

Mixed-Motivation Factors on Academic Research Commercialisation in Malaysian Technical Universities

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ABSTRACT

Commercialisation had become one of the main activities for academics. Besides generating income for the university, academic research commercialisation is able to boost up the nation economic gains and quality of life. Therefore, it is important to understand the motivation factors of academic researchers since they are the main player in the commercialisation activity. By understanding their motivation factors, the policy makers are able to execute right initiatives in boosting up the commercialization activities. Literature classifies motivation factors as extrinsic, intrinsic, and prosocial; however, limited studies discussed on the mixed-motivation factors in academic research commercialisation. Thus, this study aimed to further understand the role of mixed-motivation factors among academic researchers who had successfully commercialised their research results. In achieving the study's objective, this study utilised the Self-Concordance Theory as the study's framework and applied a qualitative case study approach. The informants in the study were the academic researchers from four Malaysian technical universities. The study revealed that the academic researchers were motivated by the mixed-motivation factors in supporting their commercialisation activities. There are two groups of mixed-motivation factors that had been identified in the study, which the difference between those two is the overlapping size of the prosocial motivation factor in the Venn diagram. It shows that the prosocial motivation is either extrinsically-driven or intrinsically driven. It is hoped that, by knowing the right motivation factors for the academic researchers, the policy makers will execute the best strategy to motivate the novice or unexperienced academic researchers to commercialise their research results as to boost up the research commercialization rate in local universities.

Keywords: Academic Research Commercialisation, Self-Concordance Theory, Mixed-Motivation Factors, Prosocial Motivation, Malaysian Technical Universities.

1. INTRODUCTION

The Malaysian government has taken many initiatives to improve the research commercialization rate in the country. In 2009, for example, the government had enacted the Intellectual Property Law to facilitate academic researchers in protecting their inventions from being imitated by others. The law also explains in details the wealth distribution for the inventors and the incentives for invention disclosures. The academic researchers might receive RM250,000 to RM5 million for an invention, and up to RM10,000 for each patent granted (MOSTI, 2009). The rewarding offers are worthwhile for those scientists as a payback for their years of hard work on their inventions. At the same time, National Higher Education Plan was tabled by Malaysian Higher Education Minister to list out targeted outcomes on research commercialisation rate, starting from 2007 (MOHE, 2007).

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Moreover, the Malaysian government had included the Fifth Thrust of its Eleventh Malaysia Plan (RMK-11) namely “accelerating human capital development for an advanced nation”. In the thrust, some achievements of the nation’s innovation agenda was presented, such as a total of 4,030 patents were filed and 314 patents were granted between 2010 and 2013. Likewise, in year 2013, 75 products were commercialised as compared to 36 products in 2007 (EPU, 2015). The government had also allocated RM400 million in 2018 Budget in order to encourage more research, development, and commercialisation (R&D&C) from academics (MOF, 2018). Besides, the government is actively embedding the industry with the academics as to prepare for the Industrial Revolution 4.0 era.

However, despite the various initiatives and incentives, the government had to encourage the academic researchers to commercialise their research results, from the lab to market. The young academic researchers had to learn from their predecessors on how to successfully commercializing their research results as it is a long way journey with big challenges ahead. Literature on academic research commercialisation indicates various factors that motivate commercialisation. These factors are extrinsic, intrinsic, and prosocial motivation factors. However, literatures point out that previous studies tended to give more focus on extrinsic motivation factors (Baldini, Grimaldi, & Sobrero, 2007; Göktepe-Hulten & Mahagaonkar, 2010; Lee, 2018) but less on intrinsic motivation factors and even lesser on prosocial motivation (Sayre, Lilyard, & Schoenborn, 2017; Sengupta & Ray, 2018). Hence, focusing on different types of motivation seems to be a good avenue for research (Hmieleski & Powell, 2018; Lam, 2011). Thus, this study posed a question is “How did the mixed-motivation factors influence the successful academic researchers to commercialise their research results?”.

The study enriches the literature particularly on prosocial motivation and mixed-motivation factors in academic research commercialisation. In addition, the study applies qualitative case study method as a good platform to ‘listen’ to the voice of the academic researchers with regards to what had motivated them to commercialise their academic research through face-to-face interviews. Only by understanding their voices that policy makers will be able to get some useful insight into what needs to be done to boost academic research commercialisation, which will subsequently benefit not only the industry but also the whole society.

