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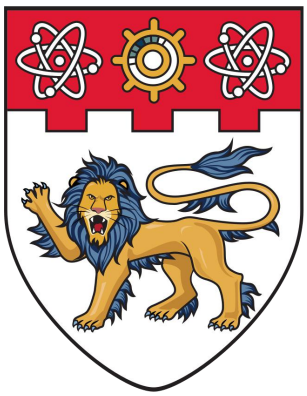

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

Wee Kim Wee School of Communication and Information

21S2-K6303-C: 21S2-SCI-K6303-INFORMATION & KNOWLEDGE ASSETS

NTU Knowledge Assets Identification and Analysis Based on I-Space Model

Group member:
Duan Yu (G2102578K)
Wei Xinyue (G2103541G)
Liu Tongyi (G2103478L)

Supervisor: LEE CHU KEONG (Dr)

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Abstract

In the context of the rise of the information society, the value of knowledge as an asset is being recognized by more and more corporate managers. As a high-density knowledge-intensive area, how to recognise and manage knowledge assets in universities is an important topic. Based on Boisot's theory about knowledge assets, this paper explores what knowledge assets exist at Nanyang Technological University and how these knowledge assets flow in I-space. In enumerating the knowledge assets on campus, this paper uses coding as a classification dimension to facilitate the differentiation of different types of knowledge assets. This paper also answers two critical questions, what are the most dominant types of knowledge transactions in NTU and what are the most prevalent forms of learning in NTU The exploration of these two questions further demonstrates our understanding of knowledge assets in universities.

Key Words

NTU, Knowledge Asset, I-Space Model

1 Background

In the 1960s, Marshall Mcluhan claimed that new means of communication would transform our society (McLuhan & Bornstein, 1966). Sixty years later, Industry 4.0, the Internet of Things and the meta-universe have opened another door for us where information in all its forms and vehicles continues to be generated and developed all around us, as does knowledge as a critical asset for organisations. We believe that modern information technology and the knowledge it transmits and stores have dramatically changed jobs, skills, products and economies. At the same time, however, these changes have had the unusual effect of reducing our understanding of organisations and management (Boisot, 1998). We, therefore, need to explore a new mindset, a new system of thinking and organisational guidelines that can better manage knowledge assets in this new era.

In Boisot's I-space model, he proposed Social Learning Cycle, which serves to link content, information, and knowledge management in a very effective way - the codification dimension is linked to categorisation and classification; the abstraction dimension is linked to knowledge creation, and the diffusion[1] dimension is linked to information access and transfer (Boisot,1999). In the current information society, this upgraded model provides a more vivid and comprehensive description of the transformation of knowledge and social learning processes.

The I-space model is a conceptual framework within which we can find the behaviour of information flows and understand the creation and dissemination of knowledge within a selected group of people. In short, the knowledge held by the actor builds the structure of information implicit in tangible objects, documents, or individual minds. Based on this, we can better understand Boisot's definition of knowledge assets: 'stocks of knowledge from whichservices are expected to flow for a period of time that may be hard to specify in advance' (Boisot, 1998). This means knowledge assets are the gradual accumulation of knowledge that leads to a cascade of valuable services and which, at the same time, enables the economical use of physical resources and minimises the rate of entropy generation.

2 Boisot Model

[1] Diffusion: Sharing the newly created insights with a target population. (Boisot, M. (1998). Knowledge assets: Securing Competitive Advantage in the Information Economy. Oxford University Press.)

The term knowledge asset was first formally introduced in 2003 by Baldrige Glossary and referred to the accumulated intellectual resources of an organisation. Types of knowledge assets include information, learning, ideas, understanding, insight, memory, technical skills and competencies. Knowledge assets are in documents, databases, software, patents, policies, procedures, etc.

Boisot creatively shifts the process of knowledge assets transformation from a two-dimensional (Nonaka, I.1990) to a three-dimensional space. Defining these types of knowledge as a three-dimensional epistemological space - what he calls 'parts or 'places' in space' (Boisot, 1998) - and defining a social learning cycle between the four corners of the I-Space (the four points, ABCD, in the diagram below).

As shown in Figure 1 below, in Boisot's I-space model, knowledge stars from the same point, A. Knowledge at this point is common sense(Keith D, 2020), which, according to the coordinates of the I-space model in three dimensions, is diffused, uncodified, and concrete, such as 'animals do not drive a car', 'my dad is older than me', or 'pressing the keys of a piano can make a sound'. We move to point B through scanning[2], where knowledge becomes undiffused, uncodified, and concrete, meaning that it has been understood by an individual or a particular group of people. For example, in the case of Lang Lang, knowing how to recognise music and play the piano is this type of knowledge. And then, knowledge goes through problem-solving[3] (codification) and abstraction[4], reaching point C, where knowledge is undiffused, codified and abstract. Following the example of Lang Lang, point C means that he has developed his musical aesthetic by playing the piano and then used his aesthetic and taste to create his musical score. After the fourth step - diffusion - in which Lang Lang edits and publishes his score as a music textbook, selling and disseminating it to the public, the knowledge reaches point D in which it is diffused, codified and abstract.

Finally, and in my opinion, the most subtle and most demanding step to understand, is that after the four steps abovementioned, the diffused, codified, and abstract knowledge, through absorption[5] and impacting[6], comes back to the starting point becomes a new common sense. Cooperating with Chicago Symphony Orchestra, Lang Lang plays Tchaikovsky's Piano Concerto No. 1 in his style, and this 'new style' and 'new fit' becomes new 'concrete' knowledge that will enter a new cycle as 'new common sense'.

