Third-generation Business Incubation Practices in Malaysian ICT Incubators – A Bridge Too Far?

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Business incubation is an economic development tool that is widely used to stimulate the growth of small-to-medium sized enterprises (SMEs). The Malaysian government in line with the country's aspirations to become a developed nation by the year 2020, has established its own incubation programs to catalyze the growth of ICT SMEs. This paper examines four constructs of the business incubation process: Selection Performance, Monitoring and Business Assistance Intensity, Resource Allocation and Professional Management Services. A total of 118 incubatees from ICT incubators in Malaysia responded to an online survey questionnaire. Principal component analysis and multinomial logistic regression analysis were used to determine the components of business incubation process and test their relationships with Business Incubation Performance. Results show that all four constructs and their respective components are significant predictors of Business Incubation Performance. The findings provide valuable information for policy-makers, business incubator managers, and potential incubatees regarding better incubation management practices thus driving incubator development towards best-practice, third-generation incubators.

INTRODUCTION

The increasingly important role of business incubation as a useful strategy and effective method to accelerate growth and development of technology-based small-to-medium sized enterprises (SMEs) has been widely acknowledged in the economic and entrepreneurship literature (Aernoudt, 2004; Lee & Yang, 2000; OECD, 1996; Phan, Siegel, & Wright, 2005). Atherton and Hannon (2006) state that incubators are known to accelerate the growth of new businesses and to create significant employment opportunities through the generation of new businesses. Furthermore, international benchmarking studies, such as the Global Entrepreneurship Monitor (GEM) concur with the notion that new businesses, facilitated by incubators, play an important role in advancing a nation's competitiveness through enhanced innovativeness and the exploitation of new knowledge and technology. Additionally, incubators have also been observed to reduce new business failures (Feng-Ling et al., 2004).

This paper examines four constructs of the business incubation process: Selection Performance, Monitoring and Business Assistance Intensity, Resource Allocation, and Professional Management Services and their significance in predicting incubator performance. Principal component analysis (PCA) and multinomial logistic regression analysis were used to first reduce and order the data to a more manageable set and then examine relationships between the four identified constructs and their associated components with the categorical, dependent variable – business incubator performance. Results revealed that all four constructs and individual components of the constructs are significant predictors of business incubation performance. The empirically-based findings in this paper indicate that the current state of play in Malaysian ICT incubators is characterized by small pockets of excellence though overwhelmingly there is room for substantial improvement in the way incubators are organized and managed; in the way incubatees are selected; in the way their progress is monitored, and in the way ICT incubators in Malaysia create and leverage knowledge regarding best practices across the entire industry. The paper proceeds as follows; firstly, a review of the incubation literature is provided, followed by an outline of the methodology adopted regarding data collection and analyses, leading on to presentation of results and discussion. The paper ends with a summary and conclusions.

LITERATURE

The term 'business incubator' has been defined in various ways by researchers in the extant literature. The reason for this variation in defining business incubator could be largely due to the diversity among incubators, their sponsors, and their purposes. This is supported by Voisey *et al.* (2006) who added that the continuous growth in business incubation and the on-going diversification of configurations has led to increased difficulty in defining business incubators precisely.

The National Business Incubation Association (NBIA) in America defines business incubator as 'a business assistance program targeted to start-ups and early stage firms with the goal of improving their chances to grow into healthy, sustainable companies' (Adkins, Sherman, & Yost, 2001). Alternatively, Business Innovation and Incubation Australia (BIIA), defines business incubator as a new hybrid type of economic development facility that combines features of entrepreneurship, business facilitation and real estate development (businessincubation.com.au). The Small Business Council of Australia defines business incubation as 'a systematic approach to new enterprise development which can be described as consisting of five dimensions including enterprise development, a business consultancy network, entrepreneurial synergy, flexible affordable working space and shared office services' (http://www.small businessaustralia.org.au). These dimensions can be generally understood as the purpose, benefit, design and management of business incubators. For this study, the latter definition was adopted as it provides a comprehensive meaning of the term.

The development of business incubation practices has been a subject of significant interest because of its proven ability in stimulating economic growth through job and wealth creation as seen for example in the United States and the United Kingdom. The reported impacts of business incubation have largely been realized in the increased number of SMEs as well as increased competitiveness in new venture creations. Subsequently, business incubators are also known to create employment opportunities (Besser, 1996; Peters, Rice, & Sundararajan, 2004) and have impacted gross domestic product (GDP) of countries such as the US and China (NBIA, 1997). North American business incubators alone have reportedly created more than 250,000 jobs over a ten year period up to 2004 (Peters et al., 2004; Semih & Erol, 2004). Job creation from activities related to business incubation is an indicator of the positive growth in economic performance in some parts of the world. Various agencies from the public and private sectors as well as research institutes and universities have taken keen interest in business incubation, leading to an increasing breadth of literature on the subject (CSES, 2002; Kae-Kuen & Hung-Shun, 2006; UKBI, 2003).

Early studies conducted include lessons learned from European incubators (Berger, 1984), business incubator as economic development tool (Carroll, 1986), structure, policy, and services in the incubator industry (Allen & McCluskey, 1990) and developing regional areas through business incubators (Kang, 1993). More recent studies (e.g. Schwartz and Hornych, 2008) focused on strategic specialization of incubators for example in the biotechnology, biochemistry or pharmaceutical industries. Studies have also been conducted on business incubation in developing countries, Adegbite (2001) for example examined the development of incubators in Nigeria and found that one of the major constraints on incubator performance was chronic tenant overstay.

