

ENTREPRENEURIAL SKILL DEVELOPMENT NEEDS OF POTENTIAL AGRI-BASED TECHNOPRENEURS

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ABSTRACT

This study aims to identify the entrepreneurial traits which distinguish current technopreneurs from potential technopreneurs in agri-based technologies, with the end view of developing these traits among the latter. The study's respondents were as follows: 6 current technopreneurs, 18 technology developers-researchers and 88 Bachelor of Science in Agribusiness Management and College of Agriculture students, specifically B.S. in Food Science and Animal Science students. Descriptive statistical tools (i.e., frequency counts, means and cross-tabular analysis) were used to analyze the data. The Personal Entrepreneurial Competency (PEC) scores of the respondents were also determined. Analysis of Variance (ANOVA) and T-test analyses were further employed in order to determine the significance of differences in mean scores across PEC traits among the different respondent groups. Results show that technology developers and students in the University of the Philippines Los Baños (UPLB) significantly differed from current technopreneurs in terms of opportunity seeking, risk-taking and self-confidence. There was also an observed lack of networking and negotiation skills among the technology developers and students and even among the current technopreneurs. It is recommended that the UPLB Agriculture, Forestry and Natural Resources (AFNR) project and other entrepreneurship-related programs should focus on enhancing the aforementioned competencies among UPLB technology developers and students. Emphasis on the development of these traits through the institutionalization of new courses and training programs and/or the improvement of existing courses and programs and teaching and training methodologies should be done.

Key words: technopreneurship, personal entrepreneurial competencies (PECs), agricultural technologies

INTRODUCTION

In recent years, developments in Information and Communication Technology (ICT), biotechnology, engineering, and other science & technology (S&T)-based areas have captured the attention of the business sector. Such developments have led to the increasing popularity of the concept of technopreneurship. Technopreneurship is a synergized term formed from the words "technology" and "entrepreneurship" (Gonzales, 2008). It involves venturing into high technology areas such as agri-related technologies which include those for crop and varietal improvement; crop production; dairy processing and products; feeds and animal nutrition; germplasm conservation and tissue culture; pest management; plant breeding protocols; and agricultural biotechnologies (UPLB, 2011).

Technopreneurs are therefore those who make money out of existing or new technologies which may or may not have been developed by the themselves. The best candidates for technopreneurship, especially in the area of agricultural technologies, are researchers as well as students with science and technology background. In recent years, the enrolment in agriculture, fisheries and natural resources (AFNR) courses in many state universities and colleges (SUCs) has been on a downtrend. The enrollment in AFNR-related fields has declined by 6.2% from 1998 to 2007. About 41% of AFNR graduates were unemployed. Entrepreneurship or more specifically, technopreneurship, is thus being considered as a viable career option for AFNR students and graduates (Camacho et al. 2010). However, engaging in technopreneurship is still not prevalent in the country. In the University of the Philippines Los Baños (UPLB), only 5 biotechnologies out of the 31 (or 16%) have been commercialized through licensing and marketing agreements between UPLB and private institutions (Nepomuceno, 2008). One possible reason behind this is that those in the generally academe do not possess an entrepreneurial mindset. An entrepreneurial mind or mindset can be described as “the attitudes and behavior of successful entrepreneurs” (Virtanen, 1997).

This study aimed to identify the entrepreneurial traits which distinguish current technopreneurs from potential technopreneurs in agri-based technologies, with the end view of developing these traits among the latter. It specifically aims to: 1) determine the socio-demographic and entrepreneurial profile of current technopreneurs and UPLB technology developers and students; 2) determine the entrepreneurial skill needs of the technology developers and students; and 3) suggest courses of action that would enhance the entrepreneurial skills of the potential agri-based technopreneurs in UPLB. The study can provide valuable inputs for the design of trainings, courses, and curricular programs which can promote and lead to the development of technology-based entrepreneurship in UPLB and other SUCs.

The Entrepreneurial Mindset and Traits

The mainstream of ‘people school’ research refers to the so-called ‘trait approach’ to explain both entrepreneurial intentions and entrepreneurial success. This approach stresses that an individual having ‘entrepreneurial characteristics’ always finds the path to entrepreneurship regardless of environmental conditions. The most widely used traits linked to entrepreneurial inclination are the need for achievement (McClelland, 1961) and the locus of control (Rotter, 1966; Levenson, 1973). Tolerance of ambiguity and creativity have also often been linked to entrepreneurship. Lastly, Bateman and Grant’s (1993) proactive personality has been cited as a promising determinant of entrepreneurial behavior (Vesalainen and Pihkala, 2000).