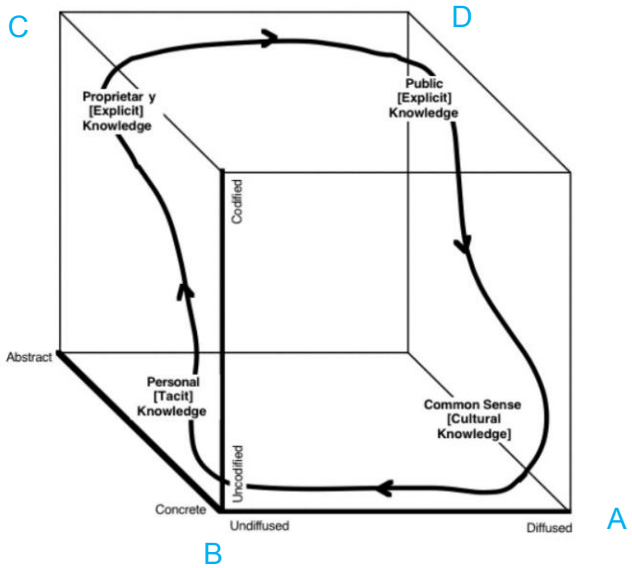

Figure 1 Knowledge Diffusion: Information Space Model (Adapted from Boisot 1998,p.59)

[2] Scanning: Identifying threats and opportunities in generally available but often fuzzy data
[3] Problem Solving (codification): The process of giving structure and coherence to such insights
[4] Abstraction: Generalizing the application of newly codified insights to a wider range of situations.
[5] Absorption: Applying the newly codified insights into different situations in a 'learning-by-doing' or a 'learning by using' fashion.
[6] Impacting: The embedding of abstract knowledge in concrete practices.
The above definitions are derived from (Boisot, M. (1998). Knowledge assets: Securing Competitive Advantage in the Information Economy. Oxford University Press.

In this model, Boisot embeds abstract knowledge into concrete practices. This embedding can occur in artefacts, technologies or organisational rules, and behavioural patterns. Absorption and influence often work in tandem, and their value is demonstrated in: (1) He adopted a pluralist epistemology distinctive among organisational and management theorists. (2) He built a theory for the interaction of these knowledge types and summarised that firms follow a social learning cycle, moving back and forth through the space (DeAngelis & Rose, 2018).

Training in knowledge scaling with this model is beneficial because it helps us articulate, refine and share people's perceptions of the components of an organisation's knowledge assets and how they are distributed in the I-space.

Therefore, in this paper, we will study six NTU-related knowledge assets based on the I-space model and analyse :
(1) why this is a knowledge asset, (2) what competitive advantages it has and (3) what are the mechanisms by which it is embedded. Finally, describe the social learning curve of this knowledge asset and the changes or transformations in the I-Space.

3 Classification Criteria

We selected six NTU knowledge assets for analysis. And to answer our questions in a more structured way, we chose one of the three dimensions proposed by Boisot and divided the six types of knowledge assets into two categories: codified and uncodified, according to ‘the extent to which knowledge can be given form’ (Boisot, 1998).

Further analysing this criterion, Boisot argues that "knowledge that is to be embedded in mass-produced artefacts usually has a more structured form and a higher degree of codification than that is put into text in a more expository manner" (Boisot, 1998). For instance, building a piano requires more complex and precise process drawings, technical instructions and schedules than playing a piano piece. Even the discursive knowledge, if it is to be transferable, must be minimally codified and much more so than most knowledge that generally resides in people's minds.

With this criterion in mind, we have established a definition of codable and non-codable, i.e. whether it can be expressed clearly and accurately in physical forms, such as drawings/instructions, and its content does not change in the dissemination pr. For example, a guide on building a bicycle is a codified knowledge asset, where the manufacturing drawings do not change either through dissemination or printing; in contrast, riding a bike is an uncodified asset, as this knowledge exists in the human brain, and everybody teaches and learns to ride a bike in a different way that cannot be standardised in a written form. Similar examples include knowledge about the personal habits of a close relative, a scene from childhood and so on.

After identifying this criterion, we selected and classified the following six assets belonging to the NTU, which are following.

- Codified knowledge assets
  - Laboratory (standardised production artefacts, instruction, etc.)
  - Library books (collections)
  - Research results
- Uncodified knowledge assets
  - Teachers
  - NTU culture and extraordinary stories
  - Graduate bosses (providing resources for employment, internship opportunities)

3.1 Laboratory

Due to Singapore's limited land area and lack of resources, technology has to be studied hard. Thus, laboratories become valuable knowledge assets. The most important intangible asset is knowledgeable, highly competent employees (or labour). It takes researchers most time to analyse and manipulate the data from the laboratory and

improve knowledge transfer in a collaborative workplace with the automation of laboratory work. Knowledge transfer between individual employees and teams can be facilitated to stimulate creativity and innovation and boost research (Dotzert, 2020).

Aside from the laboratory's personnel, its instrumentation, samples, and data are also crucial tangible laboratory assets. According to Overbrook (2022), as laboratory operations are highly complex and instrumentation requirement profiles constantly change, the requirements to properly manage those assets cannot be underestimated. In most laboratories, regardless of their size, the internal resources and expertise will be codified into manuals or instructions for the lab to manage the equipment assets and maintain a reasonable level of efficiency and cost-effectiveness.

One example of NTU's comparative advantage over other universities is the joint laboratory, set up by L 'Oreal Singapore and NTU, organised by the Singapore Centre on Environmental Life Sciences Engineering (SCELSE) to research the microbes that live on our skin and scalp. The joint laboratory, located on the NTU campus, results from a long-term collaboration between SCELSE and L 'Oreal Singapore. The partners have jointly patented the new technology, a move that will further strengthen their cooperation in the future. The collaboration between NTU and L 'Oreal reflects Nanyang Technological University's "Strategy 2025": transforming knowledge into the industry and benefiting industry and society through partnerships.

