categories, a multifaceted concept incorporating elements of both cultural and economic capital along with subjective self-perception, are often benchmarked by self-identified social class, occupational prestige, and the strength of community and social networks. By employing these benchmarks and corresponding questions, researchers can gather comprehensive data on respondents' cultural capital, economic capital, and social class, thereby enabling a nuanced analysis of socio-cultural stratification and mobility within the study population. The data presented in the Table 1, Table 2 and Table 3 offer a detailed demographic and socio-economic breakdown of the respondents, which is essential for understanding the sociotechnical system and identifying potential sociotechnical blocks in the technology transfer process.

Table 1: Respondents by ethnic, gender, age and education level

Categories	N (total sum)	Percentage (%)
Ethnic		
Malay	20	100
Chinese	-	-
Indian	-	-
Gender		
Male	18	90
Female	2	10
Age		
26 to 30	15	25
31 to 35	1	5
36 to 40	4	20
Education level		
PMR/SRP/LCE	-	-
SPM/MCE	10	50
STPM/HSC	-	-
Diploma	10	50
Others	-	-

Table 2: Respondents by job position, hometown and social class

Categories	N (total sum)	Percentage (%)
Job position		
Technician	14	20
Senior technician	4	20
Trainer	2	10

Hometown		
Urban	8	40
Suburban	12	60
Social class		
Lower	1	5
Middle	19	95
Upper	-	-

Table 3: Respondents by socialization path, cultural capital and economic capital

Categories	**N (total sum)**	**Percentage (%)**
Socialization path		
Boarding school	10	50
Daily school	10	50
Cultural capital		
Yes	8	40
No	12	60
Economic capital		
Yes	8	40
No	12	60

DISCUSSION AND FINDINGS

Anthropotechnology is a field that emphasizes the adaptation of technology to human needs and capabilities, ensuring that technological solutions are both effective and user-friendly. This approach is crucial in industrial settings, where the successful integration of new technologies often depends on their alignment with human factors such as ergonomics, cognitive ability, and cultural practices. Anthropotechnology seeks to optimize the interaction between humans and technology by considering these factors during the design and implementation phases (Trist 2000).

The Role of Anthropotechnological Island in Technology Transfer

Wisner's (1985) concept of anthropotechnological islands builds on the principles of anthropotechnology by proposing the creation of micro-societies within enterprises that replicate the technological and social structures of the source country. This concept is particularly relevant in contexts where advanced technologies are transferred from developed to less developed countries. According to Wisner (1985), these islands serve as isolated environments where the contradictions between local societal norms and modern technological practices are minimized. By transplanting both the technological processes and the organizational structures from the developed country, these micro-societies ensure that the technology can function effectively without being hindered by local societal constraints. This approach provides a controlled setting where technology transfer can occur more seamlessly, allowing local workers to gradually adapt to and master the new technology under the guidance of experts from the source country.

Sociotechnical Systems and Technology Transfer

Sociotechnical systems (refer Figure 1) theory expands on these ideas by promoting the design of work systems that enhance both technical efficiency and human well-being by aligning technological solutions with organizational structures, work practices, and social relationships. This approach recognizes that the success of technological solutions depends not only on the technology itself but also on the social context in which it is implemented (Cherns 1976). Sociotechnical systems theory advocates for a holistic view that considers the interdependencies between technology, work processes, and human factors. The flow from anthropotechnology to anthropotechnological islands and then to sociotechnical systems (refer Figure 2) illustrates the progression from foundational design principles to practical application in controlled environments and, ultimately, to broader organizational integration. It is crucial in understanding how technology transfer can be effectively implemented in different contexts, such as the VIRISTAM case study involving the VR technology transfer from Airbus to Malaysia. Anthropotechnology provides the foundational principles for designing technology that meets human needs and capabilities.

