INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH
2022, VOL. 60, NO. 14, 4464–4486
https://doi.org/10.1080/00207543.2021.1966540

Taylor & Francis
Taylor & Francis Group



# AI based decision making: combining strategies to improve operational performance

Abdulrahman Al-Surmi [a], Mahdi Bashiri[a,b] and Ioannis Koliousis [c]

[a]School of Strategy & Leadership, Faculty of Business & Law, Coventry University, Coventry, UK; [b]Centre for Business in Society, Coventry University, Coventry, UK; [c]School of Management, Cranfield University, Cranfield, UK

**ABSTRACT**

This study investigates the strategic alignment between marketing and information technology (IT) strategies and provides production and operations decision makers a model for improving operational performance. Based on a comprehensive literature review, the combined strategies were used to develop a novel decision-making framework. The hypothesised relationships of an SEM model are validated with data collected from 242 managers from various industries. An artificial intelligence (AI)–based method is developed using artificial neural networks (ANN) feeding into a decision-making framework which explores the optimality of the combined strategies. The results indicate that (a) IT strategy is positively mediated by marketing strategy on performance and (b) the organisational structure moderates the mediation of marketing strategy on performance. The analysis confirms that the extracted strategies based on the proposed framework have superior performance compared to existing strategies. This paper contributes to the literature by conceptualising and empirically testing the mediation role of marketing strategy on IT strategy, performance and operational decision-making. The use of a novel three-phase decision-making framework which uses AI processes improves operational efficiency, increases insights and enhances the decision accuracy of complex problems at the strategic level in industries such as manufacturing. It could help operations executives to apply effective decisions.

**ARTICLE HISTORY**
Received 9 September 2020
Accepted 30 June 2021

**KEYWORDS**
AI based decision making; SEM; operational strategies; optimal strategy selection; neural network

## 1. Introduction

An important theme in the field of strategic management, operations management, information systems and production research is the concept of alignment (Cao, Baker, and Hoffman 2012). Some studies in production research focus on product design (e.g. Dou, Zhang and Nan 2017), while some have considered the manufacturing and supply chain (e.g. Ivanov, Das, and Choi 2018). Product economy is another avenue of research, which was investigated by Bullinger and Schweizer (2006). This study focuses on the third route within the production research literature and explores the role of organisation strategies (Marketing and Information Technology [IT]) on the product and consequently on business performance. It is worth noting that, in production research, the incorporation of marketing strategy in production planning is known for overall cost reduction and significantly increasing profits (Leitch 1974). Relationship marketing as the main pilar of a marketing strategy aims to build long-term relationships with customers, suppliers and distributors with mutually satisfying customers; this strategy has the key objective of earning and retaining their long-term preference, loyalty and business (Buttle 1996; Foss and Stone 2001; Peck et al. 1999). IT has been advancing in both power and speed over the past decades and has inspired organisations to formulate an IT strategy that facilitates the control of operational costs (Chen, Tu, and Lin 2002). According to Venkatraman (1997), IT strategisation encourages firms to maximise global interconnectivity and data sharing, which allows minimising data redundancy and improving operational efficiency.

The increased technological advancements and market complexity requires all organisations to take advantage of strategic alignment. The importance of aligning business and functional priorities with the different firm strategies – such as manufacturing, marketing, technological and operational – in the pursuit of its objectives is specifically underlined (Ritson 2011). The importance aligning or fitting of business strategy with internal strengths of organisation and external environmental opportunities/threats has been emphasised in the literature. The concept is widely used across the

**CONTACT** Abdulrahman Al-Surmi alsurmi.research@gmail.com School of Strategy & Leadership, Faculty of Business & Law, Coventry University, Coventry CV1 5DL, UK

operation management literature and is classified under either external or internal fit (Schniederjans and Cao 2009). According to Skinner (1974), internal fit refers to the connection and consistency between practices and tasks. External fit emphasises the importance of aligning functional strategies to the overall corporate strategy, leading to a focused and pursuit of corporate objectives (Skinner 1969). The literature presumes misalignment will undermine business performance – that is, the set of symptoms or factors of misalignment that organisations might experience – and indicate that an organisation is not optimised (Luftman 2003); this might include an inappropriate strategy for the external environment or a poor operationalisation of the chosen strategy (Heracleous and Werres 2016).