Entrepreneurs were found to be higher in achievement motivation, risk-taking propensity, and preference for innovation than small business owners, and corporate managers (Stewart et al. 1998). The “Jack-of- all-Trades” theory of entrepreneurship (Lazear, 2005) asserts that successful entrepreneurship requires a wide range of general abilities. Baumol et al. (2009) found that inventors were most likely to have engineering backgrounds; entrepreneurs only were still fairly likely to have their degree in engineering but were also significantly more likely to have a degree in business; and individuals who were both inventors and entrepreneurs similarly again came overwhelmingly from engineering backgrounds. Bioentrepreneurs (or technopreneurs) are able to translate their inventions into products/solutions that could be of use to consumers and convert these into viable businesses. Scientists must make a conscious transition to be a bioentrepreneur (or technopreneur) with the following intangible attributes to win in business - adaptability, emotional intelligence, confidence, ambition, persistence, risk-taking, humility, flexibility and patience (Ella, 2009). Scientists, though well- trained in technologies and their discipline are missing a set of skills, which handicaps them both in academic and for-profit environments (Cohen, 2009). In the Philippines, Madarang (2007) compared a typical entrepreneur with a high-expectation entrepreneur/

technopreneur. The latter has wider social networks, is innovative and technology-savvy, knows people who have business, sees good opportunities for entrepreneurship, is confident in his/ her skills, has knowledge to start a business, and has lower risk aversion or fear of failure.

In the attempt to profile the mindset and behavioral traits of entrepreneurs, a set of qualities has been evolved by behavioral scientists and is collectively called Personal Entrepreneurial Competencies (PECs). A research by McClelland identified 14 personal entrepreneurial competencies (PECs) which appear to characterize the behavior of successful entrepreneurs. The study also found that these PECs transcended culture, country and continent. These competencies were grouped into 3 main clusters and the EMPRETEC model has merged some of these competencies to derive 10 PECs: 1) opportunity seeking; 2) persistence; 3) commitment to work contract; 4) risk-taking; 5) demand for efficiency and quality; 6) goal setting; 7) information Seeking; 8) systematic planning and monitoring; 9) persuasion and networking; and 10) self-confidence (Diaz, 1993). These PECs are considered synonymous to entrepreneurial skills as they are translated into actions by an individual and not just remain as traits which passive or mere mental pre-occupations (Diaz et al., 1997). Formal and/ or informal education programs can set up conditions similar or resembling the enterprise culture through lectures, exercises and practical work. Further, entrepreneurship development programs (EDPs) can be specially designed to develop entrepreneurial motivations, attitudes and skills.

METHODOLOGY

The descriptive research design was employed to address the research objectives of the study. Using specially-designed questionnaires, data related to the socio-demographic, enterprise and entrepreneurial as well as the Personal Entrepreneurial Competency (PEC) profile of the following groups of respondents were gathered: current technopreneurs, technology developers and graduating undergraduate students. The PEC questionnaire was developed by the UP Institute of Small-Scale Industries (UP-ISSI) and adapted from the Management Systems International (MSI) and McBer and Company) (Diaz et al. (1997). Data was collected from July to August, 2009. The sample sizes for each group were as follows: current technopreneurs (6), technology developers (18) and students (88). Random selection of graduating undergraduate students (as of A.Y. 2009-2010, Summer 2010, and First Semester of A.Y. 2010-2011) was done. The selection of the majors of the students represented in the sample was based on who were most likely to get involved in the AFNR short courses and mentoring components, considering the technology tracks (i.e., functional fruit juice, cheese and microbial rennet) of the project. The final student sample included 39 B.S. in Agribusiness Management students and 49 College of Agriculture students, specifically 32 B.S. in Food Science and 17 Animal Science majors.