Phan *et al.* (2005) acknowledged incubator development as one of the main prongs of business incubator-incubation research, alongside research done at the incubatee level, entrepreneur level, and system level. Research suggests that incubator level research involves issues that generally relate to the institutional aspects of the incubator; for example, profile of incubators, examination of the physical constitution of incubators, benefits of co-locating within incubators, types of services at the incubators, best practices of business incubators and critical elements of success of the incubators. Extensive incubator level research has been undertaken with the purpose of profiling the incubator types according to their objectives, services, and facilities offered and their role in enhancing economic development. Among the studies that have been conducted at the incubator level, Allen and Rahman (1985) studied positive environment for entrepreneurs within incubators and Cooper (1985) investigated the role played by incubator organizations in promoting growth-oriented firms. Both studies discussed incubator characteristics and the relationship between incubators and small firms. Similar-themed studies were also conducted by Carroll (1986) and Martin (1997) who examined topics including business incubator life cycle, types of funding available for incubators, benefits of incubation, and how incubators play a role in developing new enterprises. Another key area of investigation was undertaken by Tornatzky, Batts, McCrea, Lewis and Quittman (1996) who suggested that business incubation is an effective development tool and requires modest investment while providing excellent return on investment to regional economies.

Despite extensive research conducted on business incubation, the literature suggests that limited academic research on incubation development in Malaysia has been undertaken and even less so on ICT incubators. Information regarding business incubation in Malaysia is, to date, primarily descriptive, originating from consultant survey reports and government white papers, and provides a rather narrow perspective on the incubation system. This research fills this gap and provides a response to the Government of Malaysia's (InfoDev, 2010; Malaysia Plan, 2011) concerning incubator operators and incubatees improving their knowledge and practices regarding the incubation process and management.

The research provides a basis for understanding the current scenario of the Malaysian ICT incubation system and proposes recommendations for the betterment of incubation management in terms of knowledge and best practices. The outcomes of this research are significant for current and future entrepreneurship research, especially in the area of business incubation, as it provides empirical analysis of the components that influence ICT business incubation performance in Malaysia. Findings from this research allow understanding of better incubation management practices leading to possible generation of more sophisticated ICT start-ups with greater potential for growth and sustainability, by the incubators.

METHODOLOGY

Data Collection Procedures

A questionnaire based on previously tested and validated scales from studies conducted by Hackett and Dilts (2008) was distributed via email and in person to 180 ICT incubatees, covering the entire ICT incubator population in Malaysia. Participants for the survey questionnaire were initially identified from their respective incubator websites. Basic information regarding the name of the incubatees, email addresses, and phone numbers were then obtained from the incubator managers. The participants were tenants of the ICT incubators, referred to in this study and in the literature as incubatees. These companies are ICT-based companies with diverse business natures ranging from mobile and wireless communication to internet-based business applications. The link to the online survey questionnaire was emailed to the incubatees of ICT incubators in February 2010 together with a short introductory letter from the researcher indicating the nature of the research, the researcher's affiliation, and that participation was entirely voluntary. By the end of May 2010, the total number of useful responses was 118, yielding a response rate of 65.5 per cent.

Data Analysis Procedures

In selecting an appropriate technique for analysing the data set, Hair *et al.'s* (2010b) procedures for selection of multivariate technique were followed. Principal component analysis (PCA) was selected as the most appropriate technique given the exploratory nature of the initial analysis. Tabachnik and Fidell (2007) support this approach advocating PCA is a better choice for researchers that require an empirical summary of a data set.

Data analyses were undertaken in three principal stages (data screening, exploratory factor analysis, and multinomial logistic regression) using PASW Version 18.0. As part of the preparation and screening process, data were tested for violations of statistical assumptions (e.g., multicollinearity, outliers, and normality) as well as identifying missing data. Data screening revealed that there were no missing data and the data was fit to analyze. The statistical procedures involved a two-step process: firstly, exploratory factor analysis (EFA), followed by multinomial logistic regression. Factor analysis was conducted to assess the unidimensionality of the four constructs developed in examining relationships with Incubation Performance: (i) Selection Performance, (ii) Monitoring and Business Assistance Intensity, (iii) Resource Allocation and (iv) Professional Management Services.

This paper reports on the results of the multinomial logistic regression that tested the significance of the four constructs in the business incubation process on the dependant variable, Business Incubation Performance. The initial analysis using PCA reduced 86 variables to a more manageable eleven components. The eleven components accounted for 79.2% of the total variance explained. This more than meets the acceptance level of 60% of total variance explained set out by Hair *et al.*, (2010a) and Tabachnick and Fidell (2007). Reliability analysis was undertaken at two levels; firstly to measure internal consistency of the measures and secondly, to measure the reliability of the extracted component structure. Total scale reliability as well as individual component reliabilities as measured by Cronbach's coefficient alpha were all well above the .60 threshold advocated by Hair *et al.*, (2010a). Subsequently, the associations between the eleven extracted components were examined using multinomial logistic regression to test the significance and explanatory power of the identified components in relation to Business Incubation Performance.

