An Investigation into the Possible Gaps between the Employers' Needs and Tertiary Courses in Quantitative Subjects

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Abstract

This paper reports the findings of an investigation into the employers' requirements with regard to quantitative skills. The main purpose is to investigate possible gaps between the employers' need and the skills provided by tertiary courses in quantitative subjects and to recommend possible solutions if needed. The surveyed employers were selected randomly from the regional Australia.

In many cases, quantitative modelling approaches can certainly aid managerial decision making to reduce wastage; and increase productivity and profitability. It was discovered that the majority of the surveyed firms however, did not perceive mathematical skills as being important in their decision making activities. A close analysis of the data demonstrated that these industries, regardless of their type, had a preference for graduates with practical skills in quantitative subjects. Hence, this lack of interest by the employers for quantitative tools and techniques could be due to the nature of materials and teaching approaches adopted in tertiary courses.

Key words: Employers' Needs, Quantitative, Statistical Forecasting.

Introduction

The establishment of universities can be traced back to the Middle Ages. Initially, these institutions were either ecclesiastical or had royal links. Some of the oldest universities in Europe include Oxford, Cambridge and Paris; these were established sometime in the 12th Century. Until the late 19th Century, women were not allowed to enter universities, and most of the medieval universities were developed to educate young men in law, religion and medicine. Hence, there was an attempt by these ancient universities to meet the needs of the society at a higher and different level. For centuries, universities have continued to supply the needs of the society through their courses and research output.

Unlike the ancient times however, we now live in a world which has different needs and demands. Overpopulation and pollution were not considered as important

issues in the ancient world. We live on a planet with a mere diameter of just over 12,000 Km! Yes, that's all we have, but it is not difficult to get the feeling that we live on a flat piece of land, which extends to infinity in every direction. So, let us remember that every small piece or amount of material obtained from Mother Earth is valuable. With this kind of awareness, we will be able to accept and embrace the concept of resource constraints in our production and consumption activities. Hence, we have no choice but to minimize wastage and maximize efficiency when it comes to resources. Mathematical modeling techniques can be invaluable in management of our scarce resources.

This study is an effort to determine the extent to which the quantitative techniques taught at a tertiary level are used by businesses. The next sections present findings and analyses of the data collected from a randomly selected sample of firms in regional Australia.

Employers' Needs and Expectations

Many industries have become aware of their needs and have started to adjust their requirements in terms of employee skills. The concept of "employability" and how that translates into tertiary course development has become a major topic throughout the world. The European community is developing benchmarks for course design through their Quality Assessment Agency (QAA). In South Africa a Chief Research Specialist for the Human Sciences Research Council includes in her paper that "The tacit skills, knowledge, and attitudes formerly developed through work experience are now expected to be an integral part of higher education programmes and curricula…" (Kruss, 2004, p.673). An Australian study (Department of Education, Science and Training 2002, Employability Skills for the Future) was funded by the Department of Education, Science and Training (DEST) and the Australian National Training Authority (ANTA). The purpose of that review was to obtain industry's view of what constituted "employability" and that these findings be provided to the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), the Australian Vice-Chancellors' Committee (AV-CC) the National Training Quality Council (NTQC) for review and implementation.

It can be argued that the employers are the ultimate customers of the educational institutes. Hence, their needs and expectations should be taken into consideration.

As an initial study, a sample of 50 organisations representing both goods producing and service providing industries were randomly selected from the Darling Downs Region (in and around Toowoomba) of Queensland in Australia. Most (90%) of these industries employed less than 100 employees. Data collection was carried out by telephone and a specially designed brief questionnaire was completed during each call. The questions aimed to identify the applicability of quantitative Production and Operations Management techniques favoured and utilized by these industries.

