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EVALUATION OF NEW SERVICE DEVELOPMENT STRATEGIES USING MULTICRITERIA ANALYSIS: PREDICTING THE SUCCESS OF INNOVATIVE HOSPITALITY SERVICES

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Abstract

The purpose of this study is to gain insight into criteria that contribute to the success in new service development (NSD) projects in the hospitality economy. The results of the exploratory study are conducted in a precise predictive model for the successful hotel services. The analysis is based on data collected via in depth structured interview with questionnaires from hotel managers knowledgeable about NSD in their organization. A multicriteria methodology is used to examine the potential of a predictive model for successful NSD projects in the hotel sector. A comparative analysis with other popular classification methods is also performed.

Keywords: New service development, service innovation, hospitality services, tourism, multicriteria analysis, critical success criteria

1. INTRODUCTION

During the recent years the competitive environment has become very demanding. At the same time the general pace of doing things has accelerated tremendously mainly due to technological developments. These changes motivate the interest among management researchers regarding the role of innovation in gaining competitive advantage. This literature to date has focused on tangible products innovation. However, the literature on services innovation has grown significantly over the last decade, reflecting the increased contribution of services to national economies.

New services come up with opportunities for organizations but the risk associated with these services always exists. The success rate for new service projects is on average 58% (Griffin, 1997), in other words four out of ten new services fail in

the market place. The empirical studies, which have investigated the success factors at the project level, showed that success or failure is not the result of managing one or two activities very well, it is the result of a holistic approach, managing several aspects competently and in a balanced manner (Johne and Storey, 1998). It is therefore obvious that management is highly interested in learning about those factors which influence the success of new services. The identification of these factors based on empirical research is the objective of success factor studies in New Service Development (NSD). Management can use the results of NSD research, in order to improve NSD activities in their respective firms. Because of its direct practical relevance as well as its inherent appeal to researchers, it is not surprising that NSD research has been intensified over the last ten years. It still, however, remains deficient in various economic sectors.

To address the challenge of high failure rate, a significant number of studies have focused on the factors that affect the performance of new services. The critical dimensions that influence new service performance can be categorised into four clusters: (1) product-related, (2) market-related, (3) company-related, and (4) process-related (De Brentani, 1989).

Greater insight into understanding what contributes to successful new service development can be obtained by examining and comparing the development practices that have occurred for both successful and unsuccessful new services.

This paper reports on research into the characteristics that distinguish between success and failure of new hotel services in Greece. It thereby contributes to the improvement of success rates by allowing managers to refine their development processes for new services. Towards this end, the paper explores the potential of developing a predictive model that incorporates the unique characteristics of services and is demonstrated to distinguish effectively between successful and unsuccessful new hotel services.

The analysis of the research objective includes two phases. The first phase uses factor analysis to identify the factors that describe NSD. The analysis reduces the number of variables to a more manageable number. In a second stage a multicriteria model is developed with the UTADIS method, which discriminates between success

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and failures. The performance of the proposed multicriteria methodology is compared to other classification techniques.

The majority of NSD research has concentrated on the financial service sector, but so far there has been no important research on NSD in the largest industries world-wide, the hospitality industry and especially hotel sector. Tourism is one the world's largest and fastest growing industries and accounts for more than 10% of the global GDP, employment and capital formation (WTO, 2003). It plays an important role in: (a) contributing to the growth of wide range of supportive domestic industries (e.g., transportation, agriculture, food processing, commercial fishing, construction among others), (b) the economic and technological development of nations by stimulating the development of basic infrastructure, and (c) attracting foreign investment (especially in hotels) and facilitating transfer of technology.

This study will be the first empirical research of the success factors in NSD, specifically studying the hospitality economy and the first to analyze the innovation process in NSD using multicriteria methodologies.

The rest of the paper is organized as follows: Section 2 reviews the critical success factors studies in service innovation and discusses the relevant empirical research. Section 3 describes the data and the methods used in the analysis, whereas section 4 presents the obtained results. Finally, section 5 concludes the paper and proposes some future research directions.