As for the UPLB technology developers, lists of the researchers in the agricultural research and development (R & D) units of UPLB (i.e., UPLB BIOTECH, the Institute of Plant Breeding, and the College of Agriculture (Dairy Science and Food Science clusters) were obtained. Random sampling was then conducted which yielded a total of 18 respondents. Lastly, for the current technopreneurs, UPLB's list of Science and Technology Park (UPLB-STP) tenants was referred to. Agri-based technopreneurs in Laguna, Philippines were also pre-identified. The final sample of 6 consisted of those who had been engaged in agri-based technopreneurial ventures for at least two years.

Descriptive statistical tools such as frequency counts, means and cross-tabular analysis were used in analyzing the data. There was also content analysis done of qualitative information gathered through open-ended questions from key informants like their view of technology-based entrepreneurship and the hindrances to engaging in technopreneurship. This enabled the researchers to interpret properly the meaning of qualitative information provided by the respondents.

Personal Entrepreneurial Competencies (PEC) scores were computed after obtaining the respondents' scale ratings (i.e., 5 – Always; 4 – Usually; 3 – Sometimes; 4 – Rarely and 1 – Never) to 55 brief statements. The score per PEC trait was computed by adding the scores in items associated with a PEC and adding a constant (6) (Diaz, et. al., 1997). Lastly, analysis of variance (ANOVA) and T-test analyses were done in order to determine the level of significance of the difference in mean scores across PEC traits among the different respondent groups.

RESULTS AND DISCUSSION

Socio-demographic profile of current technopreneurs

The six current technopreneurs interviewed had an average age of 56.5 and most were between 60-69 years old. There were three male and three female respondents who were all married. There were Ph.D. holders (2) in Food Science and Genetics and M.S. holders (2) in Food Dairy Science and Entomology. In addition, one was a B.S. graduate (Mechanical Engineering) and another did not finish his B.S. but who had spent two years in college as an Agriculture student major in Plant Pathology. Half of the respondents were also full-time employees. The mean number of children of the 5 respondents who had children was 2.2 (Table 1).

Table 1. Summary of the socio-demographic profile of current technopreneur-respondents.

Socio-Demographic Variable	Mode	Frequency (n=6)	Percentage (%)	Mean
Age	60-69	3	50	56.5
Gender	Male	3	50	
	Female	3	50	
Marital Status	Married	6	100	
Highest Educational Attainment	Ph.D.	2	33	
	M.S.	2	33	
	B.S.	1	17	
Currently Employed	Yes	3	50	
	No	3	50	
Number of children	1-2	3	50	
	3-4	2	33	2.2

Profile of the entrepreneurs and their enterprises

The profile of the entrepreneur and their enterprises show that two technopreneurs were engaged in the production of microbial-based biofertilizers/ compost and the rest (one each) were engaged in the processing of the following products - virgin coconut oil (VCO), improved dairy products, biofuel-related, specifically coco-methyl ester (CME), and probiotic feed supplements (Table 2). Three claimed that technopreneurship is the same as entrepreneurship. The same number (3) contended that the former is not different from the latter. Two (33%) claimed that they were not aware of technopreneurship. Half of the respondents' businesses (50%) had been existing for not more than 5 years and required initial capital investments of above Php 500,000.00 to Php 5 M. According to all of the respondents, their capital was acquired through their own initiative. Some of

them had partners, government and private support, while only one of them depended on a loan for the establishment of his business. Most of the respondents' businesses (83%) catered to domestic markets with one distributing to as far as Davao. One technopreneur claimed that her products reached as far as China. The techno-ventures reported selling to farmers, other distributors, and direct customers.

Table 2. Enterprise and entrepreneurial profile of current technopreneur-respondents.

Variable	Category/ Mode	Frequency (n=6)	%
Technologies	Microbial-based fertilizer/ compost	2	33
	Virgin coconut oil	1	17
	Improved dairy products	1	17
	Biofuel product (CME)	1	17
	Probiotic feed supplement	1	17
Is technopreneurship different from entrepreneurship?	Yes	3	50
	No	3	50
Awareness of technopreneurship	Very much aware	2	33
	Not aware	2	33
Existence of business	1-5 years	3	50
	6-10years	1	17
	>10 years	2	33
Initial capital investment	< 50,000	1	17
	50,000- 500,000	2	33
	>500,000-5M	3	50
Financing means	Self-financed	6	100
Geographic reach	Domestic	5	83
	International	1	17
Involvement in the developed of a technology	Yes	6	100
Sources of business ideas*	Technology developers	3	50
	Family members	3	50
Motivating Factors*	Commercialable technology	3	50
	Technical background	2	33
Attendance in business trainings/ seminars	Yes	3	50
	No	3	50
Future Plan	Market expansion	5	83

