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COMMERCIALISATION ACTIVITIES OF BIOMEDICAL RESEARCH RESULTS IN FOUR MALAYSIAN UNIVERSITES

Mohsen Ashourian[1], AhmadReza Shekarchizadeh[2], Noorulsadiqin Azbiya Yaacob[2], Amran Md Rasli[2],

[1]Islamic Azad University, Majlesi Branch, Iran
[2]Faculty of Management and Human Resource Development
Universiti Teknologi Malaysia (UTM)
81310 UTM Skudai, Johor, MALAYSIA
sadiqin@uum.edu.my, m-amran@utm.my

ABSTRACT

This paper discusses the results of a survey conducted on academic researchers working on biotechnology related research from four leading research universities in Malaysia. One-way ANOVA tests were conducted to examine whether perceptions on commercialisation activities of research results differ based on the demographic background of the researchers. The result of this study revealed significant differences in perceptions on commercialisation initiatives particularly with regards to years of research experience, experience as administrator/top level management at university level and job status. Other researches which could be conducted were recommended to complement this exploratory study.

Keywords

Academic Researchers, Commercialisation Activities

1.0 INTRODUCTION

Universities are increasingly being recognized as having a key role in the regional development process. Universities also make many contribution to economic and social/cultural in nature to their localities (Goddard, Charles, Pike, Potts & Bradley, 1994) but commercialisation have a particular appeal to policymakers in times of seemingly accelerating technological change, strikingly uneven regional economic performance and tight budgets for higher education. Due to that, universities have to put effort to commercialise their research results as alternative sources of income.

There is some confusion about the difference among research results, knowledge and technology. Gray & Walters (1998) clarified "The important point is that technology implies the application of knowledge having practical value and utility. Research results are not the same thing as a technology. Research results, whether empirical findings, statistical relationships, or new conceptual schema, are new knowledge" (p.219).
At the heart of knowledge and technology transfer is the individual academic researcher who makes decisions about how to disseminate the results of their research, i.e., whether or not to collaborate with industry, disclose their inventions to their university or start a company based on their knowledge. However, even with encouragement and advocacy from the government, the issues to transfer the potential research results to the industry to be developed and commercialised still experiencing low success rates. How to get the universities to better contribute to innovation process has become an important issue in the international agenda and also in Malaysia.

Transferring the results of university research to industry may take several forms and thus can be achieved in different ways. These include publications, conferences, consulting, conversations, recruitment of graduates, co-supervising, collaborative research, patents and licenses (Agrawal & Henderson, 2002). Some of these methods involve the transfer of knowledge about new technologies to the economy as a public good (Gu & Whewell, 1999). Estimates of relative importance of different knowledge channels suggest that these 'non-commercial' methods represent the majority of knowledge transferred from universities to industry (Agrawal & Henderson, 2002).

Although there had been other researches on knowledge and technology transfer which are focused on faculty members, the research had been done mainly in developed countries (refer works by Zucker, Darby & Armstrong, 1998; Zucker, Darby & Brewer, 1998; Zucker & Darby, 2001; Louis, Blumenthal, Gluck & Stoto, 1989; Bercovitz & Feldman, 2004). Furthermore, most of the technology transfer studies used a Technology Transfer Office (TTO) report as a performance guideline. Jensen, Thursby & Thursby (2003) noted that many technology transfer office directors believe that substantially less than half of the inventions with commercial potential are disclosed to their office.

As such, a potential issue in the form of gaps between the declared commercialisation activities of TTO and how the academicians view their research commercialisation activities may arise. Noticeably absent from the institution and technology transfer literature is a systematic and broad based analysis of the commercialisation activities of research results.

The integration of the demographic variables would be useful to explain the differences in perceptions based on the background of the respondents. Previous researches by Allen, Link & Rosenbaum (2007) as well as Morgan, Kruytbosh & Kannankutty (2001) indicate that some demographic variables may influence individual perceptions thus affecting their commercialisation activities. Thus, this research seeks to investigate the extent to which commercialisation activities differ based demographic background.

This paper focuses on commercialisation activities at the research universities in Malaysia. The primary unit of analysis is the academic researcher who is involved in biotechnology related research. Although the scope of the research is limited to research universities, however, there is still a possibility to derive some general trends, indicators and facts which would contribute to the theory and guide further research.