2. LITERATURE REVIEW

Since the 1970s, researchers found plenty of evidence concerning factors that influence new product outcomes. In a similar fashion, although studies for services are more recent and less proliferate, the relevant literature has explored new service success and failure in order to succeed in achieving high performance. The methodological approaches for these studies vary from direct matched pairs to multivariate analysis techniques such as factor, regression, and discriminant analysis. Methodological approaches have also varied from single case studies to multi-industry approaches; and from examining a series of successful cases to examining the converse, a number of situations where the new product failed. Another, more

encompassing series of studies has examined both the successful and unsuccessful cases simultaneously (Edgett and Parkinson, 1994).

Both Cooper and Marquis have examined success and failure in isolation from each other in their earlier work (Cooper, 1979a; 1979b; Myers and Marquis, 1969). In later works, both researchers have adopted a success-failure methodology for analysing new products thus establishing control groups (Cooper and Kleinschmidt, 1987a; 1987b; 1987c; Maidique and Zirger, 1984). Without a control group, no discrimination can be made between success and failure. Instead, a researcher is limited to describing traits that were common to one group or the other, and is unable to say why the product became either a success or a failure (Edgett and Parkinson, 1994). The process of comparing a number of successful and unsuccessful new products simultaneously with a set of criteria, enables researchers to establish two dependent variables – success and failure. This technique allows differentiation between new product development practices that succeed and those that fail (Maidique and Zirger, 1984).

New product screening models have been developed by comparing successful and unsuccessful new products (De Brentani, 1986). The need to develop products differently, depending on the type of product (old or new), has been examined successfully via a comparative study of US and UK manufacturing firms (Johne and Snelson, 1988; 1989). The approach has also been successfully applied by Parkinson (1981) who used it for comparing new product development in British and German machine tool manufacturers, as a discriminating function in a number of studies on new product success and failure. Examples are Phases I and II of Project SAPPHO (Rothwell, 1972; Rothwell et al., 1974, Rothwell, 1985) and Project NewProd Phases I and II (Cooper, 1979a; Cooper and Kleinschmidt, 1987a; 1987b; 1987c; 1990) can be considered as the “pillars” for other projects. Both studies focused on several industrial sectors. Although SAPPHO included information from several countries, it did not have enough data to perform international statistical comparisons. NewProd was local in nature because it only considered Canadian companies. Studies such as the Stanford Innovation Project (Maidique and Zirger, 1984) were focused in just one industrial sector and in one particular country. Keys to New Product Success and Failure (Link, 1987) was local, focusing on Australian companies. Other studies have

also been carried out which focus on international comparative studies (Edgett et al., 1992; Dae Hoon et al., 1996; Buisson et al., 1997).

The comparison method has also been used with good results in a number of studies on new services. For example, Edgett and Parkinson (1994) used it to compare new service development in British building societies that were registered and maintained active membership status in the Building Societies Association. Edgett (1994) used it to compare new service development activities in UK banks and building societies. In a study of new commercial service companies Cooper and De Brentani (1991) compared successful and unsuccessful services in a way similar to the methodology previously used by Cooper (Edgett and Parkinson, 1994; Ernst, 2002).

The success of the comparative methodology for tangible new product studies earlier and for new services later, indicated that this approach would be suitable and reliable for this study. A useful framework has been provided by these studies for similar work in a service setting, as each attempt has identified new product development characteristics that effectively discriminate between successful and unsuccessful new products (Edgett and Parkinson, 1994).

In the context of literature review presented in this paper, the most important recent large-scale NSD studies have been recorded. These studies were identified using sources of service marketing, service management, operations management, and technology and innovation journals. Seven characteristics distinguished of NSD performance studies in order to design and to ensure the validity of data collecting for the empirical study ensues. Each study had to meet two specific criteria for inclusion in this review, that is (1) a dependent variable measuring the performance of a new service project or program and (2) one or more explanatory factors identified as determinants of new service performance.