The social learning curve of laboratory knowledge assets is described in Figure 2. The diffused, uncodified and concrete knowledge starts from point A as common sense, such as the equipment in the laboratory has responding methods to use. Through scanning, the knowledge of concrete techniques in using the equipment case by case has been understood by an individual (we say the instructor). The knowledge becomes undiffused, and we move to point B. And then, tacit personal knowledge becomes proprietary explicit knowledge, reaching point C through codification and abstraction. Following the laboratory example, point C means that the instructor has summarised the general user guide for the equipment by practising and then used this guide to conduct a series of studies. After diffusion, in which the instructor edits and issues his guide as an equipment instruction, disseminating it to the public, the knowledge reaches point D. Finally, the explicit public knowledge comes back to the starting point and becomes a new common sense through absorption and impacting. Cooperating with other researchers, the instructor applies the equipment to a new field of study. This new application for this area becomes new concrete knowledge that will enter a new cycle as new common sense.

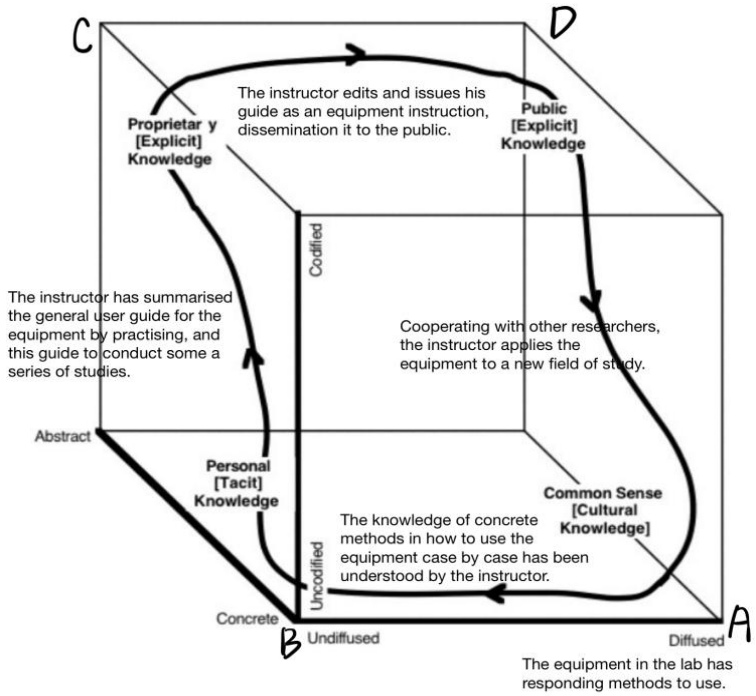

Figure 2 The social learning curve and transformation process of Laboratory knowledge assets in NTU

3.2 Library books

Books are one of the most common sources of knowledge. According to Oppenheim et al. (2001), knowledge sources have to do with people, and knowledge assets are those accumulations that yield a stream of valuable services over time while economising on the consumption of physical resources (space, time, and energy). The knowledge service of the library is the information service of high level and helps save time to facilitate knowledge transfer and sharing; it is a user-centred knowledge-based service. NTU library supports academic exchange and research, assists students in preparing for the knowledge economy, creates a dynamic learning environment on campus, and conducts all activities with users at the centre.

The collection of books as knowledge assets is a source of competitive advantage for universities that possess them — they allow these universities to cultivate superior students or develop research in different fields of higher quality and larger volumes than their competitors can match.

Compared with other universities, one of NTU's competitive advantages is that there are nine libraries on the main campus aside from the online, which are Lee Wee Nam Library, Art, Design & Media Library, Business Library, Chinese Libraries, Communication & Information Library, Humanities & Social Sciences Library, Library Outpost in the Hive, Wang Gungwu Library.

The knowledge services that NTU libraries support are innovation. To meet the needs of the knowledge economy era and cultivate all-round innovative talents, Nanyang Technological University has promoted a series of reforms and innovations in teaching and research in recent years. The NTU library is responsible for cooperating with the teaching and scientific research, so it is necessary to carry out various innovative services to actively cooperate with and vigorously support the university’s innovation. At the same time, the library’s innovation is also an inevitable response of the library itself to adapt to the development of the times and meet readers’ needs.

In recent years, NTU libraries have some practical experience in innovation which is another competitive advantage, such as building subject rooms and learning commons, providing Web 2.0 new technology services, implementing the concept of "library-in-your-pocket", developing mobile information services, deepening subject information services, establishing NTU Institutional Repository (DR-NTU), etc.

The social learning curve of library knowledge assets is described in Figure 3. The diffused, uncodified and concrete common sense that books are stored in the library starts from point A to B through scanning. Point B is where a group of people has acquired the knowledge and skills of how to recognise and read different books, and this knowledge becomes undiffused. And then, tacit personal knowledge becomes proprietary explicit knowledge, reaching point C through codification and abstraction. Following the library example, point C means that people develop their talents through reading books, and then create their articles to the best of their ability. After diffusion, in which people edit and issue their papers, disseminating them to the public, the knowledge reaches point D. Finally, the explicit public knowledge comes back to the starting point and becomes a new common sense through absorption and impacting. Collaborating with others, people communicate and express their opinions, and then update their insights, such as new writing styles. This unique style becomes new concrete knowledge that will enter a new cycle as new common sense.