Results and Discussion

(1) Comparison of the types of company in terms of number of people employed

According to the findings, the service providing companies employ fewer people than the goods producing companies (Table 1). Approximately 85 percent of the service providing companies have less than 10 employees and none has more than 30 employees. On the other hand, over 34 percent of the goods producing companies have more than 30 employees. A Chi-Squire test has indicated that there is a significant difference between the company type and the number of people employed (χ^2= 8.779, p-value=0.032).

Table 1: Comparison of types of company in terms of number of people employed

			Types of Company		Total
			Goods Producing	Service Providing	
Number of people employed	<10	Count	11	11	22
		% within Types of Company	37.9%	84.6%	52.4%
	10-30	Count	8	2	10
		% within Types of Company	27.6%	15.4%	23.8%
	30-100	Count	6	0	6
		% within Types of Company	20.7%	.0%	14.3%
	>100	Count	4	0	4
		% within Types of Company	13.8%	.0%	9.5%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square= 8.779, p-value=0.032

(2) Comparison of types of company in terms of frequency of statistical forecasting methods (SFM) used for planning

More than 17 percent of the goods producing companies 'quite often' use statistical forecasting methods (SFM) for planning. On the other hand, no service providing company has reported the use of SFM as quite often. Just over 46 percent of the service providing companies and 24 percent of the goods producing companies 'sometimes' use SFM for planning. However, the majority of both types of companies have never used SFM for planning. There is a considerable heterogeneity among the service providing companies in terms of applying SFM for planning and so is the case among the goods producing companies (Table 2). However, while applying the Chi-Squire test it is revealed that there is no significant difference between the types of companies and frequency of SFM used for planning (χ^2=3.683, p-value=0.159).

Table 2: Comparison of types of company in terms of frequency of SFM used for planning

			Types of Company		Total
			Goods Producing	Service Providing	
Frequency of SFM used for planning	Often	Count	5	0	5
		% within Types of Company	17.2%	.0%	11.9%
	Sometimes	Count	7	6	13
		% within Types of Company	24.1%	46.2%	31.0%
	Never	Count	17	7	24
		% within Types of Company	58.6%	53.8%	57.1%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square= 3.683, p-value=0.159

(3) Comparison of the type of company in terms of frequency of Mathematical Programming Techniques (MPT) used for resource allocation

Around 70 percent of both types of companies 'rarely' used MPT for resource allocation. Less than 21 percent of the goods producing and 8 percent of the service providing companies 'quite often' use MPT for resource allocation. The percentage of 'sometimes used' category for the service providing companies is higher than that of the goods producing category (Table 3). However, Chi-Squire test shows that there is no significant difference between the types of company and frequency of MPT for resource allocation (χ^2= 2.897, p-value=0.235).

Table 3: Comparison of types of company in terms of frequency of MPT for resource allocation

			Types of Company		Total
			Goods Producing	Service Providing	
Frequency of MPT used for resource allocation	Often	Count	6	1	7
		% within Types of Company	20.7%	7.7%	16.7%
	Sometimes	Count	2	3	5
		% within Types of Company	6.9%	23.1%	11.9%
	Rare	Count	21	9	30
		% within Types of Company	72.4%	69.2%	71.4%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square= 2.897, p-value=0.235

(4) Comparison of types of company in terms of importance of Systematic Prediction Methods (SPM)

In a five scale mapping, it is revealed that the perception of the importance of systematic prediction methods (SPM) is 'very low' in the majority of cases for both types of companies. In comparison to service providing companies the importance is

slightly higher than that of goods producing companies in which around 7 percent companies are in 'very high' category whereas this category is nil among the service providing companies (Table 4). However, the percentage of companies in the 'high' importance category is greater for the service providing companies (15.4%) than for the good producing companies (6.9%). A Chi-Squire test has revealed that there is no significant difference between the types of company and the perception towards the 'scales of importance' of SPM (χ^2=2.824, p-value=0.588).