The review presented in Table 1 bears strong resemblance with the review format proposed by Montoya-Weiss and Calantone (1994, p. 401-403) also by Flikkema (2008), who conducted a comprehensive review of the literature about new product performance. They distinguish characteristics of new product performance studies. We focus especially on quantitative data analysis methodologies, since this the main focus and contribution of this study.

All eighteen studies included in this review reported the sample size and the number of companies. Sample sizes seem difficult to compare at first instance, since different measures are used to describe them. The same applies to the number of companies. Nevertheless, from Table 1 it is evident that the scale of the sixteen NSD studies varies significantly. The study of John and Pavlides (1996), for example, reports responses of just eight companies, while Van Riel et al. (2004) report about 251 projects in their success study.

The level of data collection was not reported very accurately in most studies. In the case of Martin and Horne (1993, 1995) it is unclear from which level of the organization the data have been collected. Most studies collected data at the top level. The respondents are senior executives. Seniority, however, varied from CEO's (Drew 1995) to individuals at a senior level, having the most involvement with the actual development of the new product (Cooper et al. 1994). Project managers might be less appropriate for assessing the overall success of NSD efforts (Flikkema, 2008). Johne and Pavlides (1996) pursued a process of data collection, which was designed to avoid the problems of single-respondent response.

The performance perspective taken in a majority of the studies was binary (both success and failure were examined), with many studies examining just project or program success. The current body of NSD research usually focuses on some particular sectors (Johne and Storey 1998, De Jong and Vermeulen 2003). Financial services are extremely well covered. Two recent studies cover hospitality services but only in success service projects. Other service sectors are less researched, though ICT services, consulting and transport obtained attention in about 20% of the studies. Note that reviewing the sectors studied was hindered by ill-defined service classifications in most of the studies.

Most of this literature has been taken part on countries or regions, including UK, US, Canada, Germany, Australia, Belgium, Japan and Greece. Most of the studies were single-country studies. An exception is Van Riel et al. (2004) who studied innovation projects from companies in Europe, the US and Japan, although without testing for regional differences.

As far as the data analysis methodologies are concerned, all studies used standard statistical tests and multivariate statistical analysis. Most studies explicitly

stated what factors describe the phenomenon of new service development and which of them contribute in success performance of the service project. Few studies lead on a predictive model.

3. DATA AND METHODOLOGY

3.1 Data

Previous researchers have argued that it is both necessary and appropriate for further empirical studies in this subject area to explore a specific service industry rather than to take the traditional cross-sectional approach (Cowell, 1988, Easingwood, 1986). Therefore, only a single service economy sector comprised the resulting sample frame: Greek 4* and 5* hotels in eight intensive tourism areas (Athens, Thessaloniki, Chalidiki, Chania, Rethymno, Heraklio, Lasithi and Rhodos). The regions which are considered in the study include Central Greece, Crete, Dodecanese and Macedonia. These regions account for the 67% of total Greek hotel capability. This is a safe and representative target for our survey (Kitsios, 2005).

The restriction to 4/5* hotels effectively limited the sample population to those hotels that were large and innovative enough in order to examine their innovativeness in service marketing. A total of 99 hotels took part in the study, representing 33% of total rooms (66% 4* and 21% 5*) in the regions used in the analysis. The collection of the data was performed through a direct communication with the hotel managers.

Through this procedure, 165 projects were recorded overall during autumn 2004, all reflecting new hotel services. These were divided into 134 successes and 31 failures. The lower number of failures than successes was expected and is consistent with previous research studies using a comparative methodology (i.e., Cooper, 1979a; 1979b; Cooper and Kleinschmidt, 1986; De Brentani, 1989; Rothwell et al., 1974).