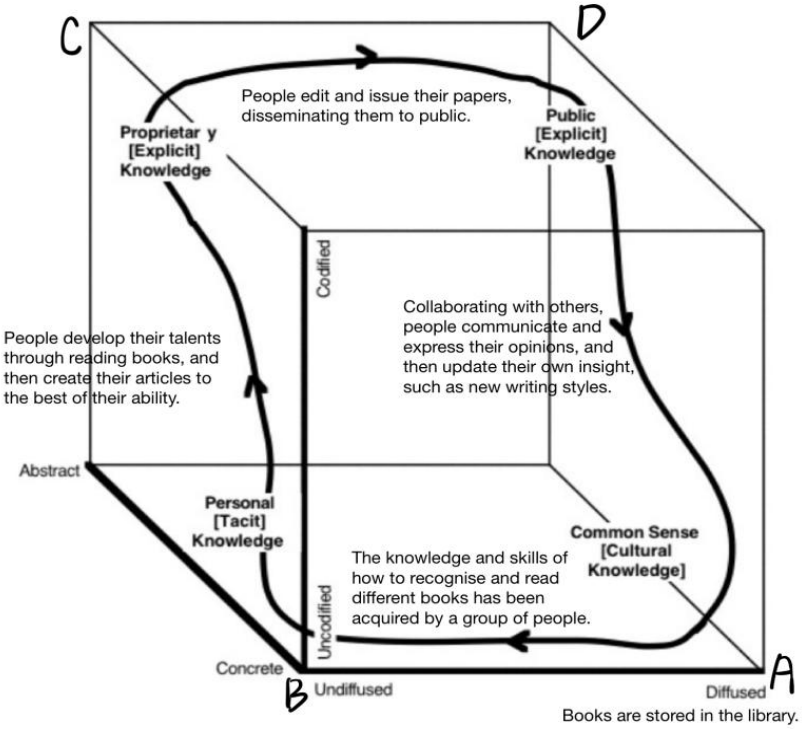

Figure 3 The social learning curve and transformation process of Library books knowledge assets in NTU

3.3 Research results

As a comprehensive research university, NTU has produced impressive research results in many fields, and these research results are, of course, NTU's intellectual assets. Research results can take different forms, such as applied technology, patents, and theses. In this paper, we refer to research results that are published in the form of papers. For example, in 2022, a research team led by Prof Tan of NTU designed a catalyst, pentanidium (pentane), which is essential for the effective generation of sulfur-based pharmacophores, and thus has the potential to advance drug development and generate new therapeutics. This scientific achievement has been published in the scientific journal Nature. As a carrier of scientific knowledge, the paper can be understood as a physical, intellectual asset owned by NTU.

Let's recall again Boisot's definition of a knowledge asset, which is an accumulation of knowledge that can generate a sequence of valuable services. It can be stored as data in a physical object such as a human document. Research teams at universities use the knowledge in their minds, combined with experiments, to produce innovative discoveries. For such innovative findings to be documented and disseminated, they need to be coded. The process of putting research results into a paper is essentially the codification and documentation of innovative knowledge in a standardised language and form so that it can be disseminated and subjected to peer review. The competitive advantage that research results bring to NTU is clear; it enhances the university's reputation for research and innovation, which helps to attract more researchers and students. It helps to improve NTU's academic ranking globally and attracts more research grants and funding, which further contributes to the research strength.

The social learning curve of scientific research results is shown in Figure 4 above. First, there is the scanning stage, as defined by Boisot, where researchers identify threats and opportunities in the weak data signals to generate personalised and unique insights, which can be understood as the stage of scientific research where questions are identified, propositions are made. Next, researchers give coding and abstraction to their findings, both of which may occur simultaneously, and researchers produce results through experimentation and document the findings in a standardised framework, of which publication is one form, thus making them knowledgeable results that can be understood and applied. It is worth noting that the diffusion of new scientific results is limited for a long period due to

the existence of patents, i.e., the innovation will not, in the short term, be transformed into common knowledge, and it may only be disseminated in a small area, understood and applied by some people.

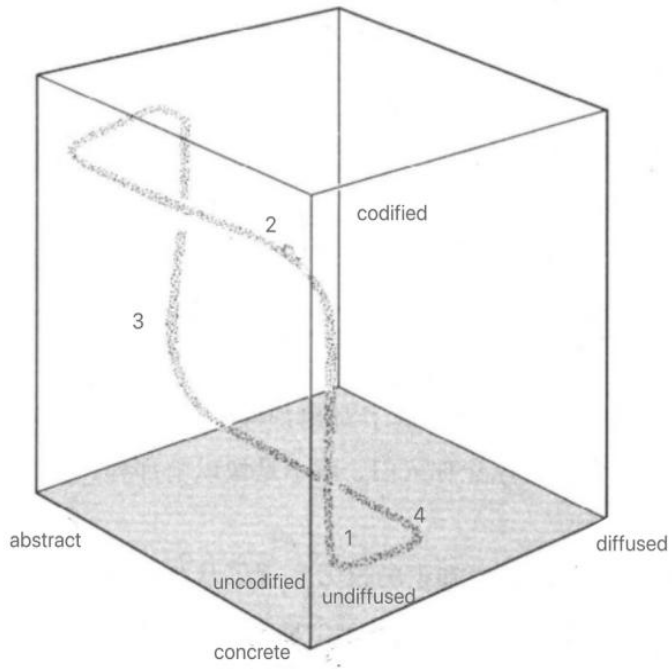

Figure 4 The social learning curve and transformation process of Research results in knowledge assets in NTU.