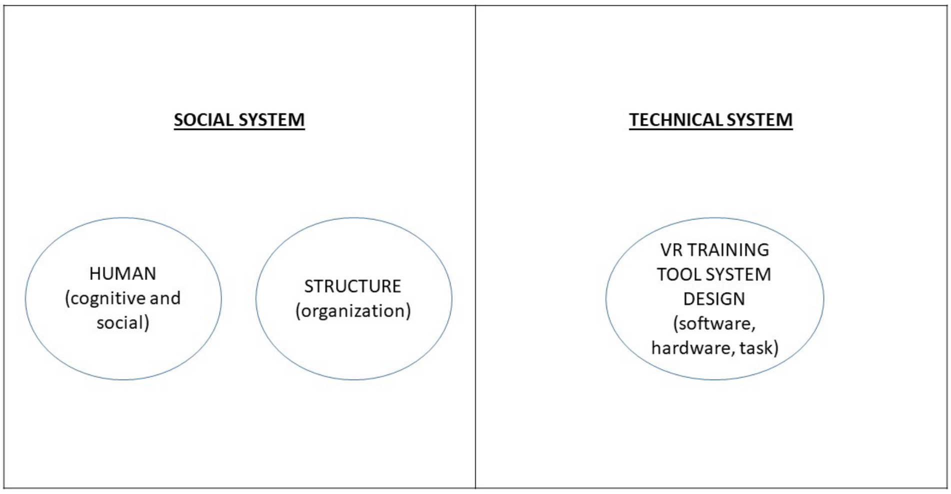

Figure 1: Sociotechnical system in VIRISTAM research project.

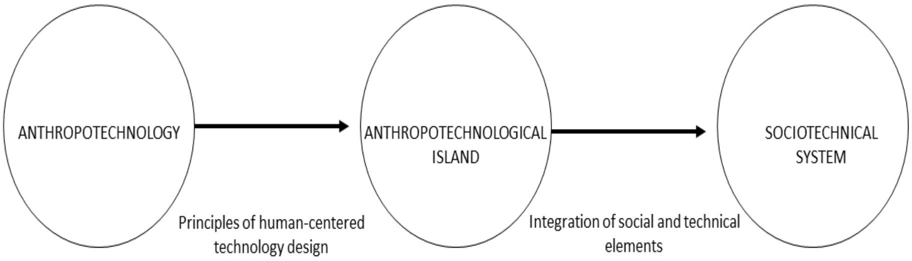

Figure 2: Framework for integrating human-centered design in technology transfer through anthropotechnology and sociotechnical systems

In the VIRISTAM case study, the VR training platform from Airbus is designed to be accessible and effective for aerospace manufacturing technicians in Malaysia. This platform combines equipment, training, and guidance to align with the specific needs of the local workforce, thereby addressing potential mismatches between the technology and the users' skills and work environments. In the context of the VIRISTAM project, an anthropotechnological island is established within the local plant CTRM in Melaka. This controlled environment allows for the gradual adaptation and mastery of the VR technology by local engineers, who receive training and supervision from Airbus engineers. This method helps resolve contradictions between local societies and modern technologies by providing a space where local workers can develop new skills and knowledge under expert guidance (Wisner 1985). Finally, sociotechnical systems theory integrates the social and technical elements of an organization to ensure that technological solutions are both effective and sustainable. This theory promotes a holistic view that aligns technological solutions with organizational structures, work practices, and social relationships. In the context of the VIRISTAM project, which aims to transfer VR training platforms to enhance local capabilities in the Malaysian aerospace industry, the demographic and socio-economic data of the respondents provides critical insights into the sociotechnical system and potential sociotechnical blocks.

Sociotechnical Blocks in the Malaysian Aerospace Industry

The workforce at CTRM, similar to many industrial settings, has a diverse demographic profile in terms of age and expertise. The age distribution of workers at CTRM is varied. The data shows that the workforce is entirely Malay, which simplifies cultural integration but may limit exposure to diverse perspectives and practices crucial for enriching the technology transfer process. The age distribution indicates a predominantly young workforce, with 75% aged 30 and below, which implies adaptability and willingness to learn new technologies. There is higher degree of technological adaptability and familiarity with digital tools. Older workers, usually aged 35 and above, contribute valuable experience and knowledge of traditional manufacturing processes. This generational mix can both enrich the workplace with a range of perspectives and pose challenges in aligning varying levels of tech-savviness and openness to new training methodologies.