2. LITERATURE REVIEW

2.1 Academic Research Commercialisation

Academic research commercialisation activities focus on the research commercialization activities at the individual level rather than at the university level. Academic researchers are the heart of a university’s research commercialisation because they are the ones who embark on a research project until the research product is successfully commercialised. Research commercialisation is the final phase in the complex innovation or technology transfer process. The numbers of researchers involved in a research commercialisation project are usually more than one as it entails a lot of work leading to successful commercialisation process. The intellectual property right of the invention is usually registered under the name of the institution in which the research works are carried out. As the inventor, the project leader and his or her team are entitled to get royalty for the research project they are involved in. The amount of royalty they receive is mutually agreed with the university.

The process of transferring a university’s invention to the industry for further development and commercialisation is called technology transfer (AUTM, 2012). The process starts with a scientific discovery and ends with commercialisation activities where academic researchers involve at all stages of the technology transfer process. The technology transfer office (TTO)

intervenes only after they have disclosed their inventions. The TTO searches a potential industrial partner, and facilitate in closing deals with the technology taker. The synchronisation between academic researchers and the TTO makes the research commercialisation activities become successful. Conclusively, the academic researchers' role is very important in a successful technology transfer project (Siegel, Waldman, Atwater, & Link, 2004).

Vanaelst *et al.* (2006) emphasised that academic researchers as the 'key supplier' or the 'agent of research commercialisation'. It is crucial to conduct an in-depth study on the role of academic researchers as they are the ones who make the tactical decisions in commercialising their research results and in leading the directions of the research results (D'Este & Patel, 2007; Jensen, Thursby, & Thursby, 2003).

2.2 Academic Research Commercialisation in Technical Universities

Technical universities are universities that are technical-oriented. They focus on traditional research in engineering and machineries. They are expected to play a significant role in accelerating the country's commercialisation rate as technical courses taught in these universities have a big potential for supporting new product commercialisation. The nature of study focuses more on applied research rather than basic research (Audretsch & Lehmann, 2005a).

In Germany, technical universities are allocated more funds than other types of universities, such as comprehensive universities, to nurture and encourage spillovers from new technologies to firms as well as to support technology commercialisation into industries. For that reason, these technical universities have generally attracted more high-tech firms to be their industrial partners. The German government believes that these universities will generate and leverage the knowledge spillovers from university research better than other universities. Not only that, the technical universities also might help increase the country's performance in technology commercialisation and support its economic growth (Audretsch & Lehmann, 2005b).

Audretsch and Lehmann (2005a) compared the impact of technical universities in general on firm growth. They also studied the impact of a technical university on the firms that are located at the same vicinity as the university. Those firms exhibited a significantly greater propensity to apply for patents than the firms located at the vicinity of other types of universities. Fisch *et al.* (2014) compared and contrasted patenting performance of 300 universities worldwide. They utilised technical universities as the control variable. They found that the highest patent output was in chemistry while the second highest was in engineering, which are the major courses in technical universities. They concluded that technical universities had shown the good performance in research commercialisation activities across countries and across different fields of study. In Malaysia, there are four public technical universities which formed the Malaysian Technical Universities Network (MTUN). This study will focus on the successful academic researchers from these universities.

2.3 Mixed-Motivation Factors

Studies on the role of extrinsic motivation on academic research commercialisation are plenty (Baldini, Grimaldi, & Sobrero, 2007; Göktepe-Hulten & Mahagaonkar, 2010; Owen-Smith & Powell, 2001), in contrast to those that examined intrinsic motivation (Bengtsson, Nilsson, & Rickne, 2009; Ismail, Omar, & Majid, 2011). The research initiates a discussion on the third type of motivation, i.e. prosocial motivation, which is widely discussed in other fields but not in research commercialisation (Lam, 2011).

