American Journal of Economics and Business Administration 3 (1): 24-32, 2011
ISSN 1945-5488

Perceptions of Commercialization Activities of Research Results among Academic Researchers in Malaysia

[1]Noorulsadiqin Azbiya Yaacob, [1]Amran Md Rasli,
[1]Aslan Amat Senin and [2]Siti Norezam Othman
[1]Department of Management, Faculty of Management and Human Resource Development,
University Technology Malaysia, 81310 Skudai, Johor, Malaysia
[2]Department of Technology and Operation Management, UUM College of Business,
University Utara Malaysia, 06010 UUM Sintok, Kedah, Malaysia

Abstract: Problem statement: This study discusses the results of a survey conducted on academic researchers working on biotechnology related research from four leading research universities in Malaysia. 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. **Approach:** Factor analysis and reliability tests were conducted to identify dimensions of commercialization activities and to determine statistical reliability of the dimensions. Subsequently, a series of one-way ANOVA tests were conducted to examine whether perceptions on commercialization activities results differ based on the demographic background of the researchers. **Results:** The result of this study revealed significant differences in perceptions on commercialization initiatives particularly with regards to years of research experience, experience as administrator/top level management at university level and job status. **Conclusion/Recommendation:** Qualitative studies were recommended to complement this exploratory study.

Key words: Academic researchers, commercialization activities, one-way ANOVA

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 but commercialization have a particular appeal to policy makers 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 commercialize their research results as alternative sources of income.

There is some confusion about the difference among research results, knowledge and technology. What is research result? New knowledge is created from knowledge discover process through synthesizing prior knowledge and combines it with data or information (Roxanne *et al.,* 2010). Gray and 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 commercialized 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 and recruitment of graduates, co-supervising, collaborative research, patents and licenses (Agrawal and Henderson, 2002). Some of these methods involve the transfer of knowledge about new technologies to the economy as a public good (Gu and Whewell, 1999). Estimates of

Corresponding Author: Noorulsadiqin Azbiya Yaacob, Faculty of Management and Human Resource Development, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia

relative importance of different knowledge channels suggest that these 'non-commercial' methods represent the majority of knowledge transferred from universities to industry (Agrawal and 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 (Zucker *et al*., 1998; Zucker and Darby, 2001; Louis *et al*., 1989). Furthermore, most of the technology transfer studies used a Technology Transfer Office (TTO) report as a performance guideline. Jensen *et al*. (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 commercialization activities of TTO and how the academicians view their research commercialization activities may arise. Noticeably absent from the institution and technology transfer literature is a systematic and broad based analysis of the commercialization 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 *et al*. (2007) as well as Morgan *et al*. (2001) indicate that some demographic variables may influence individual perceptions thus affecting their commercialization activities. Thus, this research seeks to investigate the extent to which commercialization activities differ based demographic background.

This study focuses on commercialization 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.

MATERIALS AND METHODS

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

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 then 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.

Measurements: A modified version of a questionnaire measuring research results using items developed in previous study was used for this research. The questionnaire consists of 11 items and several questions on the demographic background of the respondents. The 11 questions specifically referred to commercialization activities of their research results. Commercialization activities of research results 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 committee 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. The aforementioned 11 items are consistent with those identified by Landry *et al*. (2007).

Academic researchers responded to the 11 items based on a 5-point frequency scale (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 solicited is as follows: Research experience, highest level of education, experience as administrator/top level management and academic post status.

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. The analyses will not seek to explain why such differences exist. The latter is certainly important and will be addressed briefly in this study, but a more involved discussion is beyond the scope of this study.

Data will initially be analyzed using descriptive statistics to provide basic understanding of the demographic background and questionnaire items. Before data been analyzed, upon testing hypotheses, some of the preliminary steps need to be completed. These help to ensure that the data are reasonably good and assured quality for further analysis. For a good quality data, the reliability and validity of a data should be tested. In this study, the construct validity was evaluated by using Exploratory Factor Analysis (EFA) and the reliabilities (internal consistencies) of commercialization activities of research results dimensions were determined by looking at Cronbach's alpha values. 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 commercialization activities were compared for each demographic variable using one-way ANOVA. Thus, the following research hypothesis using one-way ANOVA was formulated to compare mean of all items (attributes) measuring the commercialization activities of research results groups by each demographic variable:

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

RESULTS

The data collected were tested using descriptive analysis, factor analysis, reliability test and one-way ANOVA analysis. First, the individual responses from all respondents for all the attributes were analyzed by calculating percentages of the number of respondents answering each question. This is then followed by factor analysis to group the research result variables into descriptive components and assess data for statistical reliability. Finally, a series of one-way ANOVA was performed on the dimensions uncovered from the factor analysis based on the demographic background of the respondents.