The educational qualifications, with 50% having basic education (SPM/MCE) and 50% holding diplomas, point to a need for further training and skill development to handle advanced VR technologies effectively. The job positions, with a majority being technicians (70%), followed by senior technicians (20%) and trainers (10%), reflect varied levels of experience and expertise within the workforce. The training background of workers at CTRM typically includes on-the-job training, where new employees learn through practical experience under the supervision of senior staff. For engineers and technicians, training often involves specific technical skills pertinent to aerospace manufacturing and maintenance. Before the introduction of VR technology, traditional training methods at CTRM included classroom-based theoretical instruction and hands-on practice with actual aircraft components. Furthermore, the data on socialization paths shows an even split between boarding school and daily school backgrounds, which may influence the learning styles and adaptability of the workforce. Addressing these sociotechnical blocks involves enhancing continuous professional development, and investing in infrastructure and support systems to ensure equal access to the VR training technology. By implementing these strategies, the organization can overcome these sociotechnical blocks, ensuring smoother and more effective integration of the VR training platform, thereby fostering a more inclusive and resilient sociotechnical system within the Malaysian aerospace industry.

In the VIRISTAM case study, the final integration of the VR technology into the broader organizational structure is guided by sociotechnical systems theory as pictured in Figure 3. This approach ensures that the technology is not only technically sound but also fits well within the local work practices and organizational culture. By involving local engineers in the adaptation process and ensuring that the technology meets their specific needs, the sociotechnical system approach enhances both technical efficiency and the well-being of the workforce. The progression from anthropotechnology to anthropotechnological islands (refer Figure 3) and then to sociotechnical systems illustrates a comprehensive approach to technology transfer. This approach ensures that the VR technology from Airbus is effectively adapted and integrated into the local context, resulting in sustainable and meaningful technological advancement for the Malaysian aerospace industry. This holistic integration not only enhances productivity but also supports the socio-economic development of the region by building local technological capabilities. This approach aligns with the broader objectives of ensuring that technological advancements contribute positively to the local context, thereby promoting long-term sustainability and development (Perkins, Rasiah & Woo 2017; Economic Planning Unit 2021).

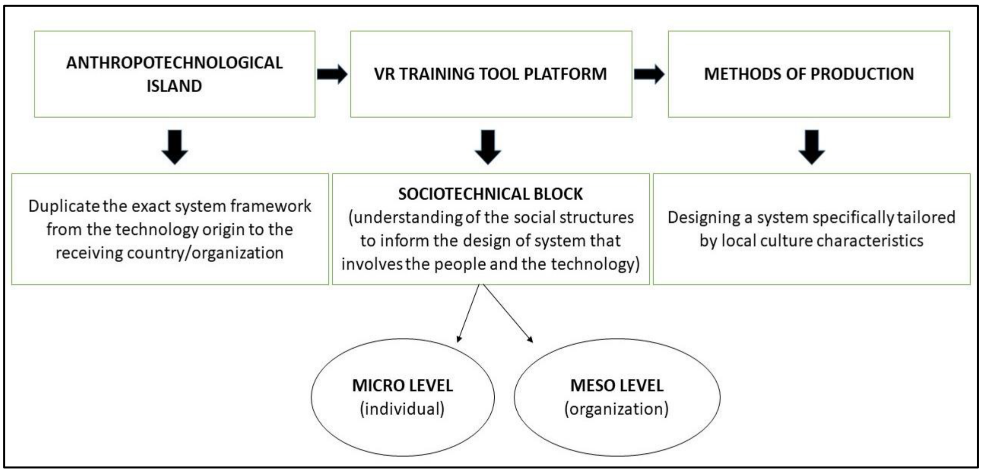

Figure 3: Flow of VIRISTAM technology transfer based on theory of anthropotechnological island

The process of technology transfer involves not just the physical relocation of technology, but also its adaptation to the local cultural and social context. In the case of Malaysia, the technology imported from France comes with its own work systems, necessitating modifications to fit the receiving culture. This adaptation process involves various social actors, including engineers, universities, industries, government bodies, and technology users. Understanding the conditions and consequences of technology transfer within the framework of anthropotechnology is crucial. Alain Wisner (1995) emphasized the importance of considering the historical, geographic, and ethnological dimensions of the receiving partner when planning a technology transfer project.