2.0 METHODS

This section presents methods utilized in this research including sampling, data collection, measurements and analysis.

2.1 Sampling

Listing of academic researchers was obtained from the Malim Sarjana expertise database developed by Higher Education Ministry. The list include active academic researchers comprising of molecular biology, plant biotechnology, animal biotechnology, industrial and environmental biotechnology, forensic biotechnology, food biotechnology, biopharmacy biotechnology, marine biotechnology, bioinformatics and biosafety and bioethics field of research.

A stratified sampling method was used in this study. Stratified random sampling is composed of grouping the members of the population into strata. By using simple random sampling scheme, samples are drawn from each stratum and than the selected observations are pooled to form a single sample set. Within the context of this study, each research university is treated as independent, thus making stratified sampling method appropriate to develop the final sampling frame for the survey.

2.2 Data Collection

This study utilized a questionnaire in identifying the perceptions of academic researchers who are involve in biotechnology related research rather than relying on commercialisation activities reported by their Technology Transfer Office. A modified version of a questionnaire measuring research results using items developed in earlier studies by Jusoh (2008) that were originally adapted from Landry, Amara & Ouimet (2006) was used for this research.

2.3 Measurements

Eleven questions that targeted pressing commercialisation activities of research results, which are also believed to be relevant to academic researchers productivity, were selected as dependent measures. Commercialisation activities of research results measures include: (1) publishing academic writing, (2) communicated to other users outside the academic environment/priority parties such as private firms or government agencies through seminar, conference, exhibition, report in printed or electronic media, (3) invited to present research results to group and organization who could make direct use of them, (4) been involved in comittee which is interested in using and exploiting new knowledge based on the research result, (5) given consultation service/technical (based on technology field/research result) to private firm, government agency or others, (6) disclosed the invention based on my research result, (7) applied patent based on my research result, (8) got patent based on research result, (9) gave the licence to other party or organization to produce or market the product from my research (10) the license that have been given to other party, have been resulted in monetary return and (11) research result has created spin off company that specifically produce and commercialize the research product. Academic researchers responded to these eleven questions on a 5-point frequency scale whereby 1=never, 2=rarely, 3=sometimes, 4=often and 5=very often. The independent variable of interest for this study was academic researchers' demographic background. The demographic information used in the study consists of research experience, highest level of education, experience as administrator/top level management and academic post status.

2.4 Analysis

The analyses used in this study are essentially exploratory and broadly seeks to address the research question of interest, i.e., to document any differences in opinion between demographic backgrounds group.

Firstly, data will be analysed using descriptive statistics to illustrate the demographic background of respondents. Secondly, factor analysis and reliability tests were conducted to ensure data validity and statistical reliability respectively. Subsequently, Terrell's transformation technique (Pallant, 2005) was used to convert ordinal data into indices for mean and one-way analysis of variance (ANOVA) analyses. Finally, differences of means for each factored components of commercialisation activities were compared for each demographic variable using one-way ANOVA. Thus, the following research hypothesis[1] using one-way ANOVA was formulated to compare mean of all items (attributes) measuring the commercialisation activities of research results groups by each demographic variable.

Ha_1 : There is difference in mean of commercialisation activities of research results groups based on the demographic background.

3.0 RESULTS

3.1 Descriptive Analysis of Demographic Background of Academicians Working on Biotechnology Related Researches in Malaysian Research Universities.

Seventy nine academicians working on biotechnology related researches in Malaysian research universities participated in the survey. The descriptive analysis over the collected data illustrated the diverse background of respondents even though they originated from four Malaysian research universities.

Table 1: Frequency Analysis on Demographic Background

Research Experience	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 5 years	17	21.5	21.5	21.5
5 to 10 years	28	35.4	35.4	57.0
More than 10 years	34	43.0	43.0	100.00
Total	79	100.0	100.0	
Education Level	Frequency	Percent	Valid Percent	Cumulative Percent
Master	10	12.7	12.7	12.7
PhD	62	78.5	78.5	91.1
Post doctoral	7	8.9	8.9	100.0
Total	79	100.0	100.0	

Administration/ Top Level Management Experience	Frequency	Percent	Valid Percent	Cumulative Percent
Faculty	39	49.4	49.4	49.4
Research Centre	5	6.3	6.3	55.7
University	12	15.2	15.2	70.9
No experience	23	29.1	29.1	100.0
Total	79	100.0	100.00	
Academic Post	Frequency	Percent	Valid	Cumulative

[1] Originally there are 3 groups of commercialization activities of research results and 4 demographic variables in the questionnaire thus implying the possibility of 3x4=12 hypotheses to be generated. However, all the hypotheses are group into 1 major research hypothesis.