According to Andrews et al. (2009), it is necessary to ensure that there is a fit between the selected pursuing strategy and the internal characteristics of an organisation. A misalignment between strategy and structure would hinder performance. Alignment has thus become an issue of importance and may even be more challenging today as contemporary organisations undergo a tremendous change in their operational and strategic models. A number of studies have shown the connection between alignment and business performance in the operations management literature. For instance, considering alignment between operations management aspects such as workforce, inventory, organisations and logistics could lead to enhanced business performance (Smith and Reece 1999). The impact of such connection on performance in a manufacturing setting has been considered important within the operations management literature (Joshi, Kathuria, and Porth 2003). Alignment in the IT strategy context is challenging because organisations find it difficult to articulate their IT strategies fully upfront to face environmental dynamism (Yeow, Soh, and Hansen 2018). The evidence is clear that IT strategy contributes to business performance significantly (as does marketing) which are both important for an organisation strategically. However, despite indications that, at an operational level, existing of a closer link between those aforementioned strategies will have a significant impact on business performance, there have been only a limited number of studies examining the strategic linkages between marketing and IT which consider external factors such as environmental dynamism (Al-Surmi, Cao, and Duan 2019; Hooper, Huff, and Thirkell 2007).

A key factor to the profitability and success of many service providers or manufacturers – specifically in today's fast changing technology-based business market – is taking advantage of such a strategic alignment. For instance, Henriques et al. (2019) conceptualised the potential of achieving and strengthening the desired strategic alignment through the integration of artificial intelligence (AI). This powerful analytical technique can provide production and operations decision makers with high quality information that they could not obtain without adopting technologies and business intelligence (Visinescu, Jones, and Sidorova 2017). AI can be used in different stages of manufacturing and operations management. For example, AI can be used in production, quality control or packaging, which improves the productivity of these stages. It can also be used in warehousing and transportation to provide analytical perspectives. Lee et al. (2014), for example, used machine learning to estimate two parameters of the Bass model before launching a new product. They proved that the AI-based estimation outperformed previous traditional models. Diffusion of AI as an analytical tool depends on its analytical accuracy. Li et al. (2015), for example, used data mining and machine learning to analyse available limited information obtained in the experimentation stage of a new product before mass production. There is thus more reason to implement this type of analytical approach to unveil the optimal strategic alignment of marketing and IT for operational performance.

In view of the above, the following problem arises this study tends to fill the abovementioned gap in theorising strategic alignment of marketing and IT. Therefore, this study presents the following research question:

> RQ: How production and operations decision makers can use marketing and IT strategies to improve operational performance using AI?

This paper contributes to operations management research in several ways. First, drawing upon strategic decision-making theory, this paper addresses the mediation and moderation effects of the connection with organisational structure using structural equation modelling (SEM) and bridges the gap in existing literature as recommended by Andrews et al. (2009). Second, there is a lack of research and conceptual frameworks on how to improve existing alignments at both strategic functions, as recommended by Al-Surmi, Cao, and Duan (2019). Third, this paper develops a strategy selection framework using an artificial neural network (ANN), and the best structure for the simulation of which an ANN is constructed is analysed. The data were used in training the neural network to generate possible strategy scenarios, and the performance of each business sector such as manufacturing industry is predicted. Finally, the best strategy for each business sector was extracted by the proposed methodology. This contributes to the literature by employing predictive analytic methods to examine and analyse observations in research models (Shmueli and Koppius 2011). The proposed approach in

this study can be used for production and operations management decision makers. Consequently, an ANN can be used to determine the relationships among variables using available data and as an intelligent tool to make a decision. Although we used it for strategy selection, the proposed approach can be used for various types of decision-making within the manufacturing and supply chain.

In the following sections, we critically review the literature on marketing, IT strategic alignment, AI and operations management, as well as studies which have used both SEM and ANN methods. We also present a research model by formulating a set of three hypotheses based on an examination of the theoretical arguments. We then used the data gathered from 242 respondents to test the model empirically. The results of using the AI-based decision-making framework are provided in section 5. We then discuss the theoretical, methodological and practical implications of the findings from our study and summarise our contributions.

## 2. Literature review

To develop a conceptual understanding of the influence of marketing and IT strategic alignment on operational performance, a systematic literature review was conducted. The identification of relevant articles began with a search through several high-ranking journals (3 and 4 stars categorised by the Association of Business Schools) to identify the primary gaps in the field. The process focused on journal articles that specifically dealt with IT, marketing strategies and typologies. Accordingly, the identification process included searches of relevant published empirical studies using online databases such as Taylor and Francis, Business Source Premier, ScienceDirect, Emerald, JSTOR, Elsevier and EBSChost. The following keywords were used in the searches: strategic alignment, IT strategies, marketing strategies, operational performance, multivariate approach and bivariate approach. This resulted in the identification of over 250 articles from high-ranking journals. To narrow the frame for this research, we selected articles that addressed alignment and strategy, include IT or marketing variables, and also measured firm performance.