Anthropotechnology employs a comparative method, advocating for a deeper understanding of the cultural context in which technology is being transferred (Wisner 1976). The case study of VR technology transfer from Airbus to the local plant CTRM in Malaysia highlights the challenges and adaptations required for successful technology transfer. CTRM's experience underscores that technology is culturally conditioned and can elicit varied reactions such as acculturation, integration, assimilation, accommodation, or rejection (Kroeber 1948). The technology transfer process at CTRM involves high usage of technology in manufacturing and operations. The organization's approach aligns with the concept of anthropotechnological islands, where expatriate senior executives and researchers from Airbus ensure that knowledge transfer meets the quality standards of the headquarters. This includes training and briefing local senior engineers at Airbus headquarters in France. However, the standardized system of anthropotechnological islands was disrupted by the involvement of local technicians in designing the VR training tool. These technicians, who are the end users of the technology, needed the technology to fit their capacities for successful transfer. Language barriers emerged as a significant challenge. The senior engineers designing the VR tool primarily spoke English and were fluent in French, whereas the local technicians were more comfortable using Malay. During focus group discussions, technicians were given English sentences to read, comprehend, and edit for the VR instruction board (refer Figure 4). The original English instructions had to be translated into Malay, with specific amendments to technical terms used by floor technicians. Figure 5 shows the amendments made by the technicians during the focus group session. For example, the technicians noted that:

> The instructions given are too broad and not specific. You cannot just say ‘close the door properly’. The word ‘properly’ should be explained in detail on what to do specifically, or it will risk safety. (CTRM Technician, Respondent A)

> Some terms we use here on the floor are different from what the engineers use. We have our own terms among us. (CTRM Technician, Respondent B)

These insights led to the realization that the technology developer team must avoid terminology unfamiliar to the technicians. This scenario demonstrates how the concept of anthropotechnological islands can be expanded to anthropotechnological archipelagos, coined by Olmedo (2012), where cultural differences and language barriers are navigated to facilitate successful technology transfer. The VR training platform serves as a sociotechnical block, standardizing the method of production between the giving and receiving countries while accommodating local cultural traits. The core idea of anthropotechnological archipelagos is to make technological transfer successful by considering the cultural traits of the technology receiver. This concept modifies the 'normal' chain of anthropotechnological islands based on everyone's cultural representation. In the case of CTRM, the archipelago acts as a cultural exposure medium, integrating social, psychological, and cognitive characteristics of local workers into the learning process of the VR training tool.

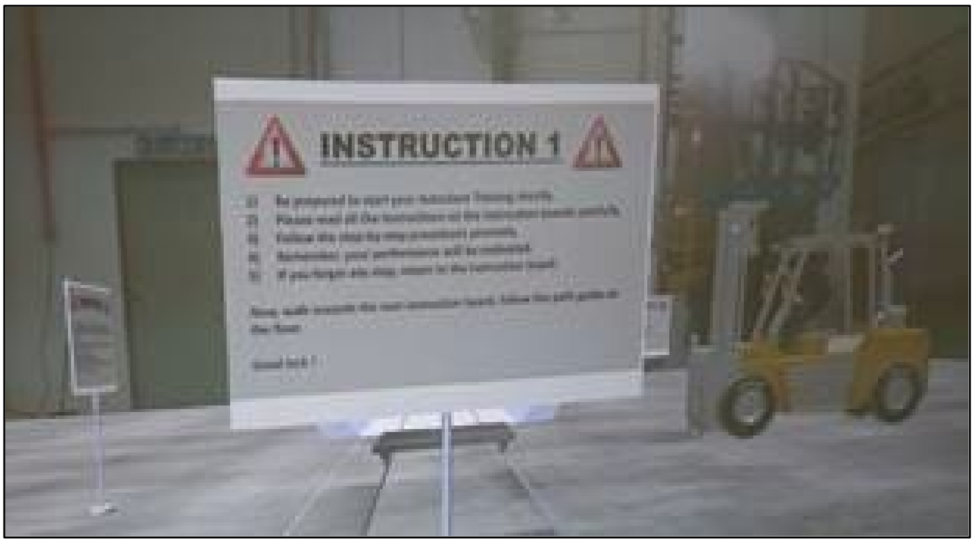

Figure 4: VR instruction board

Instruction	PROCEDURES:
2	1) Check the wheel alignment of the Christmas Tree on the track. 2) Push the Christmas Tree slowly into the autoclave until it reaches the end of the track. 3) Check all the panels are perfectly positioned on the Christmas Tree. 4) Walk out of the autoclave. 5) Close the autoclave's door properly.