Frequency 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. 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 with less than five years experience (21.5%). As expected, majority of the respondents (78.5%) posses PhD. Whereas, Master holder and Post Doctoral holder hold second and third place respectively. Regarding the experience as administer or top level management, the analysis revealed that most of the respondents (49.4%) had experience at faculty level, no experience (29.1%), university level (15.2%) and research center level (6.3%). Finally, the highest percentage of the respondents was Associate Professor (29.1%), Senior Lecturer (25.3.3%), Professor (24.1%) and Lecturer (21.5%).

Frequency analysis of commercialization activities of research results of academicians working on biotechnology related researches in Malaysian research universities: A frequency scale (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often and 5 = Very Often) was used to gauge how frequent the respondents were with 11 key activities commonly associated with commercialization activities of research results.

Table 2 summarizes frequency data of the seventy nine academicians working on biotechnology related researches in Malaysian research universities who participated in the survey. From the results, obtained, the highest percentage of frequency for the eleven items of commercialization activities of research results can be summarized into three groups. The first commercialization activities of research results group scored highest percentages at frequency scale 1 (never) that are create spin off companies (74.7%) obtain monetary return from commercialization (73.4%), gave license to external parties to commercialize (72.2%), obtain patent based on research results (70.9%) and apply patent based on research results (51.9%). The second group of commercialization activities of research results that scored highest percentages at frequency scale 4 (Often) are publication via academic writing (51.9%) and seminar, exhibition and printed/electronic media (39.2%) which score highest percentage of frequency scale at 4. The third group of commercialization activities with highest percentage of frequency scale at 3 (Sometimes) are give consultation service/ technical expertise (34.2%), disclosed

Table 1: Descriptive analysis of demographic background

Research experience	Frequency	Percent	Valid (%)	Cumulative (%)
Less than 5 years	17	21.5	21.5	21.5
5-10 years	28	35.4	35.4	57.0
More than 10 years	34	43.0	43.0	100.0
Total 79	100.0	100.0		
Education level				
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		
Administer /top level management experience				
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	100.0		
Academic post				
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		

Table 2: Descriptive analysis of commercialization activities of research results frequency

	Percentage (%)				
Items	Never	Rarely	Sometimes (3)	Often (4)	Very often (5)
Publication via academic writing	1.3	2.5	24.1	51.9	20.3
Seminar, exhibition and printed/electronic media	8.9	10.1	27.8	39.2	13.9
Invitation to present research results elsewhere	20.3	19.0	30.4	25.3	5.1
Involved in committee keen to exploit research	21.5	16.5	30.4	29.1	2.5
Give consultation service/ technical expertise	15.2	16.5	34.2	27.8	6.3
Disclosed invention based on research results	25.3	15.2	34.2	22.8	2.5
Apply patent based on research results	51.9	11.4	13.9	16.5	6.3
Obtain patent based on research results	70.9	1.3	19.0	7.6	1.3
Gave license to external parties to commercialize	72.2	12.7	8.9	3.8	2.5
Obtain monetary return from commercialization	73.4	10.1	10.1	5.1	1.3
Create spin off companies	74.7	8.9	10.1	2.5	3.8

invention based on research results (34.2%), invitation to present research results elsewhere (30.4%) and involved in committee keen to exploit research (30.4%).

Construct validity using factor analysis and reliability test: In general, construct validity is the extent to which a particular item relates to other items consistent with theoretically derived hypotheses concerning the variables that are being measured. The factor analysis used a principal component analysis as the extraction method and varimax with Kaiser Normalization rotation method to explain the item variance.

Two statistical tests should be done in order to allow for the application of factor analysis, namely, Kaiser-Meyer-Olkin (KMO) sampling adequacy test and the Barlett's test of sphericity. The KMO sampling adequacy test statistic for this study is 0.847 which is higher than the threshold value of 0.5 (Hair *et al*., 1998). This is supported by the Barlett's test of sphericity value of 0.00 that is less than 0.05. These two tests seem to support the usage of the factor analysis method using Varimax rotation with Kaiser Normalization and Principal Component Analysis. Varimax with Kaiser Normalization was applied prior to factor rotation, thus keeping factors with an Eigen value of one and greater. This procedure was chosen to eliminate error variance (Tinsley and Tinsley, 1987). Whereas, a principal component analysis was the chosen extraction method to describe the data set with a smaller set of new variable.

The factor analysis extracted three factors based on Eigen value criteria more than one. Table 3 presents the factor loading, Eigen value and percentage of variance explained and reliability coefficient for every group. These three factors together accounted for 70.96% of the total variance.