Multinomial logistic regression has been employed by previous researchers in numerous entrepreneurship (Gubrium & Holstein, 2002; McCracken, 1998; Patton, 2002; Srivastava & Thomson, 2009) and business incubation research (Rothaermel & Thursby, 2005). Multinomial logistic regression is used to model the relationship between a binary response variable and one or more predictor variables, which may be either discrete or continuous. In other words, multinomial logistic regression can be used to: predict a dependent variable on the basis of continuous and/or categorical independent variables and to determine the per cent of variance in the dependent variable explained by the independent variables to rank the relative importance of independent variables; to assess interaction effects; and to understand the impact of covariate control variables (Field, 2009).

Multinomial logistic regression applies maximum likelihood estimation after transforming the dependent into a logit variable (the natural log of the odds of the dependent occurring or not). In this way, multinomial logistic regression estimates the probability of a certain event occurring. In this paper, multinomial logistic regression is used to estimate the probability of different degrees of Business Incubation Performance occurring, delineated as (i) '*Our company is barely surviving'*; (ii) '*Our company has met its break-even and is moving on a path toward profitability'*; (iii) '*Our company is making profit*'; and (iv) '*Our company is highly profitable*'.

Multinomial logistic regression calculates changes in the log odds of the dependent, not changes in the dependent variable itself. Alternatively, discriminant analysis has been used in the past but is now more frequently being replaced with multinomial logistic regression, as this approach requires fewer assumptions in theory, is more statistically robust in practice, and is easier to use and understand than discriminant analysis. Two goodness-of-fit tests (Pearson and Deviance) were performed; tables of observed and expected frequencies, and measures of association were also produced.

RESULTS AND DISCUSSION

The initial PCA revealed that eleven components yielded Eigenvalues greater than 1, for 86 variables in the data set which is within the range advocated by Tabachnick and Fidell (2007). The multinomial logistic regression analysis was performed in five phases consisting of one full model analysis and four individual model analyses. The full model analysis incorporates the eleven components previously extracted from the EFA, and grouped under their respective broader constructs, i.e. Selection Performance, Monitoring and Business Assistance Intensity, Resource Allocation, and Professional Management Services, to enable examination of their relationships with the four outcome categories.

The individual model analyses examine each component's relationship with Business Incubation Performance. Results of the multinomial logistic regression analyses will be presented in the following manner: firstly, a full model evaluation highlighting the relationship between the four broad constructs and business incubation performance in general; secondly, results from the Selection Performance construct will be presented, followed by Monitoring and Business Assistance Intensity, Resource Allocation and finally, the Professional Management Services construct.

Evaluations of the Multinomial Logistic Regression Model

Peng, Lee and Ingersoll (2002a), advocate that multinomial logistic regression evaluations may best be based on the following: (a) overall model evaluation, (b) statistical tests of individual predictors, (c) goodness-of-fit statistics, and (d) validations of predicted probabilities. This approach has been adopted here in presenting the results.

Overall Model Evaluation

A logistic model is said to provide better fit to the data if it demonstrates an improvement over the intercept-only model (also called the null model). The intercept-only model serves as a good baseline because it contains no predictors. Consequently, according to this model, all observations would be predicted to belong in the largest outcome category. An improvement over this model is examined using inferential statistical tests such as the likelihood ratio and Wald tests. TABLE 1 presents the full model evaluation consisting of all four constructs. The table reveals that Selection Performance (F1), Monitoring and Business Assistance Intensity (F2), Resource Allocation (F3), and Professional Management Services (F4) are all significant predictors of Business Incubation Performance ($p < .05$). The chi-square values also suggest that similar relationships with high values for F1, F2, F3, and F4. The interaction of all four constructs reveals the strongest effect as a predictor ($p = .003$, $\chi(3) = 14.024$).

TABLE 1
ULL MODEL EVALUATION

Predictors	Chi-Square	*df*	*p*
Intercept	18.43	3	.001
Selection Performance (F1)	13.02	3	.005
Monitoring and Business Assistance Intensity (F2)	9.50	3	.023
Resource Allocation (F3)	8.75	3	.031
Professional Management Services (F4)	13.39	3	.004
Final	14.02	3	.003

As mentioned earlier, the dependent variable, Business Incubation Performance is measured by four categorical outcomes. Multinomial logistic regression enables independent variables to predict group memberships, and as this study uses four outcomes, one of the outcomes (‘*Our company is barely surviving’*) has been used as a reference category. Hence, there are three models generated from this data: Model 1 (‘*Our company has met its break-even and is moving on a path toward profitability’*), Model 2 (‘*Our company is profitable’*), and Model 3 (‘*Our company is highly profitable’*). Based on data presented in TABLE 2, the first model shows no significant relationship between the constructs and Business Incubation Performance with all values of *p* greater than .05. However, Model 2 and 3 show significant relationships with Business Incubation Performance (*p*-values < .05).