The strategic view of operations management goes back to Skinner's ground-breaking research (1969). Although a number of studies considers strategic decision-making theory, their study direction was pointed to operations management of what were, specifically, manufacturing firms (Jemison 1984). In line with prior studies, the present study is based on the strategic decision-making theory in the development of the research model and hypotheses. We then conducted a systematic literature review to investigate the association between IT and marketing strategies across the strategic management and operations management literatures. The application of AI on operations management and the analytical methods of SEM and ANN in previous studies are reviewed.

### 2.1. Marketing and IT strategies

Early research on strategic alignment has emphasised the position of matching functional priorities and business with the firm's strategies (Likert 1961). Prior study outputs also highlighted the importance of aligning external environmental threats/opportunities and internal organisation strengths and with business strategy (Cao and Hoffman 2011). Although Lingle and Schiemann (1996) and Hrebiniak and Joyce (1985) have presented the association between business performance and alignment, the strategic management and operations management literatures presume misalignment will weaken firm performance (Schniederjans and Cao 2009). According to Mollenkopf, Frankel, and Russo (2011), a number of firms fail to attain their strategic business objectives due, in part, to functional inability. For instance, failing to mutually develop consistent strategies such as marketing and other functional strategies is regarded as an absence of alignment (Berry, Hill, and Klompmaker 1999). Achieving alignment means getting an appropriate balance between the actual operational performance and the performance required by the market (Slack and Lewis 2014). According to Piercy et al. (1997), the implementation and development of marketing strategy directly influences other functions, such as production, finance, and personnel. An appreciation of the integration between strategies delivers the key to proper operational decision-making. Poor connections between internal functions and capabilities are critical cause of weakness. Discussion and debate of the connections between marketing and IT strategies are serious for a firm to be competitive in its markets. The fact that management is incapable to connect strategic choices between functions (Yu, Ramanathan, and Nath 2014; Zanon et al. 2013) restricts this argument and the effectiveness of strategic results in any business.

The positive influence of marketing and IT alignment on firm performance is widely reported. Utilising of IT strategies can be measured by how businesses make incorporate market information systems (e.g. collecting competitor and customer information) to help firm strategy (Sabherwal and Chan 2001; Venkatraman 1989). Borges, Hoppen, and Luce (2009) have identified the importance of using new Internet-based technologies to reinforce the production and distribution processes. Strategic IT use can also positively influence

marketing strategies by supporting the marketing activities through, for example, an Internet-mediated market improving business performance (Min, Song, and Keebler 2002).

In sensible terms, alignment of these strategies asserts that IT offers marketing with the systems that it needs to achieve its goals, or, as Henderson and Venkatraman (1989) claimed, IT strategy supports marketing through the improvement of services and products. IT strategy can therefore enhance a business performance well when it is associated with marketing strategy. Several studies have discussed the impact of aligning marketing and IT strategies on operational performance. Jaworski and Kohli (1993), for example, discussed the need to assess the role of additional factors that may influence marketing and IT strategies to investigate the complexities of the relationship and business performance. Hooper, Huff, and Thirkell (2007) have discussed the opportunity for exploring this relationship by providing more specific indications of the influence of alignment, thus strengthening the indicative possible of this method. The relationship might also be persuaded by the industry in which a business operates. For example, market share improvements might be more essential in a developing industry than in a more developed industry where profit might be more essential.

Strategy is the typical path in which a business chooses to attempt to attain its goals and objectives (King 1978) and explains for the business how all of the distinct actions are coordinated to produce a preferred end outcome. It allows the firm to go beyond its competitive environment and adjust to environmental changes to associate its strategic goals with capabilities. In the early 1990s, along with business strategy, there was much interest in strategic alignment, as IT became an integral component of organisations (Gartlan and Shanks 2007). IT strategy is defined as how IT is used to support firm processes and needs (Broadbent and Weill 1993; Henderson and Venkatraman 1989). It is part of the overall firm strategy, although the emphasis is explicitly on technology. Porter and Millar (1985) noted that IT strategy was altering the rules, changing the structure of industries and allowing businesses to generate competitive advantage. IT has become a key element in competitive positioning and a significant feature of everyday business (Gartlan and Shanks 2007).