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Table 1: Characteristics of 18 large scale NSD studies

Study	Sample size	Nr Companies	Level of data collection	Performance	Services studied	Region	Methodology
Atuahene-Gima (1996a; b)	117 services 158 products	*	Marketing manager	Success	Banking and trusts, Insurance, Computer software, Communication and IT	Australia	Factor analysis
Avlonitis et al . (2001) Gounaris et al . (2003)	132	84	NSD project leader	Success/Failure s=80, f=52	Financial services	Greece	Principal components, ANOVA
Cooper et al. (1994)	173		Senior executive	Success	Financial services, Retail and business services	Canada	Factor analysis, ANOVA
De Brentani (1989, 1991, 2001)	276	115	Senior executive	Success/Failure s=150, f=126	Financial services, Management consulting, Transportation	Canada	Factor analysis, Regression
Cooper and De Brentani (1991)	106	37	Senior executive	Success/Failure s=56, f=50	Banks, Insurance, Near Banks	Canada	Standard statistical tests, ANOVA
De Brentani and Cooper (1992)	106	37	Senior executive	Success/Failure s=56, f=50	Banks, Insurance, Near Banks	Canada	Factor analysis, Regression
De Brentani and Ragot (1996)	112	55	Senior executive	Success/Failure s=60, f=52	Computer & systems, Consultants, Marketing & advertising, Management consulting, Accounting	Canada	Factor analysis, Regression
Deal and Edgett (1997)	161	*	Senior executive	Success/Failure s=87, f=74	Banks, Building societies	UK	Factor analysis, Discriminant analysis, Logistic regression
Easingwood and Storey (1991) Storey and Easingwood (1993)	77	77	Marketing manager	Success	Financial services	UK	Factor analysis
Drew (1995)	*	44	Senior executive	Success	Banks, Financial institutions	Canada	Standard statistical tests, ANOVA
Edgett (1994) Edgett and Parkinson (1994)	148	88	Senior executive	Success/Failure s=78, f=70	British banks, building societies	UK	Factor analysis, Discriminant analysis
Kelly and Storey (2000)	*	43	Marketing manager	Success	Banking, Telecom, Insurance	UK	T-tests
Lievens and Moenaert (2000) Blazevic and Lievens (2004)	65	36	Project manager Marketing manager Product manager	Success/Failure s=37, f=28	Banks, Saving institutions	Belgium	Regression, Curvilinear regression analysis
Martin and Horne (1993, 1995)	217	88	Senior executive	Success/Failure s=88, f=88	Financial services, Consultants, Information processing	US	Standard statistical tests
Storey and Easingwood (1993) Storey and Easingwood (1995)	78	*	Senior executive	Success/Failure s=64, f=14	Financial services	UK	Factor analysis, ANOVA
Van Riel et al. (2004)	251	*	Senior executive	Success	ICT, Electronics, Internet related services, Consultancy	Europe, US, Japan, Africa	Factor analysis, Discriminant analysis, ANOVA
Ottenbacher et al. (2006)	183	*	Hospitality managers	Success	Hospitality services	Germany	Discriminant analysis
Ottenbacher and Gnoth (2005)	184	*	Hospitality managers	Success	Hospitality services	Germany	Regression

(*) Not available

3.2 Variables

A number of variables were generated around the concept of new service development based on the previous literature (innovation management, new product development, new service development, hospitality management) and the results of a number of in depth personal interviews conducted with CEO's and owners from the hotel services sector. Subsequently, the questionnaire was reviewed by five experts on innovation management, new product development, hotels and/or scale development. A pre-test was then performed as a final check, modelling as closely as possible the final methodology for the principal survey.

To identify the determinants of success or failure for a new service, 126 variables were developed and tested in nine categories (company profile, new services generally, description of new service offered, idea generation sources, activities for new service development, organization, resource allocation, market potentiality, market synergy). First, respondents were asked to select and refer to one successful new product. Then, they were asked to indicate the level of quality of performance with the way each of the 126 variables reflected the events that occurred during development of the successful new product.