*multiple responses given

All of the respondents were involved in developing a technology. However, not all technologies were commercialized into business. Those who were formerly involved in developing technologies were more likely to utilize personally- developed new technologies. They however received support from various institutions such as Philippine Rice Research Institute (PhilRice), UPLB, Fertilizer and Pesticide Authority (FPA), and Department of Science and Technology (DOST)

in the development of their own technologies. Among the six respondents, only one claimed to be utilizing a patented technology. The sources of business ideas cited (50% each) were technology developers, who shared information related to product development, market opportunities, and potential applications, and family members. Some technopreneurs also mentioned that their children, who had some knowledge in business management, also shared with them additional knowledge on handling and operating businesses.

The frequently-cited motivating factors behind their starting a business include: 1) having a commerciable technology (50%); and 2) having a technical background (33%). One added that she considers obtaining extra income as a motivation. Not all had been exposed to any seminar or training related to business management. Half of the respondents (50%) claimed that they did not attend any training or seminar on business management. The remaining half indicated that they had attended seminars sponsored by government agencies like the Department of Science and Technology (DOST) and other private institutions. As for their future plans, all of the practicing technopreneurs were more concerned with market expansion.

Socio-demographic profile of technology developers

The socio-demographic profile of the 18 technology developers are in Table 3. They were mostly aged 50-59. Most of them were married (72%) and had 3 to 4 children (62%). Majority had Ph.D degrees (72%) in Food Science, Microbiology, Applied Microbiology, Chemistry, Biochemistry, and Plant Breeding. There were also some with M.S. degrees (22%) in Food Science, Animal Science and Soil Science. Interestingly, there was a technology developer who had a Bachelor of Arts (B.A.) in English. Finally, most (83%) were working full-time as researchers with UPLB.

Table 3. Socio-demographic profile of technology developer-respondents.

Socio-Demographic Variable	Mode	Frequency (n=18)	%
Age	50-59	11	61
Gender	Female	14	78
Marital status	Married	13	72
Highest Educational Attainment	Ph.D.	13	72
	M.S.	4	22
	B.A.	1	6
Employment status	Full-time	17	94
Occupation	Researcher	15	83
Number of children	1-2	5	39
	3-4	8	62

Entrepreneurial profile of technology developers

Table 4 presents the entrepreneurial profile of the technology developers interviewed. The technologies which the respondents were involved in developing were food and food ingredient products (56%), microbial-based fertilizers and growth promoters (22%), improved plant varieties (11%), and hydroponics (11%). Majority of the technology developers (83%) were not currently engaged in any form of entrepreneurship. Most of them (72%) believed that entrepreneurship is a

different concept from technopreneurship. For them, the term technopreneurship is a kind of business that is technology-based. Other definitions of technopreneurship given include a “business that produces and offers new technologies for the consumers”, “the process of commercializing the technology per se but not necessarily being involved in venturing into any business”, and “the act of owning a new technology and the process of technical/ product improvement alone”.

In terms of awareness of technopreneurship, 33% of the respondents claimed they were somewhat aware while most (39%) said that they were not very aware of technopreneurship. It is interesting to note that although the technology developers expressed that there was a difference between the concepts of entrepreneurship and technopreneurship, they did not actually have a clear idea of the difference between the two concepts. About 44% each learned about technopreneurship from other technology developers as well as from seminars. Other popular sources of information on technopreneurship included professors/ schools (3%).

Table 4. Entrepreneurial profile of technology developer-respondents.

Variable	Category	Frequency (n=18)	%
Technologies Developed	Food and food ingredient products	10	56
	Microbial-based fertilizers/ growth promoters	4	22
	Improved plant/ Fruit varieties	2	11
	Hydroponics	2	11
Engaged in entrepreneurship	No	15	83
	Yes	13	72
Is technopreneurship different from entrepreneurship?	Somewhat aware	6	33
	Not very aware	7	39
Source of information on technopreneurship*	Technology developers	8	44
	Professors/ School	7	39
	Seminars	8	44
Motivational Factors*	Commerciable technology	11	61
	Technical background	10	56
	Additional income	9	50
Perceived Hindrances*	Lack of money for capital requirements	5	28
	Too time and effort- consuming	5	28
	No knowledge in business management and entrepreneurship	4	22