Sabherwal and Chan (2001) identified three focuses for IT strategies: comprehensiveness, efficiency, and flexibility. The flexibility strategy denotes to using IT to observe marketing information and changes and to provide the foundation for decision-making. This is even with businesses implementing a prospector strategy, because the flexibility strategy is valued highly important in strategic decision support systems and in market information systems. The efficiency strategy refers to using IT to monitor and control daily operations, facilitate operational efficiency, support information sharing and communication linking suppliers and customers and to provide a foundation for decision-making. This is ideally relevant to defender firms, because this strategy is valued highly important in interorganisational systems, operational support systems, and strategic decision support systems (Al-Surmi 2016). The comprehensiveness strategy denotes to employing IT to observe marketing information and market changes, support information sharing and communication linking suppliers and customers and to provide the foundation for decision-making. This is the perfect IT strategy for analyser businesses, because it is valued highly important in all characteristics except the operational support systems characteristic (Al-Surmi 2016).

Much research has considered marketing strategies to keep marketing strategically associated with the business's strategic goals (Baker 2008; Berry, Hill, and Klompmaker 1999) to attain an improved performance (Cavusgil and Zou 1994). Marketing strategy denotes to the decisions related to creating and sustaining competitive advantage and marketing activities (Varadarajan, Jayachandran, and Chris White 2001). Marketing activities are many and different and include product design, research and development, promoting products and setting prices. These activities are very essential when examining environmental factors (competitors and customers), and marketing strategy emphases on ways a business can distinguish itself efficiently from its competitors, capitalising on its unique strengths to supply better value to its customers within a given market (Jain 2000).

Based on the classification by Narver and Slater (1990), there are three types of marketing strategy: competitor-focused, customer-focused, and interfunctional coordination. Competitors and customers care one domain of marketing strategy (Varadarajan 2010), which includes all of the activities involved in obtaining information about competitors and buyers (Narver and Slater 1990). The third marketing strategy, interfunctional coordination, is defined by Narver and Slater (1990) as 'coordinated utilisation of company resources'. It is separated from marketing strategy to describe market competency as the collecting and distribution of information about competitor-focused and customer-focused requirements and purposes. The third strategy type is omitted from this study, in line with the previous studies (Al-Surmi 2016).

Grounded on the summary by Walker and Ruekert (1987), the strategic alignment between environmental

and structural variables and strategy may be important in defining its success. This paper examines how environmental dynamism and organisational structure affect the relationship between marketing and IT strategic alignment and operational performance. While strategic alignment has been regularly researched, there is little consensus about how environmental dynamism and organisational structure affect the association between marketing and IT strategic alignment and operational performance.

### 2.2. Artificial intelligence and operations management

Nishant, Kennedy, and Corbett (2020) have stated that AI has three capabilities: (1) data analysis and learning, (2) human cognition, and (3) emotions and thinking. This study uses AI for its first capability (machine learning). AI as a decision support tool can be used in different applications. For instance, Spanaki et al. (2020) explored the disruptive technologies of AI on agricultural operations. Grover, Kar, and Dwivedi (2020) found that data and AI determine where new oil and electricity are needed in various area of the operations management, such as manufacturing, product/service development and supply chain. They studied the feasibility of using AI with six factors. Their findings were confirmed by Papadopoulos and Spanaki (2017) in their literature review on Industry 4.0 and smart manufacturing. Dhamija and Bag (2020) classified AI studies on operations in six clusters: (1) artificial intelligence and optimisation, (2) industrial engineering/research and automation, (3) operational performance and machine learning, (4) sustainable supply chains and sustainable development, (5) technology adoption and (6) green supply chain management (GSCM), Internet of Things and reverse logistics. The current study falls within cluster 1, which focuses on how AI leads to organisational optimisation, especially across sectors/industries.

According to the review by Toorajipour et al. (2021), many AI techniques can be applied to supply chain management (SCM), including ANNs, fuzzy logic, genetic algorithm and data mining. ANNs are the most influential and prevalent technique used for information processing to find patterns and can be used in a range of applications within the SCM, including sales forecasting, decision support systems and customer segmentation. Li (1994) mentioned some applications of the ANN in business, including the decision-making of financial institutions based on the customers' behavioural scoring system, improving product quality through predictive process control systems for manufacturers, security control in airlines, investment management with risk control and prediction of stock price indexes. Here, we use an ANN as part of a decision support system to promote better decision-making.

Benzidia et al. (2019) considered four areas for AI application development: (1) leisure, shopping and social interaction; (2) work, income and creative impact; (3) health and security; and identity. These were then combined with following human impact related areas – AI competence, AI decisions, AI autonomy and AI trust – to reveal that acceptance resistance for AI trust in the third and fourth category (identity and health) applications are much higher. Acceptance resistance of AI autonomy is also high for identity applications. This study works at the intersection of AI decisions for work and creative impact, for which it appears, based on the provided matrix by Benzidia et al. (2019), that the acceptance resilience will be moderately low.