Indeks	Arahan
Arahan 2	PROSEDUR: 1) Pastikan *alignment* roda *Christmas Tree* tepat di atas **landasan.** /USED STACKER 2) Pelan-pelan tolak *Christmas Tree* ke dalam *autoclave* sampai penghujung landasan. 3) Pastikan semua panel terletak dalam susunan yang betul di *Christmas Tree*. Panel tidak boleh bergesel satu sama lain. DALAM AUTOCLAVE 4) Berjalan keluar dari *autoclave*. 5) Tutup pintu *autoclave* dengan **teliti**.

Figure 5: Amendments made by the technicians

Communication and Cognitive Gaps in VR Technology Transfer

In the context of the VIRISTAM technology transfer case study, the distinctive communication code employed by different groups of workers highlights the sociotechnical block in the technology transfer process. Bourdieu's theory of social reproduction explains that cultural capital, a key component in this context, comprises non-financial social assets like education, intellect, and speech patterns, which influence social mobility and class distinctions (Bourdieu 1996). In the case of CTRM, the technicians, who predominantly hold diplomas and are Malay, communicate in a vernacular language. This contrasts sharply with the engineers designing the training tool platform, who possess higher cultural capital, have diverse ethnic backgrounds, and command English, thus creating a cultural and linguistic gap between the two groups.

The problem is further compounded by the structure of the instructional boards for the VR training tool. The language used by the engineers in these boards often fails to match the comprehension levels and cultural context of the technicians, leading to difficulties in effective knowledge transfer. The cognitive abilities of workers, shaped by their socio-cultural backgrounds, also play a significant role in the effectiveness of technology transfer. Technicians' cognitive skills, including their ability to process and understand complex technical instructions, are influenced by their educational experiences, cultural contexts, and their experience with VR technology. The vernacular language they are most comfortable with reflects their cognitive frameworks and ways of interpreting information. If the training materials and instructions are not adapted to these cognitive frameworks, the effectiveness of the technology transfer is compromised. For example, if instructions are provided in a formal, technical language that is not familiar to the technicians, their ability to understand and implement these instructions will be hindered. In the interview, when asked about the challenges the technicians have with the instruction board given, they responded by;

> "…one of the main issues is that many of us do not really understand English well. On the shop floor, we use Malay all the time to communicate…" (Focus group Interview, CTRM Technician A).

> "…it makes it difficult to follow the instructions properly. The English terms and phrases do not always make sense to us, so we often struggle to understand what we need to do…" (Focus group Interview, CTRM Technician B).

> "…we would prefer the instruction board language to be in Malay. It is the language we are most comfortable with, and it would help us understand the instructions better and follow the procedures more accurately…" (Focus group Interview, CTRM Technician C).

Based on the data collected, it has been found that every single person in the institution have different level of English proficiency. To address these issues and facilitate a smoother technology transfer, it is crucial to ensure consistency in the communication code. The language used in training materials should be aligned with the vernacular language of the technicians, reducing the risk of misinterpretation and enhancing productivity and safety. The anthropotechnological archipelago framework supports this approach by integrating the cultural traits of the technology receivers into the learning process, ensuring that the technology is adapted to the local context (Wisner 1992). This approach mitigates the sociotechnical block by bridging the cultural and linguistic gap, ultimately promoting successful technology transfer and improving workplace efficiency. Additionally, acknowledging and adapting to the cognitive abilities of workers based on their socio-cultural background can further enhance the learning experience and effectiveness of technology adoption in diverse environments.

A STRUCTURED FRAMEWORK IN MANAGING SOCIOTECHNICAL BLOCK IN TECHNOLOGY TRANSFER

AIRBUS' duplication of organization system in their global supply chains could be explained within the concept of 'anthroptechnological islands', where all global supply chains are trained and structured as most identical as the parent company in France. For the VIRISTAM project, Airbus has been sending directors and managers of the project to control the operation within the framework of the 'mother company'. These people are seen as the representatives of the organization to ensure a complete technology transfer. They also hire local staff that have educational background in France, and preferably can speak French. These people are fluent in French and are familiar with the French culture. The managers are local staff with bi-cultural background whom have been indoctrinated with the French-centric working culture. But, that is only on the managerial level, which involves the technology developers and the senior engineers. When the technology goes down to the technicians on the floor (the user of the technology), it takes on different environment – the sociotechnical block.