This process was repeated for a new product that the respondent considered to have been a failure for the firm. Success and failure was defined by each respondent in terms of their own company's interpretation of whether or not the new service met their success criteria. The variables are measured using a 5-point Likert-type point scale anchored at each end with "percentage of 0% - not done" and "100% - completely done". This approach produced a more reliable rating than continuous scales (Churchill, 1987). Although more reliable measurements could have been obtained with a 7-point scale (Churchill and Peter, 1984), in the pilot phase of the questionnaire construction, hotel managers seem to succeed better in a 5-point Likert-type.

Out of the initial set of 126 variables, 24 were finally selected for the development of reliable success/failure prediction models. These were selected with

factor analysis as well as through discussions with experts in the field of the hotel services. The selected variables are presented in Table 2.

Table 2: The selected variables

x_1	Identification of clear strategic objectives
x_2	Expression of objectives as contribution to the income of the company
x_3	Identification of strategic focus arenas
x_4	Identification of clear strategic action plans
x_5	Systematic effort to capture and collect new ideas
x_6	Preliminary market assessment before any major investment
x_7	Time and capital spent on preliminary market assessment
x_8	Clear and focussed definition of the target market during the preliminary market assessment
x_9	Realistic business analysis
x_{10}	Review of the competitors' products
x_{11}	Expenses and sales forecasting
x_{12}	Discount cash flow analysis
x_{13}	Breakeven and return on investment analysis
x_{14}	Informal analysis (guesses and estimates)
x_{15}	Implementation of a strong promotion plan
x_{16}	Forecast of new service's performance
x_{17}	Targeting the advertising, promotion and communication effort towards the right customers
x_{18}	Knowledge of the potential market's size
x_{19}	Analysis of how the product meets customers' needs as opposed to competing products
x_{20}	Analysis of how the product fits the image of the company in the marketplace
x_{21}	Understanding customers' needs
x_{22}	Understanding customers' purchase decisions and purchase behaviour
x_{23}	Strong support for the new product after its launch
x_{24}	Potential customers had a great need for this class of product

These 24 variables can be viewed from five distinct categories: Business/Financial Analysis (x_7, x_8, x_9, x_{10}, x_{11}, x_{12}, x_{13}, x_{14}, x_{15}, x_{19}), Organizational – Internal Consequence (x_{16}, x_{17}, x_{18}, x_{23}, x_{24}), Strategy Focus (x_1, x_2, x_3, x_4, x_6), Market Synergy (x_{20}, x_{21}, x_{22}) and Idea Generation (x_5).

New services with a high degree of management organization and internal consequence in realizing planed activities, forecasting the results of the performance

of a new service in early stages, with a strong support for the new service once it is launched and the awareness of the company about the size of the potential market and needs of the potential customers, had a higher probability of success. Project Focus Strategy was characterized as the commitment level of the management tasked with identifying objectives, arenas of focus and strategic plans for action. In parallel companies strategy is direct related with resource investment and to associate the objectives with the final income and profit of the company. An effective business/financial analysis was characterized as having analytical financial analysis; being thorough and realistic and included customer's and competitor's analysis. Market synergy was characterized as tended to fit well with the existing image of the firm, provided a superior advantage compared to competitor products and were given strong support once launched. At least idea generation was characterized as a systematic effort for the capture and collection of new ideas.

3.3 Multicriteria methodology

Given the classification of the projects as successful or failures, the objective of the analysis is to explore the development of a reliable success identification/prediction model, which aggregates all the relevant information as described by the selected variables. The development of this model can be performed using several well-known statistical and machine learning classification methods. Most of these methods, however, assume that the given classification is defined in a nominal way and that the variables are simple descriptors of the observations. However, in the context of this study, both the classes (successful/failed projects) and the variables are ordinal.

Multicriteria decision aid (MCDA) methods are well-suited for such kind of data, which are often encountered in decision-making situations. Thus, in this study a MCDA classification methodology is employed, namely the UTADIS method, which implements a disaggregation approach.