Whilst previous literature discussed the three motivation factors independently, scholars argued that an individual's behaviour could be driven by more than one motivation at a time (Diefendorff & Chandler, 2010). Even though there are literatures that combine two of them (e.g., intrinsic-prosocial, or intrinsic-extrinsic motivation) (Grant, 2008; Lam, 2010), limited studies combine the three in a single study (Benedetti, 2012). Benedetti (2012) highlighted that mixed-motivations are examined in the field of organisational behaviour and human resource management. Other studies have also investigated the mixed-motivation factors in innovation and entrepreneurship (Bhaduri & Kumar, 2009; De Jong, 2006). Because of the scarcity of research in examining mixed-motivations on research commercialisation, this study embarks on such attempt.

2.4 Self-Concordance Theory

This study uses Self-Concordance Theory, an off-shoot from Self-Determination Theory (SDT), as a more suitable theory to explain the phenomenon under study. Self-concordance is defined as the degree to which a task expresses an individual's interests and values (Deci & Ryan, 2000; Sheldon & Elliot, 1999). The theory argues that individuals will put more effort and better achieve their goals when those goals are naturally aligned with the person's interests and values. Goals that are more autonomously chosen are considered to be more self-concordant. Thus, individuals' reasons for acting range on a continuum from complete control by reward or punishment to full integration and internalisation (Sheldon & Houser-Marko, 2001). For instance, an individual wants to achieve a task because it helps his own long-term goals. On the contrary, if the same task was assigned to another individual whom perceived it as less self-concordant, his desire to achieve the task is likely to fade when obstacles are encountered (Sheldon & Elliot, 1999).

In this study, the researchers propose that the motives for commercialising research results determine the successful of academic research commercialization activities. If the academic researchers feel that commercialising their research may help achieving their own goals, they will be more motivated to commercialise. If commercialisation produces the desired result, they will keep on commercializing their product. For example, if an academic researcher wants to earn extra income for his/her family, he may strive in commercialising his R&D products. However, if there is no monetary incentives for him/her to so, he/she will not commercialise his/her product.

2.5 Conceptual Framework

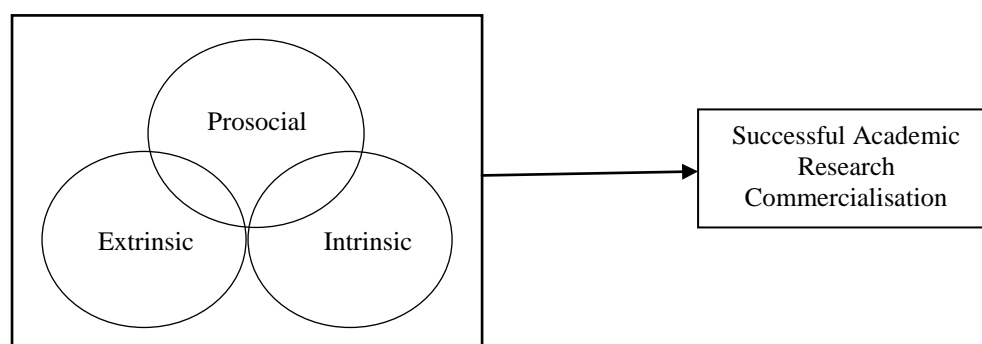


Figure 1. Study's conceptual framework.

According to motivation theories, extrinsic and intrinsic motivations are mutually exclusive. However, the third motivation type, which is prosocial motivation, can be driven extrinsically or intrinsically. The Venn diagram is used to show the relationship between the three types of

motivation. The Venn diagram comprises three overlapping circles. The overlapping interior of the circle symbolically represents the elements of the set, while the exterior represents elements that are not members of the set. The overlapping areas in this study are extrinsic-prosocial and intrinsic-prosocial motivations. For example, the first shaded overlapping area is the area in which prosocial motivation is extrinsically driven. It means the elements in that area belong to both prosocial and extrinsic motivation. The Venn diagram in Figure 1 shows that academic researchers' motivation influences their research commercialisation activities.

3. RESEARCH METHODOLOGY

3.1 Sampling Design

The cases were selected using purposive sampling technique. In this study, successful research projects at MTUN universities were the cases considered in this study. The researcher used the database from MOHE publication (RMC-MOHE, 2010) to get the list of successful research projects.