TABLE 2
PARAMETER ESTIMATES FOR THE FULL MODEL

Group 1: Our company has met its break-even and is moving on a path to profitability	β	**SE** β	**Wald's** χ^2	*p*	e^{β} **(odds ratio)**
Predictor					
Constant	.176	2.943	.004	.952	
Selection Performance (F1)	.001	.024	.002	.963	.999
Monitoring and Business Assistance Intensity (F2)	.000	.061	.000	.998	1.000
Resource Allocation (F3)	.057	.043	1.762	.184	.944
Professional Management Services (F4)	.020	.026	.585	.444	1.020
Group 2: Our company is making profit					
Constant	35.271	14.425	5.979	.014	
Selection Performance (F1)	.195	.075	6.731	.009	1.215
Monitoring and Business Assistance Intensity (F2)	.258	.107	5.828	.016	1.295
Resource Allocation (F3)	.026	.084	.098	.754	1.027
Professional Management Services (F4)	.122	.047	6.618	.010	1.130
Group 3: Our company is highly profitable					
Constant	41.092	22.568	3.315	.069	41.092
Selection Performance (F1)	.265	.134	3.914	.048	1.304
Monitoring and Business Assistance Intensity (F2)	.145	.182	.640	.424	1.156
Resource Allocation (F3)	.083	.138	.356	.551	1.086
Professional Management Services (F4)	.202	.099	4.162	.041	1.223

The Wald statistic is equal to the ratio of β divided by SE squared; it has a chi-square distribution. For each Wald statistic, *df* = 1 and *p* = .0000.

Statistical Tests of Individual Predictors

The statistical significance of individual regression coefficients (i.e., βs) is tested using the Wald chi-square statistic (TABLE 2). According to TABLE 2, F1, F2, and F4 were significant predictors of the outcome category ‘*Our company is making profit*’ ($p < .05$). The high corresponding Wald test values also show the significance of these three constructs. This means the probability of incubatees making a higher profit is higher if they are carefully selected, given adequate monitoring and business assistance, and provided Professional Management Services. Meanwhile, providing incubatees with resources does not necessarily aid them towards making profit. The test of the intercept (i.e., the constant in TABLE 1) merely suggests whether an intercept should be included in the model. For the present data set, the test result ($p > .05$) suggests that an alternative model without the intercept might be applied to the data. Consequently, F1 and F4 were also significant predictors for the outcome category '*Our company is highly profitable*'. This could be interpreted as companies tend to be highly profitable when incubators select the incubatees carefully, as well as provide them with Professional Management Services. Consequently, monitoring of incubatees and providing resources (in isolation) to the incubatees may not be significant to creating incubatees that are highly profitable.

The *βs* are the logistic regression coefficients. Negative *βs* reveal a negative or inverse relationship, whereas positive *βs* indicate positive relationship (Scarborough & Zimmerer, 2000). The odds ratio in the last columns is more straightforward in interpretation than the *β*s (log odds). An odds ratio of 1 is equivalent to log odds of 0. An odds ratio of 1, and log odds of 0 signify no relation of the independent variable to the dependent variable. The odds ratio is the probability that an event will happen divided by the probability that the event will not happen (Norusis, 1994). The findings in TABLE 2 show that for every unit increase in Selection Performance, the odds that the incubatee will be making profit is increased by 21.5%, while for every increase in Monitoring and Business Assistance Intensity, the odds of an incubatee making profit is increased by 29.5%.

Goodness-of-Fit Statistics

Two descriptive measures (R^2 indices) defined by Cox and Snell (1989) and Nagelkerke (1991) respectively, are presented in TABLE 3. These indices are variations of the R^2 concept defined for the OLS regression model. Due to the limited interpretation of R^2 in multinomial logistic regression (Peng, Lee, & Ingersoll, 2002b), the R^2 indices can be treated as supplementary to other more useful evaluative indices, such as the overall evaluation model, tests of individual regression coefficients, and the goodness-of-fit test statistic (Peng et al., 2002b). The Cox and Snell R^2 measure indicates a greater model fit with higher values, but with a limit of less than 1 (<1) (Hair et al., 2010b). The Nagelkerke R^2 is an adjusted version of the Cox and Snell R^2 and covers the full range from 0 to 1 (Hair et al., 2010b), and therefore it is often preferred. The R^2 values indicate how useful the explanatory variables are in predicting the response variable and can be referred to as measures of effect size.

TABLE 3
GOODNESS-OF-FIT TESTS OF THE FULL MODEL

	Chi-Square	***df***	***p***
Pearson	257.923	297	.951
Deviance	217.464	297	1.000
R^2			
Cox and Snell			.297
Nagelkerke			.326

In normal linear regression, summary measures of fit are functions of a residual defined as the difference between the observed and fitted value. In logistic regression, there are several ways to measure the difference between the observed and fitted values. There are two measures of the difference between the observed and the fitted values: the Pearson residual and the Deviance residual, both of which suggest that the model fit to the data well and was acceptable. In other words, the null hypothesis of a good model fit to data was tenable.

Validation of Predicted Probabilities

Multinomial logistic regression predicts the logit of an event outcome from a set of predictors. The resultant predicted probabilities can then be revalidated with the actual outcome to determine if high probabilities are indeed associated with events and low probabilities with non-events. The degree to which predicted probabilities agree with actual outcomes is expressed as either a measure of association or a classification table. Peng, Lee and Ingersoll (2002b) recommend the use of the classification table in addition to the overall evaluation table to help communicate findings to readers. The classification table (TABLE 4), which produces a contingency table of observed versus predicted responses for all combinations of predictor variables (Hall & Hofer, 1993), indicates the extent of how the model correctly predicts each outcome category. In an ideal model, all cases will be on the diagonal and the overall per cent correct will be 100%. In this study, the full model classifies correctly 48.8% which is well above the 39.5% (1.25 x 31.6% = 39.5%) chance accuracy criteria, hence classification accuracy is satisfied in this study.