The UTADIS method leads to the development of an additive value function that is used to estimate the expected outcome of each NSD project. The developed additive function has the following general form:

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$$V(\mathbf{x}_i) = \sum_{j=1}^{n} w_j v_j(x_{ij}) \in [0, 1]$$

where $\mathbf{x}_i = (x_{i1}, x_{i2}, ..., x_{in})$ is the description of project i on the set of n evaluation criteria (independent variables), which in this case correspond to the 24 selected variables, w_j is the trade-off constant of criterion j and $v_j(x_{ij})$ is the marginal value function of project i on criterion j. The trade-off constants non-negative, they sum up to 1 and are often interpreted as proxies for the relative important of the criteria in the mode. On the other hand, the marginal value functions provide a mechanism for decomposing the aggregate result (global value) in terms of individual assessment at the criterion level. Both the global value $V(\mathbf{x}_i)$ and the marginal values $v_j(x_{ij})$, for all $j = 1, \ldots, n$, are normalized in [0, 1], with higher values associated with higher likelihood of success.

To avoid the estimation of both the criteria weights and the marginal value functions, it is possible to use the transformation $u_j(x_{ij}) = w_j v_j(x_{ij})$. Since $v_j(x_{ij})$ is normalized between 0 and 1, it is obvious that $u_j(x_{ij})$ ranges in the interval $[0, w_j]$. In this way, the additive value function is simplified to the following form:

$$V(\mathbf{x}_i) = \sum_{j=1}^{n} u_j(x_{ij})$$

The assignment of a project i into one of the k predefined classes, is determined by comparing its global value $V(\mathbf{x}_i)$ to $k-1$ thresholds $0 < t_1 < t_2 < \cdots$ 1, that distinguish the classes. Thus, a project i is assigned to group ℓ iff $t_\ell < V(\mathbf{x}_i) < t_\ell$. In the two-group setting of this study, the outcome of NSD project i is expected to be successful iff $V(\mathbf{x}_i) \geq t_1$ and failed otherwise.

The estimation process for the additive value function and the cut-off thresholds, uses a set of data to fit the model (training data) using linear programming techniques. The objective of the method is to develop the optimal additive model that minimizes the classification error for the projects in training sample. Detailed description of the mathematical programming formulation used in the UTADIS method can be found in the works of Zopounidis and Doumpos (1999) and Doumpos and Zopounidis (2002). The UTADIS method has been successfully used in several

fields, such as bankruptcy prediction and credit rating (Zopounidis and Doumpos, 1999), stock selection (Zopounidis et al., 1999), auditing (Spathis et al., 2003), environmental management (Diakoulaki et al., 1999), etc.

4. RESULTS

4.1 Experimental setting

Due to the difficulty of obtaining data for NSD in the hotel industry, it was not possible to have a secondary holdout sample for validation purposes. To overcome this difficulty, the bootstrap is used. The bootstrap is performed by constructing, at random (with replacement), 500 bootstrap samples, each consisting of 165 projects (i.e., the bootstrap samples are of the same size as the original sample). According to Efron and Tibshirani (1993, 1997), generally, 100 bootstrap samples are adequate for estimating the error rate of classification models, while more bootstrap replications are required to investigate the stability of the parameters of the model. Since, this analysis involves both the examination of the significance of the selected variables and the analysis of the classification performance, an increased number of 500 bootstrap replications is employed. Each bootstrap sample is used as a training data set for the UTADIS method in order to construct a model for the distinction between successful and failed NSD projects. The model is then tested against the out-of-the-bootstrap observations. This procedure provides a good estimate for the out-of-sample performance of the proposed multicriteria methodology.

4.2 Results

Table 3 presents some statistics (mean, standard deviation, 95% confidence interval) regarding the relative importance of the criteria, estimated using the

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UTADIS methods. The results estimates obtained from the bootstrap analysis, as described earlier. Overall, six criteria account for more than 60% of the total trade-offs. These involve:

1. Informal analysis of the projects (x_{14}, relative weight: 19.46%),
2. Forecasting of new service's performance (x_{16}, relative weight: 12.78%),
3. Analysis of customers' needs for the product (x_{24}, relative weight: 10.15%),
4. Realistic business analysis (x_9, relative weight: 7.92%),
5. Identification of clear strategic objectives (x_1, relative weight: 5.78%),
6. Understanding of customers' purchase decisions and behaviour (x_{22}, relative weight: 5.15%).