There were thirteen (13) successful research projects at the time of data collection, which was November 2013. The research projects had successfully passed all phases in the research commercialisation process, from the scientific discovery to the product launching. The projects also had generated some revenue for the university. All thirteen (13) cases were included in the study. Table 1 shows the list of all thirteen (13) successful research projects by university. Pseudonyms were used to designate the university and the research projects. The informants were the project leaders and the unit of analysis is the successful research project as each project had its own challenges, merits, and limitations.

Table 1 Commercialised products and its university

University	A	B	C	D
Research Projects	White	Magenta	Red	Blue
	Ivory	Indigo	Yellow	Green
	Cyan	Coral	Black	Grey
		Orange		
	3	4	3	3
	TOTAL		13	

3.2 Research Procedures

The researchers review published documents include the Malaysian plan, the government blueprints, related policy papers, newspaper archives, and other published documents. The review exposed the researcher to the details of the informants. For example, through newspaper cuttings of their success stories and their personal blogs or websites, the researcher got to know the background of the informants. Initial information about the informants was important to help the researcher probe further questions during the actual interview (Marshall & Rossman, 1989; Merriam, 2009; Patton, 1990).

After reviewing the relevant documents, the researchers arranged interview sessions with the informants. The interviews began in November 2013 and ended in January 2014. To set up a meeting, the researcher communicated with all informants via email. The contact details were obtained from the university website. Prior to the fieldwork, an interview protocol was developed and it contains semi-structured interview questions to answer the research questions. All interviews were conducted in English, but the informants had the option to answer in Malay or English language. On average, the interview session lasted about 65 minutes.

The interview sessions were voice recorded and transcribed by the researcher. Email enquiries were sent to the informants if the researcher needed clarification of their responses. After case descriptions were written, the researcher emailed them to the respective informants for verification. The verification was more so important in some cases where technical jargons unfamiliar to the researcher were used. The informants responded by emailing the modifications. This approach increased the validity of the research. Besides interviewing the informants, the researcher made observations of the informant's office, took pictures, and requested personal documents to support the interview data.

4. FINDINGS AND DISCUSSIONS

From the transcriptions of the interview, the researchers started to analyze using within-case analysis strategy. The analysis enabled the researcher to develop a detailed case study write-up called case study database or a thick description of the case (Creswell, 2012; Merriam, 2009). The researcher wrote the case description based on the interview transcripts. In this description, the full case was written chronologically with full information and actual names. It also highlighted the uniqueness of each case.

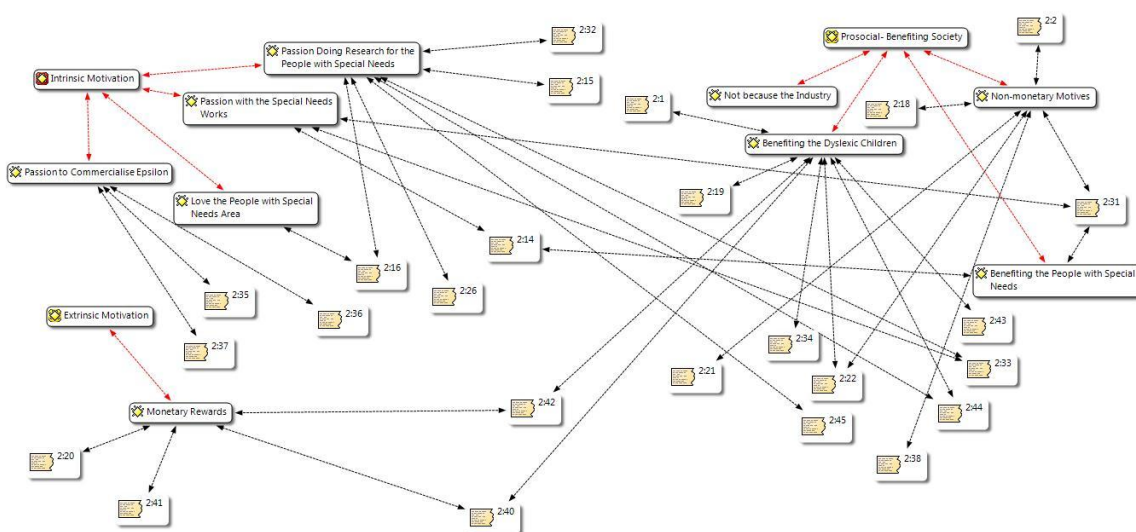


Figure 2. Network view diagram in atlas.ti software.