TABLE 4
CLASSIFICATION TABLE FOR THE FULL MODEL

Observed	**Predicted**				
	Our company is barely surviving	Our company has met its break-even and is moving on a path toward profitability	Our company is making profit	Our company is highly profitable	% Correct
Our company is barely surviving	12	6	10	0	42.9%
Our company has met its break-even and is moving on a path to profitability	8	14	14	1	37.8%
Our company is making profit	3	8	24	1	66.7%
Our company is highly profitable	1	0	2	1	25.0%
Overall Percentage	22.9%	26.7%	47.6%	2.9%	48.6%

The research focuses on the performance outcomes of the incubatees which is the dependent variable with four categories: '*Our company is barely surviving'*; '*Our company has met its break-even and moving on a path toward profitability'*; '*Our company is making profit'*; and '*Our company is highly profitable*'. Their performance can be categorized as follows: 32 firms (27.1%) were barely surviving; 44 firms (37.3%) had met their break-even; 38 firms (32.2%) were making profit; and 4 firms (3.4%) were highly profitable. The remaining results of the multinomial logistic regression analysis will be presented in the next section. The analysis examines individual components within each construct and investigates their relationships with Business Incubation Performance.

Selection Performance

Due to the exploratory nature of this study, Field (1993) recommends the use of stepwise methods in situations where no previous research exists on which to base hypotheses for testing and when the research seeks a model to fit the data. Both forward entry and backward entry methods were tested with each yielding results that were not significantly different to each other.

The model fitting information table (TABLE 5) compares the model (or models in a stepwise analysis) to the baseline (the model with only the intercept term in it and no predictor variables). It is a useful table that denotes the improvement of the model as a result of entering the predictors of the model (Hall & Hofer, 1993). The chi-square statistics for this model suggests that it is highly significant, indicating that the interactions have a significant effect on predicting whether incubatee performance was significant. TABLE 5 presents the overall model evaluation for the Selection Performance construct. The table reveals that within the Selection Performance construct, *Financial Characteristics, Managerial* and *Marketing Characteristics,* and *Product Characteristics* contribute significantly to the model ($p < .05$).

TABLE 5
MODEL-FITTING INFORMATION TABLE SELECTION PERFORMANCE CONSTRUCT

	Chi-Square	*df*	*p*
Intercept	.000	0	.
Financial-based selection	52.368	33	.017
Market and managerial-based selection	72.543	48	.013
Product-based selection	78.000	42	.001

Based on the parameter estimates in TABLE 6, selection based on product characteristics appears to be the strongest predictor for '*Our company is making profit*' (p = .041 and Wald's $\chi^2 = 4.183$). The odds ratio value of 1.157 suggests that the probability of incubatees making profit is increased by 15.7% with a unit performance increase in selecting potential incubatees based on their products.

TABLE 6
PARAMETER ESTIMATES FOR SELECTION PERFORMANCE CONSTRUCT

Group 1: Our company has met its break-even and is moving on a path to profitability	β	SE β	Wald's χ^2	*p*	e^{β} (odds ratio)
Constant	-.623	1.421	.192	.661	-
Financial-based selection	.139	.107	1.703	.192	1.150
Market and managerial-based selection	-.093	.075	1.558	.212	.911
Product-based selection	.049	.058	.735	.391	1.051
Group 2: Our company is making profit					
Constant	-4.528	2.059	4.835	.028	-
Financial-based selection	-.036	.123	.087	.768	.964
Market and managerial-based selection	.056	.087	.419	.517	1.058
Product-based selection	.146	.071	4.183	.041	1.157
Group 3: Our company is highly profitable					
Constant	-5.904	4.855	1.479	.224	-
Financial-based selection	.083	.232	.127	.721	1.086
Market and managerial-based selection	-.122	.136	.812	.368	.885
Product-based selection	.251	.194	1.678	.195	1.285

The Pearson and Deviance statistic tests for the fit of the model to the data are shown in TABLE 7. Evidence of the goodness-of-fit of logistic models can be explained by R^2 index for either the entire model or for each predictor. The Deviance statistic here demonstrates that the model is a strong fit of the data (p = .99; < .05 level), while the Nagelkerke R^2 value of .83 likewise indicates the model is useful in predicting business incubation performance.

TABLE 7
GOODNESS-OF-FIT TESTS FOR SELECTION PERFORMANCE

	Chi-square	*df*	*p*
Pearson	66.345	159	1.000
Deviance	73.844	159	.99
R^2			
Cox and Snell			.755
Nagelkerke			.830

Finally, the classification table for analysis of Selection Performance components as shown in TABLE 8 below suggests a 75.4% correct prediction, well above the 39.5% chance accuracy criteria, indicating good prediction of the model.