Table 4: Comparison of types of company in terms of importance of SPM

			Types of Company		Total
			Goods Producing	Service Providing	
Importance of Systematic Prediction Methods	Very Low	Count	15	7	22
		% within Types of Company	51.7%	53.8%	52.4%
	Low	Count	2	2	4
		% within Types of Company	6.9%	15.4%	9.5%
	Moderately high	Count	8	2	10
		% within Types of Company	27.6%	15.4%	23.8%
	High	Count	2	2	4
		% within Types of Company	6.9%	15.4%	9.5%
	Very high	Count	2	0	2
		% within Types of Company	6.9%	.0%	4.8%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square= 2.824, p-value=0.588

(5) Comparison of types of company in terms of importance of mathematical programming techniques (MPT)

In a five scale mapping of the perception towards the importance of Mathematical Programming Techniques (MPT), approximately 77 percent of the service providing companies have stated either 'very low' or 'low' importance. The percentage of the goods producing companies in these categories however, is only 55 percent. About 15 percent of the service providing companies has stated 'high' importance whereas this category is nil for the goods producing companies. However, approximately 24 percent of the goods producing companies have stated 'very high' importance of MPT but this category is nil in service providing companies (Table 5). The Chi-squire test illustrates that there is a significant difference between the types of company and the importance of mathematical programming techniques (χ^2=9.490, p-value=0.05).

Table 5: Comparison of types of company in terms of importance of MPT

			Types of Company		Total
			Goods Producing	Service Providing	
Importance of Mathematical Programming Techniques	Very Low	Count	14	8	22
		% within Types of Company	48.3%	61.5%	52.4%
	Low	Count	2	2	4
		% within Types of Company	6.9%	15.4%	9.5%
	Moderately high	Count	6	1	7
		% within Types of Company	20.7%	7.7%	16.7%
	High	Count	0	2	2
		% within Types of Company	.0%	15.4%	4.8%
	Very high	Count	7	0	7
		% within Types of Company	24.1%	.0%	16.7%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square= 9.490, p-value=0.05

(6) Comparison of types of company in terms of importance of mathematical modeling in decision making

Nearly 54 percent and 48 percent of the service providing and good producing companies respectively rated ‘very low’ in the five scale rating of importance of mathematical modeling in decision making. However, there is a significant difference between the types of company in ‘high’ and ‘very high’ rating categories. Around 21 percent of the goods producing companies have rated either ‘high’ or ‘very high’ importance while this category is nil in the service providing companies (Table 6). The Chi-Squire test has revealed that there is no significant difference between the types of company and the perception on the importance of mathematical modeling in decision making (χ^2=3.528, p-value=0.474).

Table 6: Comparison of types of company in terms of importance of mathematical modeling in decision making

			Types of Company		Total
			Goods Producing	Service Providing	
Importance of mathematical modeling in decision making	Very Low	Count	14	7	21
		% within Types of Company	48.3%	53.8%	50.0%
	Low	Count	4	2	6
		% within Types of Company	13.8%	15.4%	14.3%
	Moderately high	Count	5	4	9
		% within Types of Company	17.2%	30.8%	21.4%
	High	Count	4	0	4
		% within Types of Company	13.8%	.0%	9.5%
	Very high	Count	2	0	2
		% within Types of Company	6.9%	.0%	4.8%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square=3.528, p-value=0.474

(7) Comparison of types of company in terms of perception on skills of the university graduates

A majority of the goods producing companies (59%) recognized that the university graduates are in possession of suitable practical skills but in contrast to this, most of the service producing companies (69%) expressed that the university graduates do not exhibit these skills. Despite this large difference in figures, the Chi-Squire test has shown that there is no significant difference between the types of company and their perception on the skills of the university graduates (χ^2=2.785, p-value=0.095). It should be noted that comments and feedback provided by a number of interviewed firms have indicated the need for practically oriented mathematical skills. It is acknowledged that the universities, traditionally, have a responsibility in maintaining the rigorous and theoretical standards. They should also aim to incorporate practically oriented skills in a balanced manner.