Figure 2 shows the network view of ATLAS.ti in order to structure the findings from the study. To find the answers to the research questions, the researcher used thematic analysis to categorise the information from the interview transcripts within a case. The researcher applied open coding process to the case. After the open coding, the axial coding was constructed as to group the open codes into fewer numbers of codes. Then, the axial codes were categorised in the super axial codes or termed as “categories” by Merriam (2009). According to Creswell (2012), the axial codes can be as much as 25 to 30 codes while they can be categorised into smaller categories of five or six super axial codes.

Next, the researcher performed cross-case analysis to compare and contrast between the cases. The aim of the cross-case analysis is to build general explanation that fits the individual cases (Merriam, 2009). The analysis is a powerful tool to develop a new theory because it allows replication and extension among individual research projects. The analysis had brought

together the findings across thirteen (13) cases. The researcher completed the cross-case analysis using ATLAS.ti software for easy retrieval and to show the relationship between codes.

ATLAS.ti is capable to visualize the analysed data in order to construct the Venn diagram as in line with the study's conceptual framework. In order to develop the Venn diagram, the researcher observed carefully the codes developed in the software. The overlapping sections in the Venn diagram concern with the prosocial motivation factors, whether the factors were more extrinsically-driven or intrinsically-driven. As a result, the researcher drew the network diagram for the mixed-motivation factors for each case in order to classify the type of mixed-motivation for that case. The size of the overlapping section in the Venn diagram was determined by the arrows that showed the relationship between each motivation type. More arrows between the typology showed that the relationship between them were higher than their counterpart.

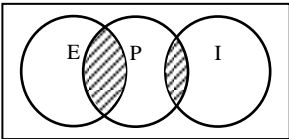
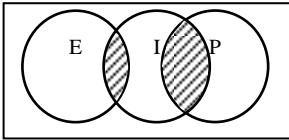
From the study, it has been discovered that the informants were motivated by all three types of motivation factors, either simultaneously or in sequence. There are two types of mixed-motivation that had been found in the study. The difference between those two types was the size of the prosocial overlapping section. The overlapping size did not indicate any major motivation factor in the research project. It was merely to depict that the prosocial motivation in the case was driven more extrinsically rather than intrinsically, and vice versa. For example, if the case fell under Type I of the mixed-motivation, it did not mean that the academic researchers were more extrinsically driven to commercialise their research result. Instead, it only showed that the prosocial factors in the project were more extrinsically driven than intrinsically driven.

Type I. In the first type of mixed-motivation factors, the prosocial factors in these academic researchers were more extrinsically driven as the extrinsic-prosocial overlapping section was bigger. There were seven cases in this category.

Type II. The prosocial motivation in his type was driven intrinsically as the overlapping section of prosocial-intrinsic motivation was dominant. There were six cases in this category.

From the study, it can be concluded that all successful academic researchers were motivated by all three motivation factors. The mixed-motivation factor showed the combination of motivation factors in each case. The mixed-motivation emerged either at the initial idea stage or at the later stage of the research commercialisation process. The motivation factors might also happen simultaneously or in sequence. The motivation types for all cases are simplified in Table 2.

Table 2 The types of mixed motivation factors for all cases

Types of Mixed-Motivation Factors	Venn Diagram	Case(s)
Type I	 <p>Type I: $E \cap P > P \cap I$</p>	Project White, Cyan, Coral, Orange, Yellow, Blue, and Grey.
Type II	 <p>Type II: $E \cap P < P \cap I$</p>	Project Ivory, Magenta, Indigo, Red, Black, and Green.

The result is corroborated with Self-Concordance Theory. Self-concordance refers to a state where a goal aligns with personal interests and values. A self-concordant individual is someone who pursues his/her life's goals. Thus, a self-concordant goal represents one's actual interests, passions, central values, and beliefs (Sheldon *et al.*, 2004).