TABLE 8
CLASSIFICATION TABLE PREDICTING MEMBERSHIP OF OUTCOME CATEGORIES BY SELECTION PERFORMANCE

Observed	**Predicted**				
	Our company is barely surviving	Our company has met its break-even and is moving on a path toward profitability	Our company is making profit	Our company is highly profitable	% Correct
Our company is barely surviving	22	8	2	0	68.8%
Our company has met its break-even and is moving on a path toward profitability	5	36	3	0	81.8%
Our company is making profit	0	10	28	0	73.7%
Our company is highly profitable	0	1	0	3	75.0%
Overall Percentage	22.9%	46.6%	28.0%	2.5%	75.4%

The following section presents regression analysis of the Monitoring and Business Assistance Intensity construct.

Monitoring and Business Assistance Intensity

The model-fitting information in TABLE 9 presents the overall fit of the model. Firstly, the chi-square statistics for this model show that comprehensiveness and quality of the business assistance contributes significantly to the model, ($p < .05$) while time intensity of the interaction is not a significant predictor to the model ($p > .05$).

TABLE 9
MODEL-FITTING INFORMATION TABLE FOR MONITORING AND BUSINESS ASSISTANCE INTENSITY CONSTRUCT

Predictors	**Chi-Square**	***df***	***p***
Intercept	4.387	3	.223
Comprehensiveness and Quality	10.598	3	.014
Time Intensity	.665	3	.881

The parameter estimates in TABLE 10 show that comprehensiveness and quality of the business services appear to be a significant predictor to the outcome '*Our company is making profit'*, ($p = .003$; Wald's $\chi^2 = 8.925$). The odds ratio value suggests that there is a 12.4% increase in companies making profit with each corresponding increase in comprehensiveness and quality of the business assistance provided.

TABLE 10
PARAMETER ESTIMATES FOR MONITORING AND BUSINESS ASSISTANCE INTENSITY CONSTRUCT

Group 1: Our company has met its break-even and is moving on a path toward profitability	β	$SE\ \beta$	**Wald's** χ^2	p	e^{β} **(odds ratio)**
Constant	-.882	1.843	.229	.632	
Comprehensiveness and Quality	.051	.028	3.255	.071	1.052
Time Intensity	-.012	.095	.016	.898	.988
Group 2: Our company is making profit					
Constant	-4.519	2.232	4.098	.043	
Comprehensiveness and Quality	.117	.039	8.925	.003	1.124
Time Intensity	.064	.108	.345	.557	1.066
Group 3: Our company is highly profitable					
Constant	-.931	3.508	.070	.791	
Comprehensiveness and Quality	.004	.055	.005	.944	1.004
Time Intensity	-.060	.186	.104	.747	.942

The Deviance statistic in TABLE 11 demonstrates that the model is a good fit of the data ($p = .954$). The Nagelkerke R^2 value of .83 also indicates the model is useful in predicting business incubation performance.

TABLE 11
GOODNESS-OF-FIT TESTS FOR MONITORING AND BUSINESS ASSISTANCE INTENSITY

	Chi-Square	*df*	*p*
Pearson	148.844	171	.888
Deviance	141.052	171	.954
R^2			
Cox and Snell			.72
Nagelkerke			.83

The classification table below (TABLE 12), for analysis of Monitoring and Business Assistance Intensity components suggests a 43.2% correct prediction, well above the 39.5% chance accuracy criteria, indicating good prediction of the model.

TABLE 12
CLASSIFICATION TABLE PREDICTING MEMBERSHIP OF OUTCOME CATEGORIES BY MONITORING AND BUSINESS ASSISTANCE INTENSITY

	Predicted				
Observed	Our company is barely surviving	Our company has met its break-even and is moving on a path toward profitability	Our company is making profit	Our company is highly profitable	% Correct
Our company is barely surviving	10	11	8	0	34.5%
Our company has met its break-even and is moving on a path toward profitability	7	15	19	0	36.6%
Our company is making profit	1	17	20	0	52.6%
Our company is highly profitable	1	3	0	6	60.0%
Overall Percentage	16.1%	38.9%	39.8%	5.08%	43.2%

The following section presents multinomial logistic regression analysis for the third component, Resource Allocation.

Resource Allocation

Based on the full model analysis presented earlier in TABLE 1, Resource Allocation appears to be a significant predictor of Business Incubation Performance. This section examines the construct's individual components and their relationship to incubation performance. The overall fit of the model for this particular construct is represented in TABLE 13. Firstly, the chi-square statistics for this model suggests that all elements within Resource Allocation are significant ($p < .05$). *Resource Utilisation* is the strongest predictor ($p = .008$) followed by *Resource Quality and Availability* ($p = .049$).

TABLE 13
MODEL-FITTING INFORMATION TABLE FOR RESOURCES ALLOCATION CONSTRUCT

Predictors	Chi-Square	*df*	*p*
Intercept	14.984	3	.002
Resource Utilisation and Quality	11.905	3	.008
Resource Availability	7.854	3	.049

Individual contributions of the components to the model indicate that not all components within the Resource Allocation construct are significant predictors for Business Incubation Performance as shown in TABLE 14. *Resource Utilisation* and *Resource Quality and Availability* appear to significantly contribute to the outcome category '*Our company has met its break-even and is moving on a path toward profitability*' (p = .019, Wald's χ^2 = 5.481; p = .017, Wald's χ^2 = 5.704) respectively. The odds ratio value (e^{β} =1.178) indicates that there is a 17.8% increase in the probability that the company will meet its break-even and is moving on a path toward profitability given every corresponding unit increase in quality and availability of resources. Alternatively, there is a 7.4% increase in the same outcome category with every corresponding unit increase in *Resource Utilization*.