Table 3: Result of the factor analysis of commercialization activities of research results

Components Commercialization Activities of research results	CNB	TT	IPAW
Involved in committee keen to exploit research	0.818		
Invitation to present research results elsewhere	0.813		
Give consultation service/ technical expertise	0.810		
Seminar, exhibition and printed/electronic media	0.737		
Disclosed invention based on research results	0.557		
Obtain monetary return from commercialization		0.850	
Create spin off companies		0.824	
Gave license to external parties to commercialize		0.767	
Obtain patent based on research results			0.878
Apply patent based on research results			0.850
Publication via academic writing			0.512
Eigen value	5.179	1.539	1.088
Percentage of Variance Explained	47.077	13.987	9.895
Reliability coefficient	0.856	0.853	0.777

Furthermore in Table 3, since the scale reliability coefficients using Cronbach Coefficient Alpha for all groups are greater than 0.7, none of the items is excluded. Nunnally (1978) suggested that a set of items with a coefficient alpha greater than 0.7 is considered internally consistent.

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 and Greene, 1993). Items of Commercialization Activities of Research Results are regrouped into different groups based on the extraction value of the rotated component matrix namely CNB, TT and IPAW as indicated in Table 3.

The first group can be classified as Committee and Network Building (CNB) and comprises of five items from the commercialization activities of research results. The following are the items of CNB: Been involved in committee which is interested in using and exploiting new knowledge based on the research result, invited to present research results to group and organization who could make direct use of them, given consultation service/technical (based on technology field/research result) to private firm, government agency or others, 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 disclosed the invention based on my research result.

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

The final group of commercialization activities of research results can be classified as Intellectual Property and Academic Writing (IPAW). The items classified under this group are the following: got patent based on research result, applied patent based on my research result and publishing academic writing.

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 difference of mean for the 3 dimensions Identified by the Factor Analysis (i.e., CNB, TT and IPAW) based on five demographic variables: Research experience, highest level of education, experience as administrator/top level management and academic post status.

With reference to Table 4, 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 5 shows mean of CNB, TT and IPAW are highest for the academic researchers who have more than 10 years experience.

With reference to Table 6, 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 7, 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.

Table 4: Analysis of research experience using ANOVA

		Sum of squares	df	Mean square	F	Sig.
CNB	Between groups	9833.991	2	4916.996	11.749	0.000
	Within groups	31805.882	76	418.498		
	Total 41639.873	78				
TT	Between groups	5593.515	2	2796.758	6.726	0.002
	Within groups	31600.578	76	415.797		
	Total 37194.093	78				
IPAW	Between groups	6211.219	2	3105.609	6.541	0.002
	Within groups	36086.601	76	474.824		
	Total 42297.820	78				

Table 5: Descriptive analysis on research experience

Group	Research experience	N	Mean	Std. Deviation	Std. Error
CNB	Less than 5 years	17	29.1176	23.26715	5.64311
	5-10 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
	5-10 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
	5-10 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 6: 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	0.337
	Within groups 40466.267	76	532.451			
	Total 41639.873	78				
TT	Between groups	3548.516	2	1774.258	4.008	0.022
	Within groups 33645.577	76	442.705			
	Total 37194.093	78				
IPAW	Between groups	3019.370	2	1509.685	2.921	0.06
	Within groups 39278.450	76	516.822			
	Total 42297.820	78				

Table 7: Descriptive analysis on highest level of education

Group	Highest level of education	N	Mean	Std. Deviation	Std. Error
CNB	Master 10.0000	48.50000	18.26502	5.77591	
PhD 62	45.7258	24.34127	3.09134		
	Post doctoral 7.0000	59.28570	14.84042	5.60915	
	Total 79.0000	47.27850	23.10508	2.59952	
TT	Master 10.0000	27.50000	33.57551	10.61751	
	PhD 62.0000	9.40860	16.14511	2.05043	
	Post doctoral 7.0000	22.61900	35.58840	13.45115	
	Total 79.0000	12.86920	21.83683	2.45684	
IPAW	Master 10.0000	40.83330	27.62458	8.73566	
PhD 62	36.5591	22.09202	2.80569		
	Post doctoral 7.0000	58.33330	20.97176	7.92658	
	Total 79.0000	39.02950	23.28690	2.61998	

Subsequently, with reference to Table 8, 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 9 shows mean of CNB, TT and IPAW are highest for the academic researchers who have experience as administrator/top level management at university level.