3.4 Teachers

Its community of teachers is a unique and valuable knowledge asset for any school. In Boisot's description, knowledge can also be stored as data in the human mind. As bearers of knowledge, teachers possess a great deal of subject knowledge, teaching experience, and life experience. We are not referring here to the knowledge possessed by teachers only in the sense that it has been sufficiently abstracted and coded, as much of this knowledge can be found in textbooks and literature. We focus on teachers' tacit knowledge, i.e., the knowledge that contains sufficient personal experience and understanding but is not fully coded and abstracted. We believe that this is what distinguishes teachers from other knowledge assets, i.e., highly personalised knowledge. Teachers' teaching experiences also belong to this category of knowledge assets. Such knowledge about sequence teaching, which teaching format to use, how to interact with students, and how to assess students is also primarily tacit. It is difficult for teachers to record and disseminate all their experiences and understandings about teaching and learning. For NTU, an excellent faculty gives it a substantial competitive advantage. NTU has several of the world's leading scientists, outstanding faculty and research staff from over 40 countries. The excellent faculty and research community enhances NTU's research strength, making its statement a research-intensive univer strong academics help it maintain a leading position in the world university rankings.

The social learning curve of faculty as an intellectual asset is shown in Figure 5. First of all, as mentioned above, teachers have a lot of tacit knowledge in their minds, Itssity. Based on their understanding and experience, which is dispersed and specific. In the process of teaching, teachers try to abstract and encode knowledge to express and transmit it, and these two processes often occur simultaneously, with personal knowledge tending to be more or less the same as textbook knowledge. Then, students receive the knowledge transmission from the teacher; knowledge is diffused. At the same time, knowledge becomes concrete and dispersed again as each individual has a filter based on personal experience and knowledge base, and absorbs knowledge through the personal filter and applies it in unique scenarios.

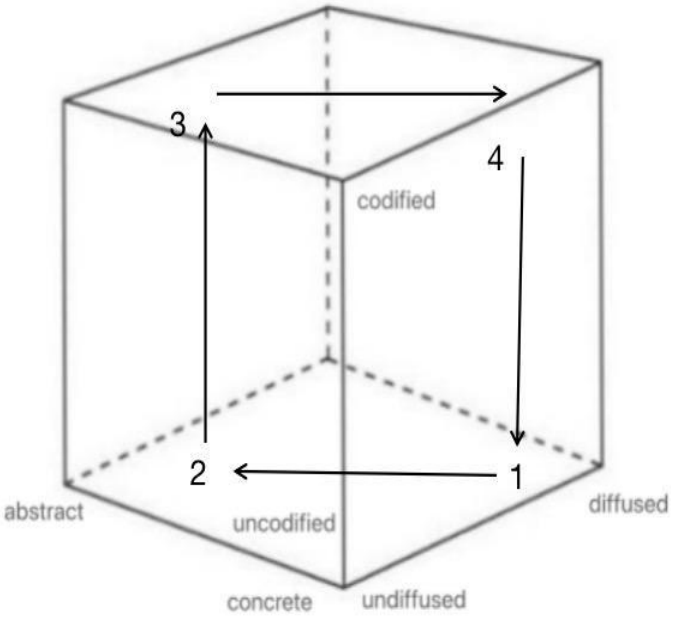

Figure 5 The social learning curve and transformation process of teachers knowledge assets in NTU

3.5 NTU culture and extraordinary stories

NTU culture and extraordinary stories are an intellectual asset because both culture and stories are an accumulation of valuable resources of NTU students, faculty and other staff, and as they recall or describe NTU culture and stories, there is always a ‘consensus’ that has a sense of ‘unity’ and ‘belonging’ and is more characteristic of NTU's local culture.

For example, these shared cultural memories and stories help knowledge assets to merge and connect, allowing NTU graduates to form many similarities years after graduation, for example, ‘the monkeys on NTU's campus like to steal takeaways’, ‘NTU is one of the best of the world's youngest university groups’, ‘Hive is the most familiar place for classes’, ‘there are long queues in front of the NTU souvenir shop every year when new shirts are released’, and ‘NTU's North Hill canteen has the best mala hot pot’, etc. Such memories and culture have achieved "entropy reduction" of NTU's impressions and labels. Therefore, we believe that NTU’s culture and extraordinary stories are an intellectual asset in terms of enhancing NTU's reputation (reflecting value) and forming a shared memory and label ("entropy reduction").

Compared to NUS, NTU’s culture and memories are more inclusive, diverse and emphasise traditional Chinese culture. Firstly, the ‘Life at NTU->Student Life’[7] section of NTU’s official website vividly illustrates studencolourfulrful life on campus, reflecting that NTU values the well-being of everyone for them to excel and exceed, and the fact that together we can foster an inclusive community and positive student experiences within NTU, with equal opportunities for everyone to thrive, regardless their race, religion, nationality, and abilities. What’s more, NTU's student community outreach channel, U-insight, where students act as 'building leaders' to introduce new students to the history and stories of each building, helps them to have essentially the same intellectual assets that have been diffused at their discretion, creating a unique sense of belonging to NTU. And these otherwise undiffused, concrete, uncodified memories and stories, embedded in vehicles such as websites and brochures as they are disseminated and told, become diffused, abstract, and codified common perceptions.