Kwong, Jiang, and Luo (2016) developed an AI-based methodology to integrate design, engineering and marketing aspects simultaneously to design new product specifications. They used fuzzy regression to model customer satisfaction and costs, and then used a non-dominated sorting genetic algorithm-II (NSGA-II) to solve a bi-objective mathematical model. They evaluated their proposed AI-based decision-making approach for an electronic iron design. Bag et al. (2021) did a study on the mining and industry of mineral processing in South Africa and showed that big data–powered AI has a significant effect on the customer, user and external market knowledge creation, which in turn has a significant impact on firm performance, as mediated by B2B marketing rational decision-making. Dogru and Keskin (2020) reviewed recent applications of AI in supply chain and operations management. They focused on healthcare, manufacturing and retail operations and extracted the main challenges and opportunities of using the AI. Canhoto and Clear (2020) found that AI and machine learning may have some value destruction potential as a business tool and noted that they should be diagnosed properly.

Table 1 shows a comparison of previous studies related to the decision aid using SEM and/or AI adopted in production research and operations management.

After confirming the applicability of AI and ANNs for our proposed model, it was also necessary to consider relevant applications of SEM (Table 2). According to the above reviewed articles, AI has been used in various dimensions of operations management. It can be used as a decision support tool, and this aspect is considered in the current study. According to the previously reviewed papers, ANN is one of the most useful tools in operations management. Previous studies confirm that AI and ANN have been widely used in different operations

**Table 1.** A summarised review of previous studies using SEM or AI.

| Paper | Approach | Main innovation |
|---|---|---|
| Adebanjo, Teh, and Ahmed (2018) | SEM | Considered the supply chain integration and innovative capabilities and investigated on the relationship between above factors on the manufacturing performance |
| Baryannis et al. (2019) | AI | They provided a comprehensive review of supply chain risk management (SCRM) literature that have considered the artificial intelligence (AI) |
| Bevilacqua, Ciarapica, and De Sanctis (2017) | SEM | They considered operational responsiveness and realised that it is partially connected to a company Lean strategy |
| Bi et al. (2019) | SVM and ANN | Proposing of a method to model customer satisfaction from online reviews was another innovation of their study.<br>They used SVM to extract Customer Satisfaction Dimensions (CSDs) and then used a neural network to find the relationship between the CSDs and customer satisfaction. |
| Chong et al. (2013) | Neural Network | They focused on adoption of c-commerce and realised that it can be predicted by interorganisational relationships and knowledge-management processes |
| Dubey et al. (2021) | SEM | They realised that supply chain's ripple effect can be decreased or quickly can be recovered after disruptions by improving information-processing capacity and supply chain resilience |
| Hou et al. (2019) | Neural Network | Review of various methods for the Prediction purpose. They mentioned that There are some classical models like support vector machine (SVM), logistic regression (LR), naive Bayesian (NB), and classification and regression tree (CART), which has been used for a prediction purpose |
| Huo, Haq, and Gu (2021) | SEM | They focused on different types of supply chain learning including internal, supplier, and customer learning and investigated the impact of information sharing on above factors to achieve flexibility performance |
| Kumar et al. (2015) | SEM | They developed a decision support system based on a structural equation modelling following GSCM taxonomy for managers |
| Kusiak (2020) | GANs and CNNs | Considering two types of Neural Networks in the manufacturing. |
| Mendes and Machado (2015) | SEM | They considered the relationship between employees' skills and MF to investigate on their impact on business performance |
| Miao et al. (2020) | SEM | Patient value dimensions were considered to extract their relationships with satisfaction of patients and their loyalty |
| Migdadi and Abu Zaid (2016) | SEM | They empirically tested the relationship between ERP-related Knowledge Management Competence dimensions and the extended Enterprise Resource Planning System Success construct |
| Thirupathi and Vinodh (2016) | SEM | They investigated on the usage of ISM to establish structural relationship between sustainable manufacturing enablers and there exist structural relationship between the enablers |
| Trappey et al. (2013) | ANN | Automatically classify and search knowledge documents stored in huge online patent corpuses |
| Tsai and Hung (2016) | ANN | Four dimensions of the SC relationship quality is predicted using an ANN with using 4 SC performance indicators. |
| Wang and Lin (2006) | Fuzzy hybrid | Decision-aid model for selecting partners |
| Zhang, Guo, and Zhao (2017) | SEM | They investigated the impact of servitisation and operational performance |