			Percent	Percent
Lecturer	17	21.5	21.5	21.5
Senior Lecturer	20	25.3	25.3	46.8
Associate Professor	23	29.1	29.1	75.9
Professor	19	24.1	24.1	100.0
Total	79	100.0	100.0	

With reference to Table 1, it is evident that most of the respondents have more than ten years research experience in the university (43%), followed by academicians with five to ten years experience (35.4%) and those with less than five years experience (21.5%). As expected, a majority of the respondents (78.5%) possess a doctoral qualification. Whereas, Master holders and Post Doctoral holders occupy second and third places respectively. With regards to the experience of the researchers as administer or top level management, the analysis revealed that most of the respondents (49.4%) have experience at faculty level, possess no experience at all (29.1%), have experience at the university level (15.2%) and have experience at the research center level (6.3%). Finally, the status of the respondents consists of associate professor (29.1%), senior lecturer (25.3.3%), professor (24.1%) and lecturer (21.5%)

3.2 Factor Analysis and Reliability Test

Within the context of this study, typology development has been used as analytical strategy where a quantitative survey was conducted, developed factors through a factor analysis and using this factors as a typology (Caracelli & Greene, 1993). For the eleven questionnaire items, there are seventy nine cases in the sample, which are sufficiently enough for conducting a single factor analysis using Varimax rotation method with Kaiser Normalisation and Principal Component Analysis. The factor analysis generated three descriptive components for commercialisation activities which are presented in Table 2.

Table 2: Rotated Component Matrix – Varimax with Kaiser Normalisation for Research and Commercialisation Activities.

Questionnaire Items Representing Commercialisation Activities	Components		
	1	2	3
4	.818		
3	.813		
5	.810		
2	.737		
6	.557		
10		.850	
11		.824	
9		.767	
8			.878
7			.850
1			.512

The first group of components can be classified as committee and network building (CNB) and comprises of five items from the commercialisation activities of research results. The following are the items of CNB: (4) been involved in comittee which is interested in using and exploiting new knowledge based on the research result, (3) invited to present research result to group and organization who could make direct use of them, (5) given consultation service/technical (based on technology field/research result) to private firm, government agency or others, (2) communicated to other users outside the academic environment/priority parties such as private firms or government agencies through seminar, conference, exhibition, report in printed or electronic media and (6) disclosed the invention based on my research result

The second group of components can be classified as technology transfer (TT) and comprises of three items from the commercialisation activities of research results. The following are the items of TT: (10) the license that have been given to other party, have been resulted in monetary return, (11) research result has created spin off company that specifically produce and commercialize the research product and (9) gave the licence to other party or organization to produce or market the product from my research.

The final group of components representing commercialisation activities of research results can be classified as intellectual property and academic writing (IPAW). The items classified under this group are the following: (8) got patent based on research result, (7) applied patent based on my research result and (1) publishing academic writing.

3.3 Comparing Means of Commercialisation Activities of Research Results Group (CNB, TT and IPAW) by Demographic Background Using one-way ANOVA

A series of one-way ANOVA was conducted to assess the differences of means for the 3 groups generated based on five demographic variables: research experience, highest level of education, experience as administrator/top level management and academic post status.

Table 3: Analysis of Research Experience using ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CNB	Between Groups	9833.991	2	4916.996	11.749	.000
	Within Groups	31805.882	76	418.498		
	Total	41639.873	78			
TT	Between Groups	5593.515	2	2796.758	6.726	.002
	Within Groups	31600.578	76	415.797		
	Total	37194.093	78			
IPAW	Between Groups	6211.219	2	3105.609	6.541	.002
	Within Groups	36086.601	76	474.824		
	Total	42297.820	78			

With reference to Table 3, all the three groups of commercialisation activities of research results demonstrated differences in means based on research experience of academic researchers since the p-value is less than 0.05. Upon further analysis, Table 4 shows the mean of CNB, TT and IPAW are highest for the academic researchers who have more than 10 years experience.