As can be observed, criteria x_{14}, x_{16}, x_{24}, x_9 are very significant according to the UTADIS method. These criteria are highly related to the implementation of a business analysis stage also with the predictions on services performance that it would be possible services managers conduct. The importance of business analysis in NSD projects has been emphasized in several studies (Montoya-Weiss and Calantone, 1994; Edgett, 1994; Edgett and Parkinson, 1994; De Brentani and Ragot, 1996; de Brentani, 2001). The importance of these criteria highlights the risky and turbulent environment that prevails in the tourism sector as well as the Greek management practices used until now in the very demanding and competitive hospitality services area. Moreover one could also observe that x_{19}, x_{17}, x_{23}, x_{10} are not very significant according to UTADIS method. This could be explained by the fact that hotel managers consider marketing activities such as identifying the competitors strategy, analyzing the customers needs as well as the launch of new services, very important but routine steps are often undertaken. This simply means that these criteria are not involved enough in the discrimination between success and failure due to the fact that are implemented from the majority of the services managers.

Table 3: Statistics on the relative importance of the criteria

Criteria	Mean	St. dev.	95% CI	Criteria	Mean	St. dev.	95% CI
x_{14}	19.46	5.11	[6.94, 28.12]	x_{18}	2.54	2.60	[0.31, 9.54]
x_{16}	12.78	4.21	[5.76, 22.42]	x_{21}	2.34	1.48	[0.39, 5.99]

x_{24}	10.15	4.55	[2.52, 19.80]	x_7	2.16	1.82	[0.06, 6.52]
x_9	7.92	3.99	[2.32, 16.77]	x_2	2.10	1.62	[0.29, 6.22]
x_1	5.78	3.79	[1.05, 14.12]	x_3	1.88	1.92	[0.22, 6.76]
x_{22}	5.15	3.11	[0.96, 13.38]	x_{11}	1.49	1.40	[0.23, 5.07]
x_6	4.47	2.53	[0.99, 10.23]	x_{15}	1.29	1.47	[0.01, 5.11]
x_5	4.18	2.38	[0.79, 8.92]	x_{19}	0.89	0.82	[0.13, 3.21]
x_{12}	4.14	2.30	[0.79, 9.54]	x_{17}	0.80	0.62	[0.10, 2.45]
x_{20}	3.17	1.76	[0.05, 6.95]	x_{23}	0.64	0.87	[0.01, 3.61]
x_4	2.84	1.93	[0.62, 7.88]	x_{10}	0.59	0.35	[0.01, 1.32]
x_{13}	2.67	2.60	[0.18, 9.78]	x_8	0.56	0.67	[0.01, 2.66]

Detailed classification results are given in Table 4. The results are analyzed in terms of the error rates for each group of projects (successful/failed), as well as for the overall error rate. The leave-one-out bootstrap error rate estimator $Err^{(1)}$ measures the expected error rate from the projects not included in the bootstrap samples. The corresponding results indicate that the multicriteria methodology performs quite well for the successful projects, but its performance for the failed projects is considerably lower. This indicates the diverse characteristics of failed NSD projects, which make the identification of failure more difficult. The overall $Err^{(1)}$ error rate is 12.19%. Efron and Tibshirani (1997) argued that $Err^{(1)}$ is an upward biased estimator of the true error rate and introduced the improved $Err^{(632+)}$ estimator for the overall error rate, which combines $Err^{(1)}$ with the apparent error calculated from the whole sample of projects (re-substitution error), weighted with a factor that takes overfitting into account. The $Err^{(632+)}$ overall error estimate for the proposed methodology is limited to 9.23%, thus indicating the high classification quality of the multicriteria methodology.