**Table 2.** A summarised review of previous studies using the hybrid method of SEM and ANN.

| Ref | Method | Prediction | Statistical Test | Decision Making | Optimal decision | Scenario generation and simulation | Application |
|---|---|---|---|---|---|---|---|
| Cao, Jiang, and Wang (2016) | SEM-SVM | * | * | | | | Customer demands |
| Priyadarshinee et al. (2017) | SEM-ANN | * | * | | | | Cloud computing adoption |
| Raut et al. (2018) | SEM, ANN and ISM | * | * | * | | | Cloud computing adoption |
| Tan et al. (2014) | SEM-ANN | * | * | | | | Mobile Learning |
| Foo et al. (2018) | PLS–ANN | * | * | * | | | Green and sustainable supply chain management |
| Leong et al. (2019) | SEM-ANN | * | * | * | | | Social media addiction |
| Current Research | SEM-ANN | * | * | * | * | * | IT and Marketing strategies |

management applications and have had a significant impact on firm performance. Although there are many benefits for the use of AI in operations management, there are challenges, which have also been studied. The current study applied ANN as an AI tool for decision support with a focus on the manufacturing sector. This study confirms the usability of AI in operations management, but the usage of AI in this study is different from previous applications.

### 2.3. Structural equation modelling and artificial neural network

Cao, Jiang, and Wang (2016) proposed a customer demand prediction approach for customer satisfaction in the service-oriented manufacturing sector; their study used SEM to analyse the relationship between the customer satisfaction index and related variables. A support vector mechanism was then used to predict customer demand in a case study.

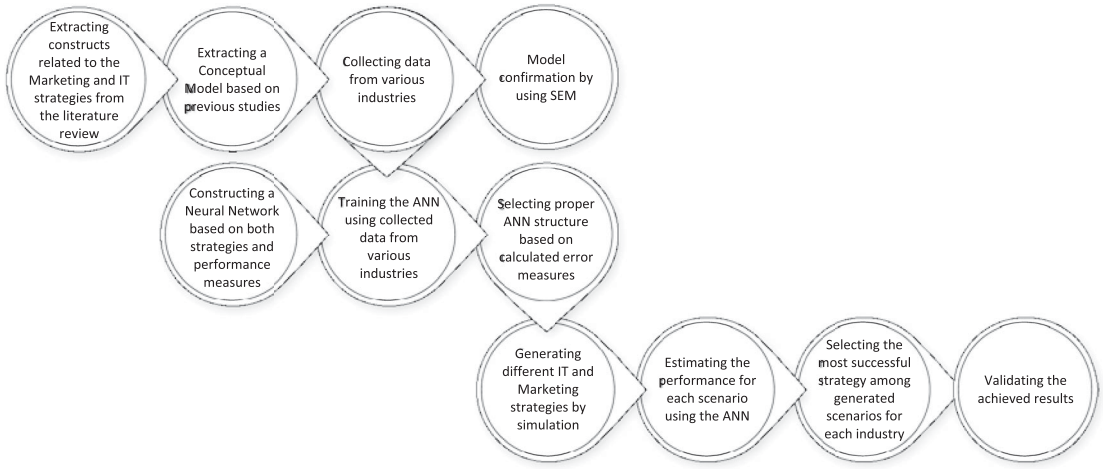



**Figure 1.** An illustrative research methodology map.

Adoption of cloud computing in Indian organisations has been studied using a hybrid method of SEM and ANN (Priyadarshinee et al. 2017). Raut et al. (2018) then completed the previous research by analysing a hybrid method involving SEM, ANN and interpretive structural modelling (ISM), called SEANIS. Significant factors which influence cloud computing adoption were extracted, and the results of the SEM were used as an input for the ANN. They proposed a hybrid approach for organisational decision makers to make appropriate choices to improve performance (Raut et al. 2018).

Tan et al. (2014) studied mobile learning using the hybrid SEM/ANN method. They used the SEM to statistically test a different hypothesis; then, three different neural networks were constructed and analysed. Foo et al. (2018) evaluated the effect of the implementation of GSCM on sustainability in 178 Malaysian firms using a hybrid PLS-ANN approach. After statistical analysis of the conceptual model using SEM, the importance of each variable was determined using the ANN. Leong et al. (2019) considered social media addiction using a hybrid SEM-ANN method, which allowed them to predict this type of addition, using analysis based on the Big Five Model (BFM) and Use and Gratification Theory (UGT).