*multiple responses given

Interest in venturing in technopreneurship among the technology developers was quite high. Majority (83%) expressed interest in venturing in a technology-based business. Most of them cited as primary motivating factors their having developed a commerciable technology (61%) and technical knowledge in certain technical aspects which can be used to venture into business (56%). Another most - frequently cited motivating factor was the desire to earn extra income (50%). One respondent

cited her voluntary services to the country by offering her technology to the farmers. Interestingly, none of the technology developers considered having an entrepreneurial family background as well as the availability of money for investment as a motivating factor. While a substantial number expressed interest in engaging in technopreneurship, there were some perceived hindrances to engaging into technology-based business. These include: 1) lack of money for capital requirements (28%); 2) a technopreneurial venture being too time and effort-consuming (28%); and 3) lack of knowledge in business management/ entrepreneurship (22%). The second hindrance may be because of a reason cited by one researcher – their being overloaded with work assignments. One also added that a business entails too much risk. Some of the respondents admitted that they were also discouraged from engaging in technopreneurship due to the slow process of technology commercialization in the university and the lack of incentives given to the technology developers. In relation to the latter, only 33% royalty is given to the technology developers in UPLB whose technologies have been commercialized by the university.

Socio-demographic profile of B.S. in Agribusiness Management and Agriculture students

The survey included 39 students in the B.S. in Agribusiness Management (B.S. ABM) majors and 49 students from the College of Agriculture (CA). The CA students were comprised of 32 food science and 17 animal science majors. The average ages of the B.S. ABM and CA students were 19.6 and 19.8 years, respectively. In both groups, the majority were female. The mean number of remaining units of the students was 15.4 for the B.S. in ABM (Tables 5) and 23.0 for the B.S. in Agriculture students (Tables 6).

Table 5. Socio-demographic variables among BS in Agribusiness Management majors.

Socio-Demographic variable	Mode	Frequency (n=39)	%	Mean
Gender	Female	21	54	
Age				19.6
Remaining units				15.4

Table 6. Socio- demographic profile of BS in Food Science and Animal Science students.

Socio-demographic variable	Mode	Frequency (n=49)	%	Mean
Course	Food Science	32	65	
	Animal Science	17	35	
Gender	Female	32	65	
Age				19.8
Remaining units				23.0

The entrepreneurial profile of the BS in Agribusiness Management and the CA students composed of food science and animal science majors are contained in Tables 7 and 8. All students were currently not engaged in any entrepreneurship undertaking. It is interesting to note that majority (69%) of the B.S. ABM majors claimed that technopreneurship is different from entrepreneurship but the opposite was true in the case of the Agriculture students. For more than half (59%) of the latter group, these two concepts were not different. Majority of the B.S. ABM students (62%) claimed they were only somewhat aware while a significant number of the Agriculture majors contended that they were not very aware (35%) and not aware (31%) of the concept of technopreneurship.

Table 7. Entrepreneurial profile of B.S. in ABM majors.

Variable	Mode	Frequency (n=39)	%
Engagement in entrepreneurship	Not engaged	39	100
Is technopreneurship different from entrepreneurship?	Yes	27	69
Awareness of technopreneurship	Somewhat aware	24	62
Source of technopreneurship information*	Professors/ School	33	85
Interest in technopreneurship venture	Yes	30	77
Motivating Factor*	Additional income	23	59
Perceived Hindrances*	Lack of money for capital requirements	14	36
	Lack of technical background	13	33

* multiple responses given

Table 8. Entrepreneurial profile of B.S. in Food Science and Animal Science students.

Variable	Mode	Frequency (n=49)	%
Engagement in entrepreneurship	Not engaged	47	96
Is technopreneurship different from entrepreneurship?	No	29	59
Awareness	Somewhat aware	14	29
	Not aware	15	31
	Not very aware	17	35
Source of technopreneurship information*	Television	21	43
	Internet	18	37
	Professors/ School	16	33
Interest in technopreneurship venture	Yes	29	59
Motivating factor*	Additional income	23	47
Perceived hindrances*	Lack of money for capital requirement	23	47
	Lack of technical background	15	31

*multiple responses given

While most the B.S. ABM majors (85%) got their knowledge on technopreneurship from professors/ school, the CA students derived their information from the television (43%), the Internet (37%), and professors/ school (32%). For both groups, there was a high degree of interest in engaging in a technopreneurship venture. The primary motivating factor cited by the respondents in both groups was additional income. There was also a similarity in terms of the perceived hindrances to venturing into a techno-enterprise undertaking. These were the lack of money for capital and lack of technical background. The latter perceived hindrance was an unexpected answer from the CA students, who were assumed to be more immersed in technical courses.