Methods of teaching quantitative subjects have certainly been influenced by modern computing (multimedia and online). They will change even more dramatically in the years to come. One thing however remains the same; and that is the ability of the teacher to convey the underlying concepts to the learner. This can even be achieved by using traditional and very practical aids such as a flexi-curve. The main purpose is to make it possible for the learner to build new meanings without simply memorizing pieces of information received from the teacher. Hence, the student will be able to adopt or customize methods to suit the problems in the real world. The ability to adapt and adjust in response to the requirements of the modern world will certainly help with meeting the employers' needs. Ironically, Plato as an ancient scholar also believed that knowledge should be acquired via a process of

criticism and questioning without compulsion. In modern time, we refer to this method as reflective learning.

Hovis and Hovis (2004) discuss the recommendations of a project on ways of satisfying the traditional needs of mathematics education with a view to responding to the technical challenges in an emerging technologies era. Recent research findings indicate that students prefer and benefit from visually rich methods of teaching in quantitative subjects. For details see Nooriafshar et al (2004); and Nooriafshar and Todhunter (2004). It is interesting to note that the use of analogies and visuals in teaching materials are identified as ways of encouraging learners to become "whole-brained", see Funderstanding (n.d.). In other words, the right brain is invoked through creative activities such as the visual features. Hence, we would not just use the part of the brain which is referred to as "50% of the brain's mighty toolkit" by Buzon (2002).

The constructivist approach to learning is also an effective way of conveying the underlying concepts to students. Constructivism encourages the learner to construct their own meanings rather than simply memorizing someone else's. It should be remembered that the general concept of "constructivism" is quite simple and practical and the underlying theory, perhaps, goes back to the Socratic times. The concept of guiding and leading the learner to find out the solution or the right answer to a problem was discussed by Plato (the ancient scholar) almost 2400 years ago. If we analyse Plato's famous "dialogue" Meno, we will realise that Socrates demonstrates to Meno how a mathematically ignorant person solves a geometrical problem through a controlled guidance procedure rather than being told directly. For an appropriate definition of learning under constructivism see Bruner (n.d.) who considers learning as an active process in which the new ideas or concepts are constructed based on the existing ones. Teaching mathematics thematically, which is also based on constructivist ideas, is reported by Handal and Bobis (2003).

It should be noted that a rich learning environments such as an interactive multimedia would also satisfy a major objective of the constructivist approach (Phillips, 1998). See Bruner (n.d.), Dougiamas (1998) and Mahoney (2004) for some examples of an introduction to constructivism.

Table 6: Comparison of types of company and in terms of perception on skill of university graduates

			Types of Company		Total
			Goods Producing	Service Providing	
University graduate got good skill	Yes	Count	17	4	21
		% within Types of Company	58.6%	30.8%	50.0%
	No	Count	12	9	21
		% within Types of Company	41.4%	69.2%	50.0%
Total		Count	29	13	42
		% within Types of Company	100.0%	100.0%	100.0%

Chi-Square=2.785, p-value=0.095

Conclusions

This paper has reported on the regional goods producing and service providing companies in terms of their quantitative skills needs and expectations. The results have shown that there is no significant difference between the types of company, except in a few minor cases, with regard to their needs. The implication of these results is that, in general, no further investigation and analysis with regard to the company type is necessary in regards to regional studies.

It was revealed that the surveyed employers, in general, do not place a high degree of importance on the use of quantitative methods for their planning and decision making. This attitude could be due to the fact that the graduates do not possess the necessary practical skills required by the employers in question. This finding is supported by the fact regardless of the nature of the company; industries appear to have a common thinking towards their needs and tertiary courses in quantitative subjects. They have a preference for graduates with skills to meet their practical needs. In order to verify and validate the overall applicability of this finding, a further investigation at the metropolitan level will be completed.

Finally, it is recommended that additional practical features should be incorporated into the quantitative courses in such a way that the underlying theories and concepts are not compromised. As suggested in discussions, research has indicated that visually rich teaching materials and environments would enhance teaching and learning.

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