[7] https://www.ntu.edu.sg/life-at-ntu/student-life

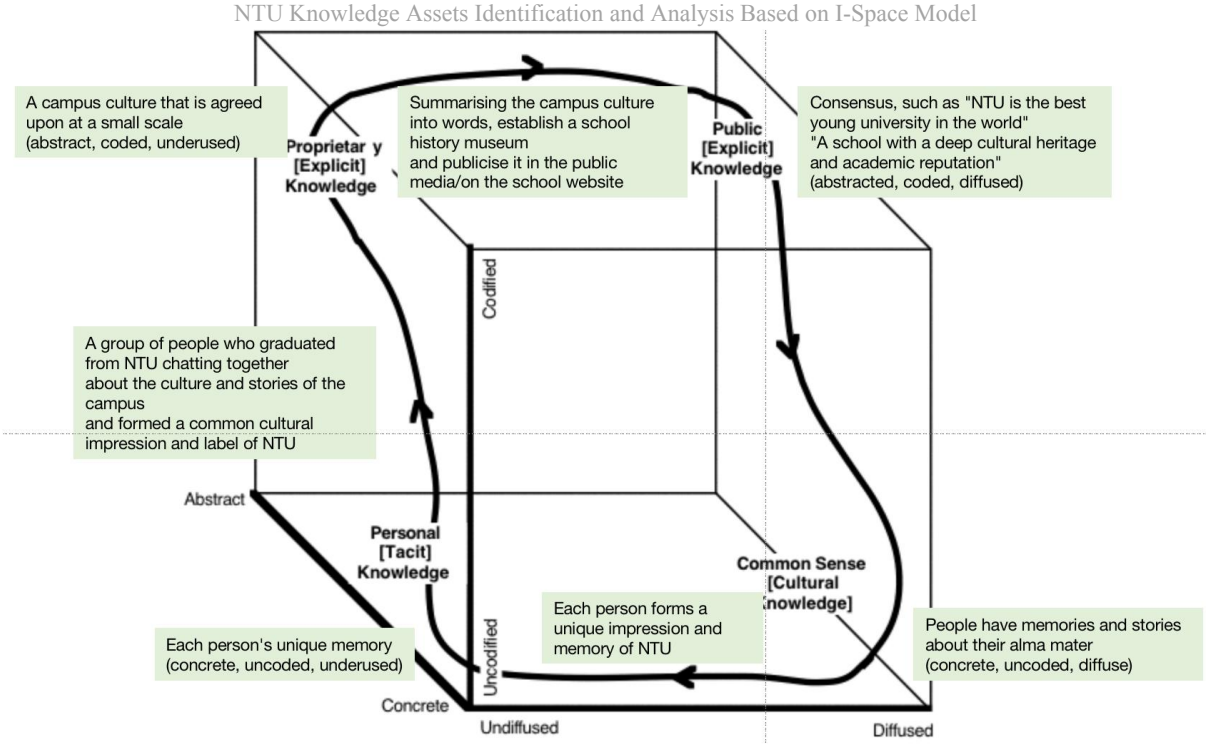

Figure 6 The social learning curve and transformation process of NTU culture and extraordinary stories

Figure 7 NTU Campus Culture Promotion -NTU official website, U-Insight

3.6 Graduate bosses

'Graduate bosses' is an interesting term. In this article, we define people who have their own companies after graduation and have moved into various roles to help NTU alumni with their careers as 'graduate bosses'. Such help includes providing internships/jobs, assisting students in connecting with other social resources through networking, providing interview coaching, talking about career experiences, etc.

Graduate bosses are studied as a knowledge asset because the employment resources of these alumni employers are valuable knowledge that can be built up over time. As the process of collaboration between graduates and Graduate bosses progresses, it will create a more favourable employment environment for NTU graduates to seek employment,

creating a virtuous cycle and creating an "NTU Alumni Circle[8]" in some of NTU's leading industries, such as materials science and information science and helping to bring campus knowledge into practice and create value for society.

The vehicles for such knowledge assets include human ideas (the tradition of alumni helping each other), understanding (e.g. interview techniques and experience), insight (knowledge of the industry and acquired job skills), memories and alumni stories. Meanwhile, the official NTU job search information platforms, such as the career axis, have also been embedded. In addition, job search software such as LinkedIn provides information, contacts and career opportunities offered by alumni with the "NTU" label. Through the integration and categorisation of information on specialist platforms, the abstract, uncodified, and undiffused knowledge (experience, hiring needs, etc.) of ‘graduate bosses’ is scanned, diffused and codified into job posts on websites and information platforms, networking channels, regular mass campus emails, and transformed into abstract, diffused, codified knowledge that facilitates the dissemination of such knowledge through society, even more, helping NTU students gain more advantages in their careers.

Compared to the 'Graduate bosses' resources of NUS, which are more professional in layout, style and image in their various communication channels, such services at NTU are more friendly and approachable, with a more ‘family sharing’ characteristic. In addition, NTU's Graduate bosses demonstrate more advantages in the number of job search seminars and the diverse forms of activities conducted. NTU has three alumni exchange centres in Singapore offering various career services, while NUS has only one. Apart from that, the NTU alumni card has far more partner businesses than NUS, and NTU students can access better opportunities and resources at a lower cost.