As the result obtained from Table 5, it shows that only TT demonstrated differences in means based on highest level of education of academic researchers since the p-value is less than 0.05. Upon further analysis as shown in Table 6, the mean of TT is highest for the academic researchers who have Master as the highest level of education where as other two groups which are CNB and IPAW were not demonstrated any differences in its means based on highest level of education of the academic researchers since all the p-values are greater than 0.05.

IPAW	Master	10	40.8333	27.62458	8.73566
	PhD	62	36.5591	22.09202	2.80569
	Post Doctoral	7	58.3333	20.97176	7.92658
	Total	79	39.0295	23.28690	2.61998

Table 4: Descriptive Analysis on Research Experience using ANOVA

Group	Research Experience	N	Mean	Std. Deviation	Std. Error
CNB	Less than 5 years	17	29.1176	23.26715	5.64311
	5 to 10 years	28	45.0000	20.09238	3.79710
	More than 10 years	34	**58.2353**	19.26224	3.30345
	Total	79	47.2785	23.10508	2.59952
TT	Less than 5 years	17	5.3922	13.48262	3.27002
	5 to 10 years	28	5.6548	12.63885	2.38852
	More than 10 years	34	**22.5490**	27.18014	4.66136
	Total	79	12.8692	21.83683	2.45684
IPAW	Less than 5 years	17	28.4314	24.30614	5.89510
	5 to 10 years	28	33.3333	16.35511	3.09083
	More than 10 years	34	**49.0196**	24.25356	4.15945
	Total	79	39.0295	23.28690	2.61998

Table 5: Analysis of Highest Level of Education using ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CNB	Between Groups	1173.606	2	586.803	1.102	.337
	Within Groups	40466.267	76	532.451		
	Total	41639.873	78			
TT	Between Groups	3548.516	2	1774.258	4.008	.022
	Within Groups	33645.577	76	442.705		
	Total	37194.093	78			
IPAW	Between Groups	3019.370	2	1509.685	2.921	.060
	Within Groups	39278.450	76	516.822		
	Total	42297.820	78			

Table 6: Descriptive Analysis on Highest Level of Education using ANOVA

Group	Highest Level Of Education	N	Mean	Std. Deviation	Std. Error
CNB	Master	10	48.5000	18.26502	5.77591
	PhD	62	45.7258	24.34127	3.09134
	Post Doctoral	7	59.2857	14.84042	5.60915
	Total	79	47.2785	23.10508	2.59952
TT	Master	10	**27.5000**	33.57551	10.61751
	PhD	62	9.4086	16.14511	2.05043
	Post Doctoral	7	22.6190	35.58840	13.45115
	Total	79	12.8692	21.83683	2.45684

Subsequently, with reference to Table 7, all the three groups of commercialisation activities of research results demonstrated differences in means based on experience as administrator/top level management of the academic researchers since the p-value are less than 0.05. Table 8 shows the mean of CNB, TT and IPAW are highest for the academic researchers who have experience as administrator/top level management at university level.

Table 7: Analysis of Experience as Administrator/Top Level Management using ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CNB	Between Groups	9684.645	3	3228.215	7.577	.000
	Within Groups	31955.229	75	426.070		
	Total	41639.873	78			
TT	Between Groups	8507.681	3	2835.894	7.414	.000
	Within Groups	28686.412	75	382.485		
	Total	37194.093	78			
IPAW	Between Groups	10117.977	3	3372.659	7.860	.000
	Within Groups	32179.843	75	429.065		
	Total	42297.820	78			

Table 8: Descriptive Analysis of Experience as Administrator/Top Level Management using ANOVA

Groups	Experience As Administrator /	N	Mean	Std. Deviation	Std. Error

	Top Level Management				
CNB	faculty	39	51.5385	17.73911	2.84053
	research centre	5	49.0000	23.29163	10.41633
	university	12	**63.3333**	15.85923	4.57817
	no	23	31.3043	26.16457	5.45569
	Total	79	47.2785	23.10508	2.59952
TT	faculty	39	14.9573	20.69511	3.31387
	research centre	5	3.3333	7.45356	3.33333
	university	12	**32.6389**	32.84843	9.48252
	no	23	1.0870	3.81414	.79530
	Total	79	12.8692	21.83683	2.45684
IPAW	faculty	39	39.7436	20.54285	3.28949
	research centre	5	48.3333	25.95402	11.60699
	university	12	**59.7222**	24.57552	7.09434
	no	23	25.0000	17.58816	3.66739
	Total	79	39.0295	23.28690	2.61998

Similarly, Table 9 shows that all the three groups of commercialisation activities of research results demonstrated differences in means based on academic post status of the academic researchers since the p-value are less than 0.05. Table 10 shows the mean of CNB, TT and IPAW are highest for the academic researchers who entitled as professor.