Personal Entrepreneurial Competencies (PEC) analysis

The PEC questionnaire is a standard list of questions to be able to identify the strength of one's capability to engage in an entrepreneurial venture. This measures the degree of possession of the following traits: opportunity-seeking, persistence, commitment to work contract, demand for quality and efficiency, risk taking, goal setting, information seeking, systematic planning, persuasion and networking, and self- confidence. Although it is recognized by the researchers that some characteristics of a technopreneur may be different from that of a traditional entrepreneur, the standard PEC questionnaire was still used to determine the PEC levels of the current technopreneurs, the technology developers, and the students for lack of any other reliable and more superior entrepreneurial competency measurement instrument. PEC scores can be generally be interpreted as follows: 19 and above – strong; 16-18 – moderate; and 15 and below – weak.

The current technopreneurs were found to be strong in the PEC traits of Opportunity Seeking (19.8), Information Seeking (19.5) and Self-confidence (19.0). They were also found to have a substantial difference vis a vis the other groups in terms of Opportunity Seeking, Risk-taking and Self-confidence. On the other hand, the technology developers posted the highest mean score in the area of Systematic Planning and Monitoring (18.7). Lastly, among the four groups, the B.S. ABM students rated the highest in terms of Goal-setting (18.4). The technology developers were found to be somewhat weak in the area of Persuasion and Networking (15.1). All groups however were found to similarly rate low in this trait (Table 9). In general, there were no considerable discrepancies between agribusiness majors and agriculture students in terms of PEC scores. The agribusiness majors, though consistently manifesting slightly higher mean scores as compared to the agriculture students in most of the PECs had a lower mean score in Opportunity-seeking (15.7).

Table 9. PEC scores among current technopreneurs, technology developers and students.

PEC Trait	Current Technopreneurs (n=6)	Technology Developers (n=18)	Students		
			B.S. ABM students (n=39)	CA students (n=49)	Total students (n=88)
Opportunity seeking	19.8	16.7	15.7	16.1	16.0
Persistence	18.8	17.6	17.7	17.0	17.4
Commitment to work contract	16.7	17.7	17.2	16.9	17.1
Demand for quality/ efficiency	16.7	17.1	17.0	16.9	17.0
Risk – taking	18.7	16.2	16.4	15.9	16.1
Goal setting	17.7	17.8	18.4	17.5	17.9
Information seeking	19.5	18.8	18.1	18.1	18.1
Systematic planning and monitoring	18.3	18.7	17.6	16.7	17.2
Persuasion and networking	16.2	15.1	15.8	15.8	15.9
Self-confidence	19.0	17.0	16.3	15.8	16.0

Determination of differences in the mean PEC scores across groups

An ANOVA analysis was done to determine if there is a difference in the mean PEC scores across groups (Table 10). In the first ANOVA run, all the student-respondents were considered to comprise one group while in the second run, the Agribusiness Management students and the Agriculture students were considered as two separate groups. From the first run, the current technopreneur, technology developer and the student groups were found to differ very significantly in terms of Opportunity Seeking ($\alpha = .000$) and Self-confidence ($\alpha = .009$). In addition, there was a difference at 5% level of significance among the three groups in the aspects of Risk-taking ($\alpha = .024$) and Systematic Planning and Monitoring ($\alpha = .031$).

On the other hand, separating the 2 sub-groups under the student group under the second run yielded also very significant differences in the mean scores across the four groups in the aspect of Opportunity Seeking ($\alpha = .001$). There was further a significant difference (at 5% level of significance) among the 3 groups in terms of Risk-taking ($\alpha = .030$), Systematic Planning and Monitoring ($\alpha = .015$) and Self-confidence ($\alpha = .016$).