TABLE 14
PARAMETER ESTIMATES FOR RESOURCE ALLOCATION CONSTRUCT

Group 1: Our company has met its break-even and is moving on a path toward profitability	***β***	***SE β***	***Wald's χ^2***	***p***	***e^{β} (odds ratio)***
Constant	1.958	1.933	1.026	.311	
Resource Utilisation and Quality	-.302	.129	5.481	.019	.740
Resource Availability	.164	.068	5.704	.017	1.178
Group 2: Our company is making profit					
Constant	-8.494	4.248	3.998	.046	
Resource Utilisation and Quality	.155	.146	1.127	.288	1.167
Resource Availability	.147	.087	2.885	.089	1.158
Group 3: Our company is highly profitable					
Constant	-16.281	13.630	1.427	.232	
Resource Utilisation and Quality	.041	.400	.010	.919	1.041
Resource Availability	.386	.220	3.072	.080	1.472

The Pearson and Deviance statistics in TABLE 15 shows that the model is a good fit, with Deviance statistic value of p = 1.00, and Pearson value of 0.929. The Pseudo R^2 values show that both Cox and Snell's and the Nagelkerke's measures to be 0.246 and 0.271 respectively, indicating a weaker explanatory strength of the variable in predicting business incubation performance.

TABLE 15
GOODNESS-OF-FIT TESTS FOR RESOURCES ALLOCATION

	Chi-Square	***df***	***p***
Pearson	256.36	291	.929
Deviance	216.71	291	1.000
R^2			
Cox and Snell			.246
Nagelkerke			.271

The final table presented for the logistic regression analysis for Resource Allocation is the classification table (TABLE 16). The model has predicted 49.6% correctly, satisfying the criteria for chance accuracy of 39.5%.

TABLE 16
CLASSIFICATION TABLE PREDICTING MEMBERSHIP OF OUTCOME CATEGORIES BY RESOURCE ALLOCATION

Observed	**Predicted**				
	Our company is barely surviving	Our company has met its break-even and is moving on a path toward profitability	Our company is making profit	Our company is highly profitable	% Correct
Our company is barely surviving	6	9	17	0	18.8%
Our company has met its break-even and is moving on a path toward profitability	2	27	14	0	62.8%
Our company is making profit	3	10	25	0	65.8%
Our company is highly profitable	0	2	2	0	.0%
Overall Percentage	9.4%	41.0%	49.6%	.0%	49.6%

The following section presents results from Professional Management Services construct.

Professional Management Services

The model-fitting information regarding Professional Management Services in TABLE 17 indicates that only Staff and Personnel Management contribute significantly to the model (p = .044), while other variables such as *Strategic Management, Financial Management,* and *Marketing* and *Promotion Management* are not significant.

TABLE 17
MODEL-FITTING INFORMATION FOR PROFESSIONAL MANAGEMENT SERVICES CONSTRUCT

Predictors	Chi-Square	*df*	*p*
Constant	9.700	3	.021
Strategic Management	2.369	3	.499
Financial Management	4.030	3	.258
Marketing and Promotion Management	3.670	3	.299
Staff and Personnel Management	8.117	3	.044

The parameter estimates shown in TABLE 18 also indicates that *Staff and Personnel Management* is the strongest predictor to the outcome category '*Our company is making profit*'. The odds ratio value of 1.189 indicates that there is an 18.9% increase in this outcome category with every corresponding unit increase in *Staff and Personnel Management.*

TABLE 18
PARAMETER ESTIMATES FOR PROFESSIONAL MANAGEMENT SERVICES CONSTRUCT

Group 1: Our company has met its break-even and is moving on a path toward profitability	β	SE β	Wald's χ^2	*p*	e^{β} (odds ratio)
Constant	1.153	1.838	.393	.531	
Strategic Management	.075	.086	.756	.384	1.078
Financial Management	-.116	.089	1.687	.194	.891
Marketing and Promotion Management	-.100	.076	1.732	.188	.905
Staff and Personnel Management	.035	.065	.290	.590	1.036
Group 2: Our company is making profit					
Constant	-5.785	3.361	2.964	.085	
Strategic Management	-.022	.096	.053	.817	.978
Financial Management	.040	.100	.159	.690	1.041
Marketing and Promotion Management	.050	.088	.315	.575	1.051
Staff and Personnel Management	.173	.076	5.199	.023	1.189
Group 3: Our company is highly profitable					
Constant	-7.920	7.473	1.123	.289	
Strategic Management	.187	.183	1.043	.307	1.205
Financial Management	.004	.196	.000	.983	1.004
Marketing and Promotion Management	-.029	.182	.026	.873	.971
Staff and Personnel Management	.176	.147	1.426	.232	1.193

TABLE 19 presents goodness-of-fit tests for this construct and shows a Deviance statistic value of .997, suggesting that the model fits to the data well.