Similarly, Table 10 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 11 shows mean of CNB,

Table 8: 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	0
	Within groups	31955.229	75	426.070			
	Total	41639.873	78				
TT	Between groups		8507.681	3	2835.894	7.414	0
	Within GROUPS		28686.412	75	382.485		
	Total	37194.093	78				
IPAW		Between groups	10117.977	3	3372.659	7.860	0
	Within groups	32179.843	75	429.065			
	Total	42297.820	78				

Table 9: Descriptive analysis of experience as administrator/top level management

Groups	Administrator / top level management experience as	N	Mean	Std. deviation	Std. error
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 experience	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 experience	23	1.0870	3.81414	0.79530
	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 experience	23	25.0000	17.58816	3.66739
	Total	79	39.0295	23.28690	2.61998

Table 10: 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	0.025
	Within groups		36769.173	75	490.256		
	Total	41639.873	78				
TT	Between groups		6207.636	3	2069.212	5.008	0.003
	Within groups		30986.457	75	413.153		
	Total	37194.093	78				
IPAW		Between groups	8636.493	3	2878.831	6.414	0.001
	Within groups		33661.327	75	448.818		
	Total	42297.820	78				

Table 11: Descriptive analysis of academic post status

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

TT and IPAW are highest for the academic researchers who entitled as professor.

DISCUSSION

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 study 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.

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 commercialization activities of their research results in biotechnology related research.

By classifying the commercialization activities of research results into different categories or groups, it is possible to identify and develop a more focused commercialization activities of research results categories-CNB, TT and IPAW for each different group of academic researchers in commercialization 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 commercialization 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 commercialization 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 commercialization activities of their research results.

REFERENCES

Agrawal, A. and R. Henderson, 2002. Putting patents in context: exploring knowledge transfer from MIT. Manage. Sci., 48: 44-60. DOI: 10.1287/mnsc.48.1.44.14279

Allen, S.D., A.N. Link and D.T. Rosenbaum, 2007. Entrepreneurship and human capital: Evidence of patenting activity from the academic sector. Entrepreneurship: Theory Practice, 31: 937-951. DOI: 10.1111/j.1540-6520.2007.00207.x

Caracelli, V.J. and J.C. Greene, 1993. Data analysis strategies for mixed-method evaluation designs. Edu. Evalu. Policy Anal., 15: 195-207. DOI: 10.3102/01623737015002195

Gray, D.O. and S.G. Walters, 1998. Managing the Industry/University Cooperative Research Center: A Guide for Directors and Other Stakeholders. 1st Edn., Battelle Press, ISBN: 1-57477-053-5, pp: 322.

Gu, W. and L. Whewell, 1999. University Research and the Commercialization of Intellectual Property in Canada, Occasional Paper, No. 21, Industry Canada, ISBN: 0-662-64196-5, pp: 126.

Hair, J.F.J., R.E. Anderson, R.L Tatham and W.C. Black, 1998. Multivariate Data Analysis. 5th Edn., ISBN: 0-13-894858-5, p: 730.

Jensen, R., J.C. Thursby and M.C. Thursby, 2003. Disclosure and licensing of university inventions: the best we can do with the s**t we get to work with. Int. J. Indus. Organiz., 21: 1271-1300. DOI: 10.1016/S0167-7187(03)00083-3

Landry, R., N. Amara and M. Ouimet, 2007. Determinants of knowledge transfer: Evidence from Canadian university researchers in natural sciences and engineering. J. Technol. Trans., 32: 561-592. DOI: 1010007-s10961-006-0017-5

Louis, K.S., D. Blumenthal, M.E. Gluck and M.A. Stoto, 1989. Entrepreneurs in academe: An exploration of behaviors among life sciences. Admin. Sci. Quarterly, 34: 110-131. DOI: 10.2307/2392988

Morgan, R.P., C. Kruytbosch and N. Kannankutty, 2001. Patenting and invention activity of US. scientists and engineers in the academic sector: comparisons with industry. J. Technol. Transfer, 26: 173-183. DOI: 10.1023/A:1007856800497

Nunnally, J.C., 1978. Psychometric Theory. 2nd Edn., McGraw-Hill, ISBN: 10: 007047849X, p: 640.

Pallant, J., 2005. SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS version 12. 2nd Edn., Open University Press, ISBN: 0 335 21640, p: 318.

Roxanne, H.S., M. Joshua and C. Sondra, 2010. Waves of knowledge management: The flow between explicit and tacit knowledge. Am. J. Econ. Bus. Admin., 2: 129-135. DOI: 10.3844/ajebasp.2010.129.135

Tinsley, H.E.A. and D.J. Tinsley, 1987. Uses of factor analysis in counseling psychology research. J. Counsel. Psychol., 34: 414-424. DOI: 10.1037/0022-0167.34.4.414

Zucker, L.G. and M.R. Darby, 2001. Capturing Technological Opportunity via Japan's Star Scientists: Evidence from Japanese firms' biotech patents and products. J. Technol. Transfer, 26: 37-58. DOI: 10.1023/A:1007832127813

Zucker, L.G., M.R. Darby and J.S. Armstrong, 1998. Geographically localized knowledge: Spillovers or markets? Econ. Inquiry, 36: 65-86. DOI: 10.1111/j.1465-7295.1998.tb01696.x