The findings imply that there is a need to further investigate inter-group differences in the PEC traits of Opportunity-seeking, Risk-taking, Systematic Planning and Monitoring and Self-confidence as these are the areas where there appears to be substantial differences across groups. The results of a more in-depth analysis are presented in the next section.

Table 10. Significant PEC traits identified by ANOVA analysis.

PEC trait	Significance (3 groups)	Significance (4 groups)
Opportunity seeking	.000***	.001***
Risk-taking	.024**	.030**
Systematic planning and monitoring	.031**	.015**
Self-confidence	.009***	.016**

** significant at 5% level

*** significant at 1% level

Identification of PECs where potential technopreneurs differ from current technopreneurs

After identifying the PEC traits where significant differences exist across groups, T-test analyses between the current technopreneurs and each of the two other groups (i.e., technology developers and students) were done. This was to determine the specific PECs where significant differences exist between the current technopreneurs, who are considered to possess the critical traits for technopreneurial success, and the potential technopreneur groups.

1. Current Technopreneurs and Technology Developers

Current technopreneurs were found to have a highly significant difference ($\alpha = .006$) over technology developers in terms of Opportunity Seeking. The former's Risk-taking mean score was also found to be significantly different ($\alpha = .032$) from the latter group's mean score at 5% level of significance. Opportunity Seeking is related to creativity that is identifying new ways of doing things, new applications for existing technologies / products, new markets, etc. The technology developers' lower Opportunity Seeking score may be attributed to the technology developers having a full-time workload and other important priorities which prevent them from becoming aware of and taking advantage of business opportunities.

Having a “employee mindset” as well as a “researcher mindset” and not an entrepreneurial mindset may also serve as a hindrance to the technology developer-researchers seizing unusual business opportunities. This may also explain why they also do not rate high in the area of risk-taking. The technology developers also expressed that they are very concerned with possible losses in investments (Table 11) .

Table 11. Significant PEC traits identified by T-test between current technopreneurs and technology developers.

PEC Trait	Mean Scores		Significance
	Current Technopreneurs	Technology Developers	
Opportunity Seeking	19.8	16.7	.006***
Risk-Taking	18.7	16.2	.032**

** Significant at 5% level.

***Significant at 1% level.

2. Current Technopreneurs and Students

Based on the T-test between current technopreneurs and students (BS ABM and CA students combined), the two groups highly differ in terms of Opportunity Seeking ($\alpha = .000$), Risk-taking ($\alpha = .007$) and Self-confidence ($\alpha = .003$) (Table 12). Compared to technopreneurs, students have a lower score in Opportunity Seeking as the students admit that opportunities, especially business-related ones, are still not that commonly encountered by them. As they are more focused on studying, looking for and seizing and acting on business opportunities are not yet included in their list of priorities. Risk-taking involves taking calculated risks while Self- confidence means having a strong belief in one own’s ability to complete a difficult task or to meet a challenge. The students’ age and limited work, life, networking and risk-taking experiences may explain their moderate mean scores in these two traits.

Table 12. Significant PEC traits identified by T-test on current technopreneurs and students.

PEC Trait	Mean Scores		Significance
	Current Technopreneurs	Students	
Opportunity seeking	19.8	16.0	.000***
Risk-taking	18.7	16.1	.007***
Self-confidence	19.0	16.0	.003***

*** Significant at 1% level

3. Current Technopreneurs and BS Agribusiness Majors and BS Agriculture Students

T- tests were also conducted between the current technopreneurs and each of the sub-groups in the student group as the researchers desired to identify the “weak” traits of each sub-group. Consistent with a previous result, both the ABM and the Agriculture students were found to be highly significantly different from the practitioner-technopreneurs in terms of Opportunity Seeking ($\alpha = .000$ for both groups). Both groups’ Self-confidence and Risk-taking mean scores were also found to be significantly different from that of the technopreneur group’s mean scores. In the case of the Agriculture students, their Self-confidence and Risk-taking scores were found to be highly significantly different with $\alpha = .003$ and $\alpha = .008$, respectively. Lastly, the CA students group when

compared with the current technopreneurs was found to exhibit lower levels of Persistence and Systematic Planning and Monitoring at 10% level of significance (Table 13).

Table 13. Significant PEC traits identified by T-test on current technopreneurs, Agribusiness Management majors and Agriculture students.