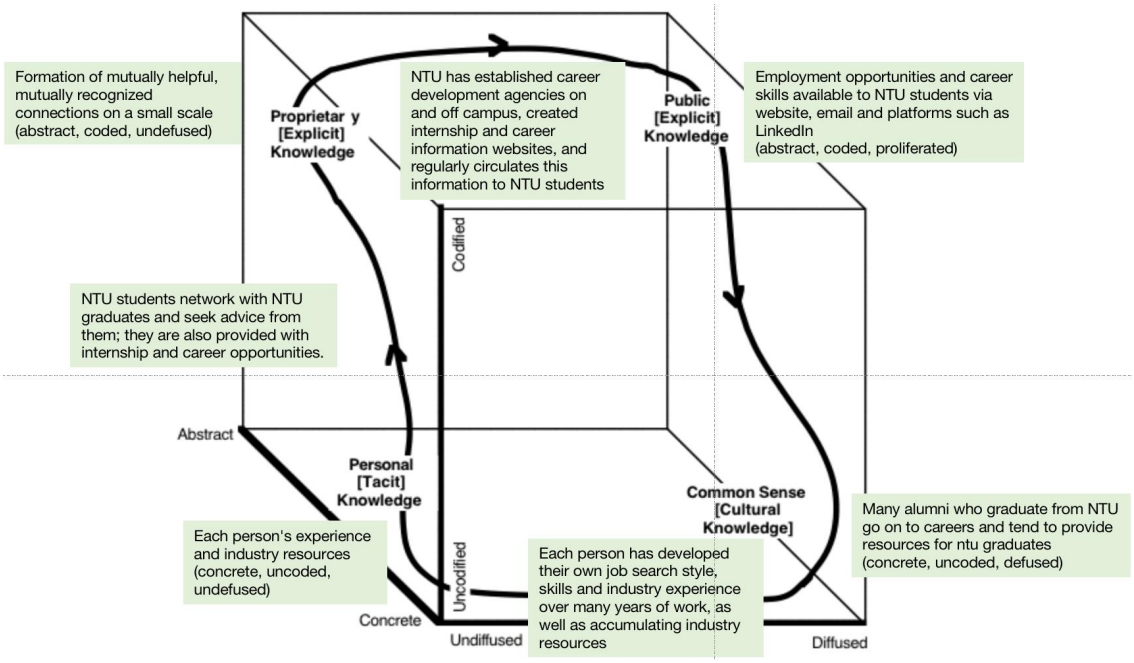

Figure 8 The social learning curve and transformation process of NTU Graduate bosses

[8] https://www.ntu.edu.sg/alumni

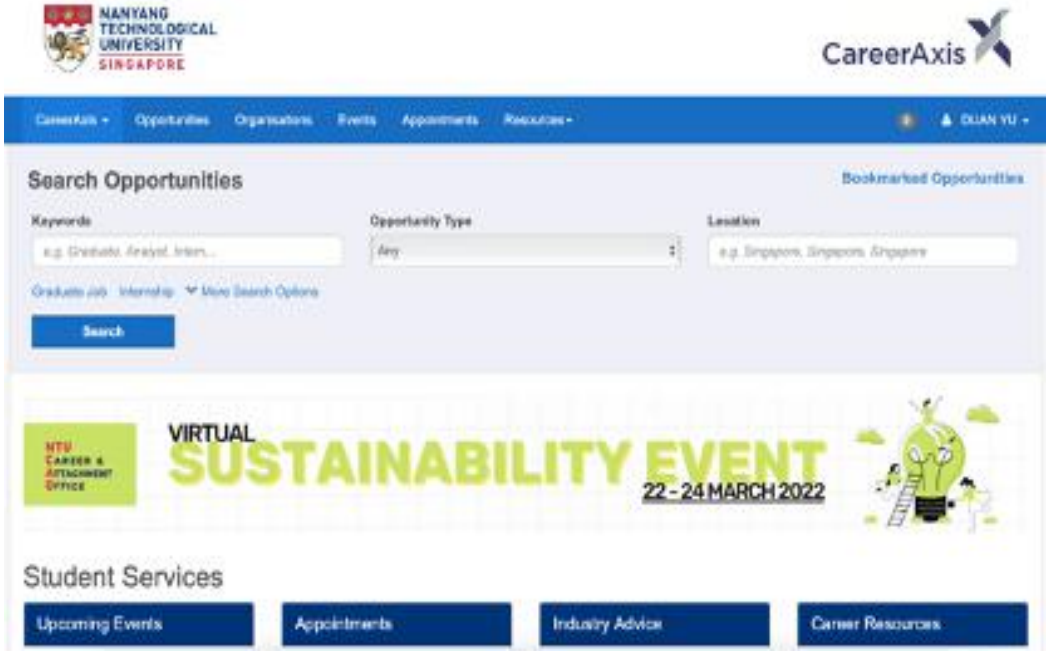

Figure 9 NTU career axis

4 Discussion

4.1 Fief is the predominant transaction type at NTU of the four transacting types

Regarding the four types of knowledge assets, we believe that the dominant one in NTU is fief. By definition, the critical element of knowledge in fief is the individual, and knowledge is traded in interpersonal relationships. The types of knowledge traded are primarily codified. The status of the owner of knowledge is not established by position and power, but by personal charisma and prestige. The owner of knowledge possesses expertise in a narrow field of knowledge through study and accumulation in that area, which is codified and traded to others. In this type of transaction of fief, the transmitter and the receiver are not in a superior-subordinate relationship, and the receiver is more like a DISCIPLE. in NTU, the transmission of knowledge from a teacher to a student would be the most common type of transaction, where the teacher codifies his or her personal knowledge and transmits it to the student, and this transaction is highly dependent on interpersonal relationships. The teacher and the student are not in a hierarchical relationship; the student is attracted by the teacher's expertise and personal charisma, develops trust in him or her, and is willing to receive this knowledge transfer. Each teacher specialises in different subjects and research directions, and therefore the knowledge he or she possesses and wants to transmit is highly specialised. In this type of transaction, interpersonal trust is an essential factor in making the transaction happen, rather than other factors such as rank. Such types of transactions can be found everywhere in universities. The interpersonal scenarios in which teachers teach students in the classroom, teachers, provide guidance to students in the lab, and students ask teachers for advice after class are all knowledge transactions in universities. These types of transactions are highly personal, where the teacher and student have some level of knowledge about each other's backgrounds, personalities, characteristics, etc.

4.2 Neoclassical learning still exists at NTU, but the trend is Schumpeterian learning

The reason why Neoclassical learning exists is that a set of facts and theories are still assembled and hierarchically organised into a vertical structure in the course, and we gradually capture all relevant information on a given theme in the lecture. Learning now is a stabilising process to acquire knowledge.