Cuctomizing Technology for Local Adoption

The structured framework (refer Figure 6) for managing sociotechnical blocks in technology transfer, particularly in the context of the VR training tools transferred from Airbus to the local plant emphasizes the intricate interplay between social and technical factors at multiple levels: individual, organizational, and national. The process begins with the duplication of production standards and the transfer of essential knowledge, skills, and equipment from Airbus to the receiving organization, ensuring that the foundational elements are in place. The R&D team is tasked with a comprehensive range of responsibilities, including setting clear goals, analyzing barriers to adoption, conducting market analysis, managing intellectual property, devising a development strategy, allocating resources, and identifying and mitigating risks. They must also determine the critical success factors essential for the project's success. At the individual level, considerations such as language proficiency, cognitive abilities, sociocultural background, and demographic factors like age and gender are crucial. At the organizational level, the existing working culture must be aligned with the new technology, while at the national level, the broader social reality and economic environment of Malaysia are taken into account.

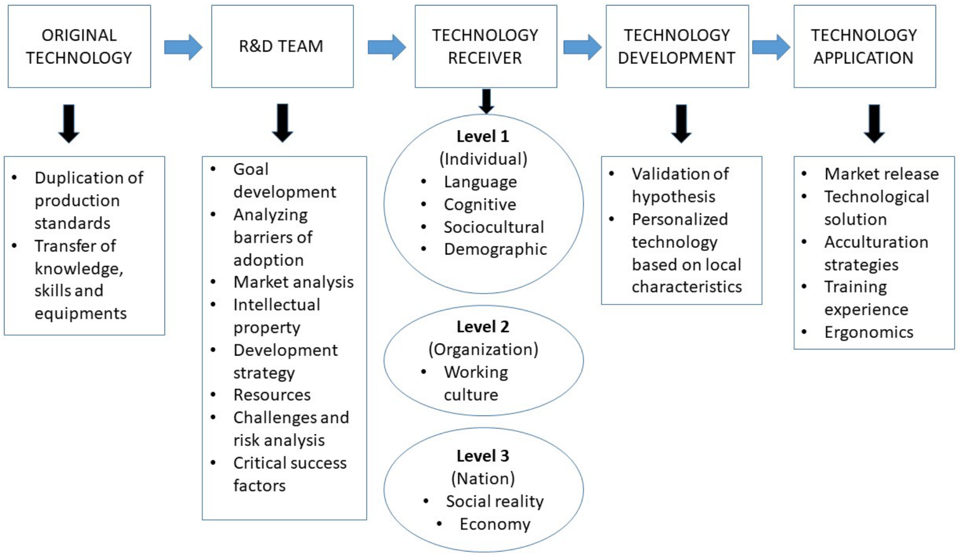

Figure 6: Structured framework in managing sociotechnical block in technology transfer

During the technology development phase, assumptions and hypotheses are rigorously tested and validated, and the technology is customized to fit local characteristics and needs. The application phase involves the market release of the technology, ensuring it provides effective solutions, implementing acculturation strategies to aid user adaptation, providing comprehensive training, and ensuring ergonomic design for user-friendliness. The concept of anthropotechnological islands, where Airbus duplicates its organizational systems across global supply chains, plays a crucial role in maintaining consistency and providing controlled environments for local engineers to adapt and master the technology under the guidance of bi-cultural managers who bridge the cultural gap. This structured framework acknowledges that while the managerial level involves technology developers and senior engineers familiar with the French-centric working culture, the real challenge—the sociotechnical block—arises when the technology reaches the technicians on the floor, necessitating significant cultural adaptations. The proposed transcultural technology transfer framework emphasizes the importance of understanding and analyzing the cultural embedding of technology, considering non-technological factors such as sociocultural, cognitive, language, and working culture at every stage to optimize the end-users' learning experience. Stakeholders' concerns are addressed comprehensively: developers focus on meeting technical requirements, users on practical usability, and the organization on added value and regulatory compliance. This holistic approach ensures that the VR training tools are not merely imposed but are adapted and integrated in a way that fosters skill development, enhances productivity, and promotes long-term sustainability, aligning technical requirements with cultural contexts and validating the principles of anthropotechnology.