TABLE 19
GOODNESS-OF-FIT TESTS FOR PROFESSIONAL MANAGEMENT SERVICES CONSTRUCT

	Chi-Square	*df*	*p*
Pearson	310.596	297	.282
Deviance	235.441	297	.997
R^2			
Cox and Snell			.217
Nagelkerke			.239

Finally, the classification table (TABLE 20) for the Professional Management Services shows that this model has classified 47.8% correctly, well above the 39.5% criteria for classification accuracy.

TABLE 20
CLASSIFICATION TABLE PREDICTING MEMBERSHIP OF OUTCOME CATEGORIES PROFESSIONAL MANAGEMENT SERVICES

Observed	Predicted				
	Our company is barely surviving	Our company has met its break-even and is moving on a path toward profitability	Our company is making profit	Our company is highly profitable	% Correct
Our company is barely surviving	13	8	10	0	41.9%
Our company has met its break-even and is moving on a path toward profitability	7	20	15	0	47.6%
Our company is making profit	7	9	22	0	57.9%
Our company is highly profitable	0	3	1	0	.0%
Overall Percentage	23.5%	34.8%	41.7%	.0%	47.8%

SUMMARY AND CONCLUSIONS

It is generally accepted that Business Incubation is a useful approach in fostering new ventures. In an ideal world, incubators will accelerate the venture creation process through reducing financial and commercial risk for incubates whilst also enabling an environment that drives collaboration and innovation resulting in knowledge spill-overs that benefit incubates, the incubators and the incubation industry as a whole. However, the literature points to substantial variation in achieving these aims and the research reported on in this paper regarding ICT incubators in Malaysia likewise observed significant issues relating to business incubation performance. The theoretical and practical understanding of the underlying components impacting upon Business Incubation Performance remains at a nascent state, particularly in the Malaysian context. The model tested and presented in this paper goes some way to improving our understanding and provides a validated basis for future research in particular regarding ICT incubation.

The significant impact of Selection Performance on Business Incubation Performance distinguishes it as a critical factor in the business incubation process. In particular, the importance of '*Product-based selection, 'Market and managerial-based selection', and 'Financial-based selection'* are worthy of note. The results suggest that adoption of detailed selection criteria in regard to each of the three attributes is essential in improving the chances of incubation success. The selection criteria should be benchmarked against world's best practice and a natural progression of the research presented in this paper is the development of such a selection criteria index. The index will enable incubatee-selection best practices among the ICT incubators to be uniformly adopted and managed across the industry so that a more granular picture of success factors may be developed industry-wide. Careful selection of potential incubatees will not only drive a 'quality in-quality out' approach it would also attract greater external investment particularly given the reduced cycle times in the ICT industry relating to product development and commercialization.

In terms of Monitoring and Business Assistance Intensity, incubators that provide extensive monitoring and comprehensive business assistance along with adequate interaction with incubator management, are characterized by incubatees that are making profit. It was found that incubators that provide a range of business assistance and that seek feedback regarding their services tend to perform better than those who do not. Furthermore, results suggest that the amount of interaction between incubatees and incubator managers is a weak predictor of incubatees' outcomes – it is the quality of the interaction not the amount! This suggests that incubators need to advance their ability to build and sustain communities of practice consisting of inter-incubator firms and external experts and facilitators. Currently, knowledge and resources reside in siloes and it will be imperative for the ICT incubation industry in Malaysia (and elsewhere) to more effectively use (appropriate) resources at the right time and adopt innovative measures such as enterprise and industry-wide digital networking platforms to both create and consume knowledge in real time. A nested network model where diversity, collaboration and connection occur amongst incubatees, between incubators and external firms and individuals, and across the ICT incubation industry is essential.

The importance of providing resources that aid in the sophistication of technology development and crucially application should not be understated, for example rapid prototyping of new products and services that result from user-driven design and innovation can significantly reduce the time (and cost) to reach the point of fail/fast – fail/cheap or hopefully rapid scale to market. Evidence from this study indicates that some of the participant incubators and many of the incubatees do not even have fully functioning websites. This is inexcusable and it would appear there are simple measures close to hand (such as functioning websites) that could easily be taken to improve market visibility for incubator products and services and to promote knowledge exchange. Incubator boundaries could be opened to attract interaction with more established firms by providing fee-for-service in the form of, for example technology labs or rapid manufacturing machinery.

Finally, Professional Management Services currently provided at the incubators were founded to be limited in terms of expertise and availability, leading to inefficient management of the incubatees. The incubation literature has established that incubatees require extended forms of support in management services to assist them, particularly in their early stages. It is quite difficult for incubator management to provide the required breadth (and depth) of services internally hence providing even greater impetus toward development of a networked, community of practice approach.

The current state of play regarding ICT incubation in Malaysia is one of some concern. Extensive funding has been poured into the industry over some time now with modest returns. It does appear that best practice is a bridge too far however there is hope and this lies in overcoming the fragmented approach that characterizes current practices and the research presented in this paper provides a base for understanding what is required to improve business incubation performance and initial directions for how this could be achieved. This will require 'galvanized good-will' from policymakers, practitioners and researchers in further developing and fine-tuning a systemized approach to Selection Performance, Monitoring and Business Assistance Intensity, Resource Allocation, and Professional Management Services; factors found in this study to be significant in predicting business incubation performance.

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