PEC Trait	Mean Scores			Significance	
	Current Technopreneurs	ABM Students	Agriculture Students	ABM Students	Agriculture Students
Opportunity seeking	19.8	15.8	16.1	.000***	.000***
Persistence	18.8	-	17.0	-	.076*
Risk- taking	18.7	16.4	15.9	.018**	.008***
Systematic planning and monitoring	18.3	-	16.7	-	.085*
Self-confidence	19.0	16.3	15.8	.011**	.003***

* Significant at 10% level
 ** Significant at 5% level
 *** Significant at 1% level

The finding that the agriculture students needed to enhance their Persistence and Systematic Planning and Monitoring skills was quite unexpected. Perhaps, there is just a need to incorporate exercises in their regular coursework which will enable them to develop persistence and also do more regular short- and long-term planning. All the traits identified in the T-tests must be enhanced through specially-designed activities in order to improve the agribusiness and agriculture students' readiness to engage in technopreneurship.

CONCLUSIONS AND RECOMMENDATIONS

It was found that quite a number of the current technopreneurs and the technology developers were in their 60s and 50s, respectively. A substantial number of them had Ph.D. and M.S. degrees in various basic and applied sciences. It is interesting to note though that the technopreneurs, especially those previously connected with UPLB, started to engage in technopreneurship only after they retired or separated from the University. There were also only a few technology developer-researchers who were currently into entrepreneurship and these were not technology-based businesses. Further, not one of the students was currently involved in any capacity in any business venture. These findings imply that there are tremendous opportunities for technopreneurship that are not harnessed, considering that most of the technology developers and students (especially the B.S. in Agriculture students) have the necessary educational background and technical expertise. The findings highlight the need to cultivate an entrepreneurial culture among UPLB's faculty members, researchers and students to fast track the promotion of technopreneurship in UPLB. The view of one technology developer seems to reflect also why only a few are engaging in technopreneurship - her view of technopreneurship is that it is "the process of commercializing the technology per se but not necessarily being involved in venturing into any business." This view reflects the need to emphasize the concept of academic spin-off among the technology developers.

Results show that technology developers and students in the UPLB differed significantly from current technopreneurs in terms of opportunity seeking, risk-taking and self-confidence. There was also an observed lack of networking and negotiation skills among the technology developers and students and even among the current technopreneurs. Further, the food science and animal science majors were also significantly different vis-a-vis the current technopreneurs in terms of persistence and systematic planning and monitoring. There was also an observed lack of networking and

negotiation skills among the technology developers and students as well as even among the current technopreneurs.

The lack of opportunity seeking, self-confidence, risk-taking, networking and negotiation and other critical PEC traits among UPLB's technology developers and students should be addressed by the UPLB AFNR project and future offshoot training programs and/or institutionalized courses and programs in entrepreneurship. The training and business/ technical mentoring components of the project could look into emphasizing the traits that have to be enhanced among the UPLB technology developers and students.

To develop UPLB constituents' PEC traits, business plan competitions, trainings and seminars, investors' forums, exhibits and fairs on agri-based technology-based enterprises and products should be regularly held and participated in by UPLB constituents. Such activities can be coordinated by the UPLB's Center for Technology Transfer and Exchange (CTTE), UPLB's mandated one-stop center for technology commercialization. In addition, business clinics and mentoring activities in coordination with the Department of Agribusiness and Management can also be organized.

It would also do well to have separate trainings, which can be later spun-off into formal undergraduate and graduate courses, for UPLB researchers/ technology developers and AFNR students so that the special needs of each group can be emphasized. Through these trainings and courses, the scientists and students will be exposed to opportunities in agri-technologies, the basics of technology commercialization, the development of entrepreneurial competencies, and the basics of entrepreneurship – cash management, marketing, management systems, etc. This will tremendously boost the technopreneurship knowledge and skills of the UPLB technology developers and students. There should be exercises in the trainings and courses which should develop the PECs where UPLB constituents are weak.

Further research is needed to identify critical PEC traits which will more completely characterize technopreneurs and to develop a PEC instrument more tailor-fitted to measure technopreneurial inclination. Although the UP Institute of Small Scale Industries (ISSI) - developed PEC questionnaire has identified the PEC traits which are possessed to a substantial degree by technopreneurs, the researchers contend that the standard PEC questionnaire still does not fully capture all the necessary technopreneurial traits and skills such as innovativeness and differentiation.

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