However, the tendency is to learn in the Schumpeterian way. We recognise that new hypotheses and theories cannot always reliably build on preceding ones. We learn new knowledge based on different foundations, papers, and theories. Previously, our focus was to obtain a certificate; but now, the objective has to be the attainment of mastery. We are looking for a blend of exploratory and exploitative learning. Since no one is universal, a culture that can manage both certainties and uncertainties is needed.

In the era of knowledge economy today, economic globalisation, talent internationalisation, science and technology advance by leaps and bounds, and knowledge innovation is greatly accelerated (Ruan & Chia, 2010). To meet the needs of the current era, NTU has been striving to cultivate innovative talents in teaching and research.

To cultivate students' innovative spirit and global vision (Ruan & Chia, 2010), NTU vigorously conducts international exchanges and cooperation. NTU cooperates with top overseas educational institutions to establish international alliances, such as the Singapore-MIT Alliance, which provides students with dual-degree and joint-degree programs. NTU also provides opportunities for its students to study in international universities or work or intern in global companies through a series of exchange programs such as GIP and the Overseas Attachment Programme.

Based on the above, to adapt to and vigorously cooperate with university innovation, NTU uses its technological advantages to launch a series of innovative services. Hence, we think Schumpeterian learning is the future.

5 conclusion

This paper identifies and lists six types of knowledge assets in NTU based on Boisot's definition of knowledge assets and the I-space model. In addition, we classify the six types of knowledge assets into "codified" and "uncodified" and analyse them in detail in terms of definition, comparative advantage, social learning and transformation processes. In the analysis based on the I-space model, we understand how to manage and apply knowledge as a critical asset of an organisation, realise that in the new era, we need to classify these assets with a more advanced management mindset and organisational guidelines and identify precisely where it is in the three-dimensional model to better promote the transformation and innovation of knowledge assets and ultimately transform them into corporate profits and social capital.

Finally, we conclude the pattern of the I-space model, in which, in the last step, concrete, diffused, uncodified knowledge becomes "social consensus" and "common knowledge", and then, after each individual's different understanding and interpretation, it will return to its origin and become concrete, common knowledge again. This means that the overall cognition of society is upgraded and optimised through the continuous transformation of knowledge assets, becoming a new 'collective wealth of ideas', and our community, in this constant change, upgrading and adjustment, becomes a better and more sustainable future.

References

Nonaka, I. (1990). Management of Knowledge Creation. Tokyo: Nihon Keizai Shinbun-sha.

Baldrige glossary (Ed.). (2003). Knowledge Assets. Baldrige Glossary Definition. http://www.baldrige21.com/BALDRIGE_GLOSSARY/BN/Knowledge_Assets.html

Darlington, K. (2020, February 25). Common Sense Knowledge, Crucial for the Success of AI Systems. Open Mind. https://www.bbvaopenmind.com/en/technology/artificial-intelligence/common-sense-knowledge-crucial-for-the-success-of-ai-systems/#:~:text=Common%20sense%20is%20the%20knowledge,mother%20is%20older%20than%20me".

Boisot, M. (1998). Knowledge assets: Securing Competitive Advantage in the Information Economy. Oxford University Press.

Boisot, M., & Cox, B. (1999). The I-Space: a framework for analysing the evolution of social computing. Technovation, 19(9), 525-536.

DeAngelis, D., & Rose, K. (2018). Which Individual-Based Approach Is Most Appropriate For a Given Problem?. In D. DeAngelis & K. Rose, Individual-Based Models and Approaches in Ecology (1st ed., pp. 67-87). Chapman and Hall/CRC Press. Retrieved 14 April 2022, from https://www.taylorfrancis.com/chapters/edit/10.1201/9781351073462-6/individual-based-approach-appropriate-given-problem-deangelis-rose.

Dotzert, M. (2020). Facilitate Knowledge Transfer to Maximize Your Greatest Asset. Lab Manager. Retrieved 14 April 2022, from https://www.labmanager.com/business-management/facilitate-knowledge-transfer-to-maximize-your-greatest-asset-23162.

Glossary, B. (2003). Knowledge Assets. Baldrige21.com. Retrieved 14 April 2022, from http://www.baldrige21.com/BALDRIGE_GLOSSARY/BN/Knowledge_Assets.html.

Gourlay, S. (2003). The SECI model of knowledge creation: some empirical shortcomings. In 4th European Conference on Knowledge Management. Oxford, England. Retrieved 14 April 2022, from https://eprints.kingston.ac.uk/id/eprint/2291/.

McLuhan, M., & Bornstein, E. (1966). An Interview with Marshall McLuhan. The Structurist.

NTU. (2022). Student Life. Corporate NTU. Retrieved 14 April 2022, from https://www.ntu.edu.sg/life-at-ntu/student-life.

NTU. (2022). University Advancement Office. Alumni NTU. Retrieved 14 April 2022, from https://www.ntu.edu.sg/alumni.

Oppenheim, C., Stenson, J., & Wilson, R. (2001). The attributes of information as an asset. New Library World, 102(11/12), 458-464. https://doi.org/10.1108/03074800110696979

Overbrook. (2022). Laboratory Asset Management. Overbrook. Retrieved 14 April 2022, from https://www.theoverbrookgroup.com/asset-management.

Ruan, Y., & Chia, Y. (2010). Supporting University innovation: a case study of NTU Library. In 5th Shanghai (Hangzhou) International Library Forum. Hangzhou, China. Retrieved 14 April 2022, from https://hdl.handle.net/10356/91864.

Savory, C. (2006). Translating knowledge to build technological competence. Management Decision, 44(8), 1052-1075. https://doi.org/10.1108/00251740610690612