Table 4: Summary of classification error rates for the multicriteria methodology

$Err^{(1)}$			
Success	Failure	Overall	$Err^{(632+)}$
6.87	35.20	12.19	9.23

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4.3 Comparative analysis

To evaluate the relative performance of the proposed multicriteria methodology, an extensive comparison with other pattern classification methods is undertaken. The methodologies included in this comparative analysis include: linear discriminant analysis (LDA; Huberty, 1994), logistic regression (LR; Hosmer and Lemeshow, 2000), the *k*-neighbor algorithm (*k*-NN, with $k = 21$; Duda et al., 2001), proximal support vector machines with the linear and the RBF kernel (LPSVM, RPSVM; Fung G, Mangasarian, 2001), as well as classification trees (CART; Breiman et al., 1984).

The comparative classification results are summarized in Table 5. In accordance with our previous observation, the results are consistently better for the successful projects. For this class of projects, the proposed UTADIS multicriteria approach performs considerably better than the other methods, followed by LDA and LR. On the other hand, the best results for the failed group of projects are obtained with k-NN and RPSVM. The overall $Err^{(1)}$ error rate and the $Err^{(632+)}$ estimate, indicate the high discriminating power of the UTADIS models as opposed to the other methods. In both measures, UTADIS provides the lowest error rates, followed by RPSVM.

Table 5: Comparative classification results

	$Err^{(1)}$			$Err^{(632+)}$
	Success	Failure	Overall	
LDA	10.79	37.13	15.74	13.37
LR	10.95	42.46	16.87	14.09
k-NN	16.14	23.73	17.57	17.14
LPSVM	12.10	35.53	16.50	14.59
RPSVM	12.15	26.22	14.80	12.17
CART	13.04	29.31	16.09	15.34
UTADIS	6.87	35.20	12.19	9.23

5. CONCLUSIONS AND FUTURE RESEARCH

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The main goal of this study has been to achieve a better understanding of how successfully new hotel services are developed. This has been accomplished by examining the actual development activities and some of the accompanying organizational matters. A predictive model has been developed which can effectively predict success and failure. This result provides a number of implications for marketing management scholars, for management involved in new service development, as well as for hotel executives

The results of the multicriteria methodology indicate that firms which conducted more rigorous forms of service development activity are more successful at developing and launching new services. This implies that there is a correlation between the eventual success of a new service and the undertaken development process activities. Diffusion of this study into the industry could thus support the management mentality of making a planned approach to new product development and help to reduce the risks associated with developing new services (Edgett and Parkinson, 1994).

This study also has research implications for organizational structures. As suggested by Johne and Snelson (1988), organizational traits have an impact on the ultimate success or failure of a new product. The organizational features are visible in criteria that are able to separate success from failure. All criteria related with organization and internal consequence in management actions have high importance in the model's forecasting ability. This indicates a need for increased intra-organizational involvement and integration among departments in the development of new services. It also highlights the inseparability and perishability of services. The inability to distinguish the development process from the personnel who is involved in delivering it, implies that closer working relationships are needed among functional groups when new services are being developed. Due to the fact that service offerings are not able to be stored, like tangible goods, the simultaneous co-operation of all groups associated with the service is required.

This study has focused on the consumer oriented hotel services sector. As a result, the generalization of the findings to other hotel service sectors and, in general, to other service sector industries is limited. However, it raises interesting questions as

to the potential for generalizing its findings to other sectors of the hotel services industry, and to other service industries in general. Further empirical research is required to determine the transferability of the findings to other service sectors. Cross-cultural comparisons would also be a fruitful area for investigation. A times-series of data would also be interesting to collect, in order to generalize the results to other time periods and to enable the analysis of the out-of-time performance of the models.

More research could also be realised in the effect of organisational factors in the success and failure of new hotel services. It could be for example investigated if some type of organisational structure guarantees optimal results and which types of new services combine themselves better with various types of organisational structures. Critical success factors determined in this study and concluded forecasting model, should be examined in other sectors of services, in order to achieve success and failure prediction in new service development process, thus using a more general approach.

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