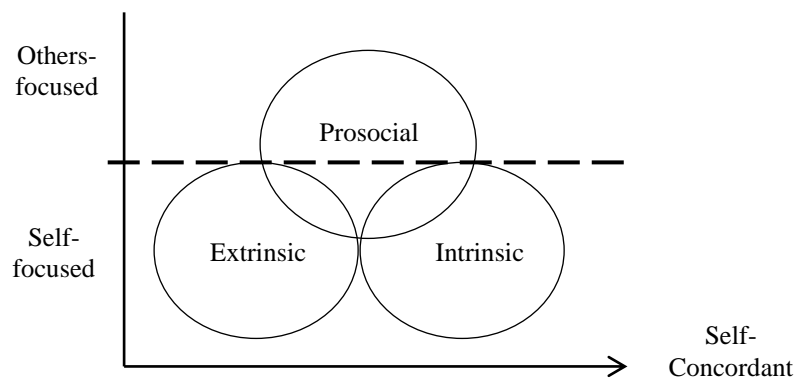


Figure 3. Self-concordance, the motivations, and the focused.

From the research findings, it can be concluded that the academic research commercialization activity was a self-concordant goal for the successful academic researchers, regardless of whether they commercialised for the sake of himself/herself or for the sake of others. The academic researchers were intrinsically-driven and had positive personal traits to commercialise their research results. Dardak (2013) argued that one of the critical success factors for successful technology transfer is passion. Passion is an intrinsically driven motivation (Lam, 2011). In this study, all the academic researchers were passionate about commercialising their research results. Besides, they also had the personal traits that kept them motivated. Because commercialisation was in accordance with their personal goals, they persevered and were determined even though it was a lengthy process. In the case of prosocial motivation, Sheldon *et al.* (2004) noted that when one pursues self-concordance goals, one engages in an activity regardless of whether it benefits other people or own self (refer to Figure 3). But, those who are focused on others, their tendency to commercialise was more than those who were not.

It is interesting to note that the mixed-motivation factors found in the study explain that the research commercialisation activity was self-concordant with the academic researchers involved in the thirteen (13) successful research projects of MTUN universities. They believe that the activity was in line with their goals in their careers. They are self-determined to juggle with all daunting tasks in commercialising their research results. Moreover, for those who are others-focused or prosocially-motivated, their tendency to commercialise was more than those who are not (Grant & Berry, 2011; Grant, 2008). If the goals are non-concordant, the academic researchers would give up if any barriers or challenges came to their way along the commercialisation process. Even if the goals are achieved, the effectiveness of the goals could be lower than those who are self-concordant (Sheldon & Gunz, 2009).

5. CONCLUSION

This study discussed the mixed-motivation factors in commercialisation, which is less discussed in the literature. Benedetti (2012) and Diefendorff and Chandler (2010) argued that an individual's behaviour could be driven by more than one motivation at a time. This study considered three mixed- motivation factors i.e. extrinsic, intrinsic, and prosocial. Because academic research commercialisation involves a lengthy process, this study found that the

academic researchers were motivated by more than one factor at a time. The mixed-motivation was closely related to the research commercialisation process. In the early stage, the academic researchers might be motivated by one type of motivation factor but at the later stages of the process, other motivation factors come in.

In this study, the academic researchers were found to be motivated by extrinsic and intrinsic rewards. Hence, the government should retain the existing incentives to encourage commercialisation. The government should also encourage the industry personnel to visit universities and other academic institutions to examine the new inventions that have the potential for commercialisations. The academic researchers were also motivated by prosocial factors. The university's management should encourage them to have good networking with the industry to identify the market needs. The university's TTO also has to strengthen their roles in accelerating commercialisation at the university, especially in determining the amount of royalty given to academic researchers in order academic researchers to use the back-door route. Theoretically, the study has proven that the prosocial motivation and mixed-motivation factors exist in the academic research commercialisation field.

Future studies may also apply other research methodologies, whether mixed-method or quantitative, to validate the present study's findings. Multiple case study method can also be used as compared to the single case study applied in this study. Besides, future studies may investigate the applicability of self-concordance theory to non-successful academic researchers or to those who are novel in commercialisation. It is because the activity is self-concordant to those who were successful but may be less or non-concordant to the non-successful academic researchers.

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