CONCLUSION

The study of culture proves fundamental in technology transfer, as illustrated in the context of this VIRISTAM case study. Anthropotechnology plays a crucial role in smoothing the transfer of technology and organizational systems across different cultural contexts. This role is not only about technical adjustments but also about understanding and integrating the social and cultural dynamics of the receiving environment. As Wisner (1992) noted, understanding the characteristics and limits of humans is essential for developing and implementing tools effectively. This approach ensures that machines and technologies are better adapted to users based on anthropometric data, which includes ergonomic considerations that take into account the physical dimensions and capabilities of human users.

In addition, another way to assist the effective transfer of technology is by studying a reference location where the technology is already inserted, aiming to identify the barriers and difficulties of its implementation. This step is crucial because it allows the transferring team to anticipate potential issues and design strategies to mitigate them. For instance, understanding the linguistic capabilities of the local workforce can guide the development of training materials in the local language, as was necessary in the CTRM case where VR instructions were translated from English to Malay to ensure comprehension and effective use by local technicians. The demographic profile of the workers, including their gender, age, educational background, and prior work experience, plays a significant role in shaping the transfer process. Most technicians were more comfortable using Malay rather than English, highlighting the need for localized training content. Furthermore, the workers' exposure to different working environments before this project varied, influencing their adaptability to new technologies. This diversity necessitates a flexible training approach that can cater to varying levels of technological familiarity.

Moreover, the sociotechnical block in technology transfer considers not only individual factors but also organizational and national levels. At the organizational level, the working culture and practices need to be aligned with the new technology. This involves creating an environment that supports continuous learning and adaptation, which can be facilitated by having local managers with bi-cultural backgrounds who understand both the parent company's culture and the local context. At the national level, social realities and economic conditions must be taken into account to ensure that the technology is not only adopted but also sustainable in the long run. The integration of sociotechnical systems theory, which emphasizes the importance of considering both social and technical elements in the design and implementation of technological solutions, is crucial in this context. In the case of VIRISTAM, this theory ensures that the VR training tools are not only technically effective but also align with the organizational culture, work practices, and social dynamics of the local plant. By involving local engineers in the adaptation process and ensuring that the technology meets their specific needs and work conditions, the sociotechnical approach enhances both technical efficiency and the well-being of the workforce. This holistic view promotes sustainable technology integration by aligning the new VR tools with the existing socio-organizational structures, thereby enhancing overall productivity and job satisfaction.

Additionally, the structured cross-cultural technology transfer framework proposed in this context highlights the necessity of considering every stage of the transfer process, from the original technology development to its application in the local setting. Each stage involves critical analyses and validations to ensure that the technology is appropriately tailored to the local context. For instance, the

R&D team plays a pivotal role in managing the technology transfer by setting clear objectives, analyzing barriers to adoption, and developing strategies to address these barriers. This structured approach ensures that all stakeholders, including engineers, technicians, managers, and end-users, are aligned and engaged throughout the process.

Without a comprehensive understanding of these factors, technology can still be transferred, but the results may not be satisfactory. Through data collection and analysis, it becomes evident that anthropotechnology significantly contributes to successful technology transfer by considering technological factors, the context of both the technology's origin and the receiving environment, and the society that will ultimately use the technology. The case of technology transfer in CTRM demonstrates that a 'universal' machine fitting all contexts does not exist. Multinational companies must account for cultural aspects when transferring technology to different countries to avoid sociotechnical blocks. This comprehensive approach ensures that technological advancements are not merely imposed but are adapted and integrated, fostering skill development, productivity, and long-term sustainability.

In conclusion, the study underscores that technology transfer is a complex process that requires a deep understanding of the cultural, social, and organizational context of the receiving environment. The successful transfer of VR training tools from Airbus to CTRM highlights the importance of anthropotechnology in facilitating this process. By considering the demographic profile of the workers, the organizational culture, and the broader national context, companies can ensure that new technologies are not only adopted but also effectively integrated into the local work environment. This approach not only supports the immediate goals of effective technology adoption but also contributes to broader objectives of socio-economic development and technological self-reliance for Malaysia.

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