Table 9: Analysis of Academic Post Status using ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CNB	Between Groups	4870.700	3	1623.567	3.312	.025
	Within Groups	36769.173	75	490.256		
	Total	41639.873	78			
TT	Between Groups	6207.636	3	2069.212	5.008	.003
	Within Groups	30986.457	75	413.153		
	Total	37194.093	78			
IPAW	Between Groups	8636.493	3	2878.831	6.414	.001
	Within Groups	33661.327	75	448.818		
	Total	42297.820	78			

Table 10: Descriptive Analysis of Academic Post Status using ANOVA

Groups	Academic Post Status	N	Mean	Std. Deviation	Std. Error
CNB	lecturer	17	40.0000	25.67830	6.22790
	senior lecturer	20	40.2500	22.21160	4.96667
	assoc professor	23	48.4783	20.08136	4.18725
	professor	19	**59.7368**	21.04715	4.82855
	Total	79	47.2785	23.10508	2.59952
TT	lecturer	17	7.3529	16.63600	4.03482
	senior lecturer	20	6.6667	16.35677	3.65748
	assoc professor	23	9.4203	14.71624	3.06855
	professor	19	**28.5088**	30.46904	6.99008
	Total	79	12.8692	21.83683	2.45684
IPAW	lecturer	17	31.8627	22.09420	5.35863
	senior lecturer	20	32.0833	21.84391	4.88445
	assoc professor	23	35.1449	18.79524	3.91908
	professor	19	**57.4561**	22.37702	5.13364
	Total	79	39.0295	23.28690	2.61998

Overall, the study shows that CNB and IPAW are not affected by highest level of education as in TT. This finding is supported by Morgan et al., (2001) study that found level of education give influence on the patenting and inventive activities of academic scientists. However, research experience, experience as administrator/top level management and academic post status have some effect on the CNB, TT and IPAW with highest mean for the academic researchers who have more than 10 years experience, experience as administrator/top level management at university level and entitled as professor. This finding also supported by previous work done by Allen et al., (2007) that indicate faculty research productivity according to appointment type (tenure-track faculty were more research productive than were faculty on other appointments) and research productivity by rank (e.g., full professor, associate professor, and assistant professor) were significant predictors of faculty research productivity.

4.0 CONCLUSION

Whether shaped by the actual or perceived significance of demographic background, the finding of this study shows that demographic background have some effect on academic researchers who were involved in commercialisation activities of their research results in biotechnology related research.

By classifying the commercialisation activities of research results into different categories or groups, it is possible to identify and develop a more focused commercialisation activities of research results categories – CNB, TT and IPAW for each different group of academic researchers in commercialisation activities of research results in biotechnology related research in Malaysian Research University.

The one-way ANOVA tests further showed that there are differences between demographic backgrounds in commercialisation activities of research results with academic researchers who have more than 10 years experience, experience as administrator/top level management at university level and entitled as professor scoring highest mean compare to the other demographic background. Therefore, it is recommended that university should practice an approach or policy to take into account demographic background such as research experience, level of education, experience as administrator/top level management and academic post status in motivating the commercialisation activities of research results among academic researchers.

For the present study, the sample was chosen from academic researchers who are involved in biotechnology related research. Further comparative works may be conducted across

different field of research such as information technology, engineering and life sciences. Comparisons among different field of research can help to understand the pattern of commercialisation activities of research results across different field of research, so that more focused research attention on commercialisation activities toward research results can be made. Finally, a possible study can be carried out at both the private and public universities in Malaysia.

Although this study shows broad demographic background differences in perception at academic researcher level, it is not completely clear how those differences play out at the institutional level. Here, qualitative studies might have an advantage over quantitative ones in providing a richer and deeper understanding of how academic researcher can benefit from commercialisation activities of their research results.

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