## 3. Research design

Previous studies which used a hybrid method involving SEM and ANN in various applications mostly concentrated on prediction, as reported in Table 2. In line with those prior studies, this study considers the hybrid method for prediction, as well as decision-making in selecting the best scenario, which confirms the methodological contribution of the current study. The current study also focuses on IT and marketing strategies, which have not previously been considered in this light. The current study has three main phases. The first phase entailed developing and confirming the model that marketing and IT strategies effect marketing performance, as mediated by environmental dynamism and organisational structure. After extracting an efficient neural network based on the gathered data from various industries, the second phase entailed the construction of an ANN, which allowed the prediction of industry performance based on the selected marketing and IT strategies. In the final phase, all of the different possible scenarios were generated for each business sector as predicted using the trained ANN. The best scenario was then extracted for each business sector. Finally, a follow-up questionnaire was used with the same industries to determine their targeted strategies and confirm the performance of the proposed model. The main steps of the proposed methodology are illustrated in Figure 1.

## 4. Theoretical framework

This section focuses on theoretical development using both SEM and ANN. The theoretical models are presented first, and then the results are discussed.

### 4.1. SEM research model

Moderating effects play an important role when investigating the association between strategy and operational performance (Allen and Kilmann 2001), and a number of studies have integrated the mediation effect when investigating interactions across various organisational strategies (Pereira-Moliner et al. 2012; Sahoo and Yadav 2017; Tortorella et al. 2019). This study builds on existing

theory and aligns four variables using novel moderation and mediation effects.

The approach describes the mediation of marketing strategy on IT strategy, which is moderated by environmental dynamism and organisational structure to offer a deeper view of marketing and IT strategic alignment. This multi-staged approach will be used to conceptualise and empirically test the influence of this strategic alignment on operational performance. To the best of our knowledge, this is a novel approach.

Market orientation enables simplified emphasis and vision in terms of an organisation's strategy, which leads to greater performance (Kohli and Jaworski 1990). Although the results on this association are questionable (e.g. Tuominen and Pekkarinen 2005), some empirical researches (e.g. Han 1998; Jaworski and Kohli 1993; Matsuno, Mentzer, and Özsomer 2002; Narver and Slater 1990) with comparatively reliable findings offer support – together in total and comparative terms – for the existence of a positive association between factors. Resources that assist value formation, for example market orientation, are possible foundations of competitive advantage that involve high barriers for competitors to match (Fahy and Smithee 1999; Noble, Sinha, and Kumar 2002). There may thus be a direct effect of marketing strategy on performance leading to the following hypothesis:

H1a: Marketing strategy is positively associated with performance

Strategic information systems have been revealed to have positive results for competitive advantage have. IT has been shown to improve performance in individual business cases by distinguishing services and products and maximising market share, dropping transaction and operation costs (Wiseman 1988). There has been a lasting discussion, however, on whether competitive advantage can be sustained (Clemons 1986) and on the sense of competitive advantage (Benjamin and Morton 1988). The indefiniteness of previous researches can be credited to conceptual and theoretical immaturity (Huber 1990; Gurbaxani and Whang 1991), to methodological complications related to the assessement of IT and performance and to un-controlled impenetrable variables (Weill and Olson 1989a, 1989b). The outcomes gained from case studies also cannot simply be matched or generalised. The effect IT on performance remains to be established empirically. Thus, it is believed that there is a direct influence of IT strategy on performance leading to the following hypothesis:

H1b: IT strategy is positively associated with performance

Marketing strategy is the centre and incentive of the customer relationship management (CRM) initiative. This is aligned with the principal belief that the thought of marketing strategy is the foundation of fruitful CRM completions. The emphasis on organisational reshape and the combined efforts of marketing and IT managers in strategy construction rather than technological excess is likely to lead to critical practical addition at the organisational level without ignoring IT potential. This combination of viewpoints shows, in a summarised way, what has been learned about CRM completion from the past. Thus, it is believed that there is a direct effect of IT strategy on marketing strategy leading to the following hypothesis:

H1c: IT Strategy is positively associated with marketing strategy

The study has evidently demonstrated that together IT and marketing, separately in their own right, use a positive effect on business performance. Several researches have also shown a positive association between business and IT alignment and business performance. Zhu and Nakata (2007) have proposed that, where there is a near connection between IT and marketing (not essentially at a strategic level), the influence on business performance seemed to be substantial. The present study hypothesises a comparable result for the association between IT and marketing at the strategic level. Thus, it is believed that there is an indirect effect of the mediating role of marketing strategy on performance, leading to the following hypothesis:

H1d: The impact of IT strategy on performance is positively mediated by marketing strategy

Numerous studies have correlated the various aspects of the association between environmental dynamism and IT strategy. Oliver (1991), for example, found that firms faced highly competitive weight to accept a growth-oriented strategy to use the main assets and attain superior competitive. Thus, it is believed that there is a direct effect of environmental dynamism on IT strategy, leading to the following hypothesis:

H2a: Environmental dynamism is positively associated with IT strategy

Isabella and Waddock (1994) found a positive association between executive assurance and business performance against strategic environmental valuation and decision. Mia and Clarke (1999) suggested that this enhanced firm performance under circumstances of amplified competition and presented a positive association between firm performance and the concentration of

competition in the market. Thus, it is believed that there is a direct effect of environmental dynamism on performance and an indirect effect of the moderating role of environmental dynamism leading to the following two hypotheses:

H2b: Environmental dynamism is positively associated with performance

H2c: Environmental dynamism moderates the mediation of marketing strategy on performance

The decentralisation – centralisation problem was the earliest to be studied up by scholars based on the evidence of Ein-Dor and Segev (1982). To date, however, there has been no unequivocal empirical confirmation of this premise. IT is believed to assist decentralisation of control and designation of decision power by easing the distribution and distributing of information through all levels and units of the business (Huber 1990; Leifer 1988). Several applications of IT can indicate to enlarged formalisation by demanding proper depictions of object systems and decision processes to be reinforced (Huber 1984). IT usage can encourage structural complexity – that is, a more distinguished and dedicated structure, by growing the placement of specialists needed to carry out an operation, control activities, and systems development (Blau et al. 1976; Robey 1981).

Opposite causality is also possible. Decentralised businesses are expected to create a decentralised IT function and apply disseminated software and hardware applications (Ahituv, Neumann, and Zviran 1989; Ein-Dor and Segev 1982). Formalised organisations are those in which more management methods such as project management, quality control, inventory control, and financial analysis are applied; in turn, these need more advanced information support (Raymond 1990; Raymond, Pare, and Bergeron 1995) and information resource management (Olson and Chervany 1980). A complex structure indicates more harmonisation, communication and control devices; this in turn needs a structure that can be assisted or improved by IT (Robey 1981; Leifer 1988). It is therefore believed that there is a direct effect of organisational structure on IT strategy, leading to the following hypothesis:

H3a: organisational structure is positively associated with IT strategy

Moderating structures should be expressed if the subsequent performance and efficiency advances are to be great. For example, attaining benefits from new IT tasks is restricted upon the formation of particular subunits, the appointment of a skilled team and the formation of tools to harmonise their efforts (Bergeron and Raymond 1992; Raymond, Pare, and Bergeron 1995; Sipior and Garrity 1992). Equally, suitable structures can substitute the development of IT usage and ease its management. For instance, organisationally advanced businesses are more suitable to apply the strategies needed to cope the dangers and earn the competitive advantages related with end-user computing (Alavi and Weiss 1985; Henderson and Treacy 1986). Thus, it is believed that there is a direct effect of organisational structure on performance, which leads to the following hypothesis:

H3b: organisational structure is positively associated with performance

Using the moderating approach, organisation researchers were able to approve that great performing organisational functions moderated a distinguished and decentralised structure with non-routine operations technology (Alexander and Alan Randolph 1985; Argote 1982). While no such outputs can be discovered in the IT literature, one can make similar assumptions. Thus, it is believed that there is an indirect effect for the moderating role of organisational structure, which leads to the following hypothesis:

H3c: organisational structure moderates the mediation of marketing strategy on performance

All hypothesised relationships are depicted in the research model (Figure 2). The proposed model is made up of six constructs and their relationships. This study examines the point to which strategic alignment has an impact on operational performance. The study specifically establishes that strategic alignment has a direct effect on operational performance. This leads to the consideration that, in addition, there may be other relevant effects that change or improve operational performance; it would be interesting to see, for example, whether the alignment of marketing strategy can modify the relationship of IT strategy and operational performance (mediation). Likewise, this study also considers whether environmental dynamism and organisational structure can strengthen the relationship between marketing strategy and operational performance (moderation).

### 4.2. ANN research model

After considering the constructs, a multi-layer ANN was constructed with twenty-two inputs and five outputs. The ANN was trained with training data to extract the best weights (W) and bias (b) in the model with an iterative algorithm. Test data were then used to check ANN performance in predicting the performance variables. The ANN-based model is illustrated in Figure 3.

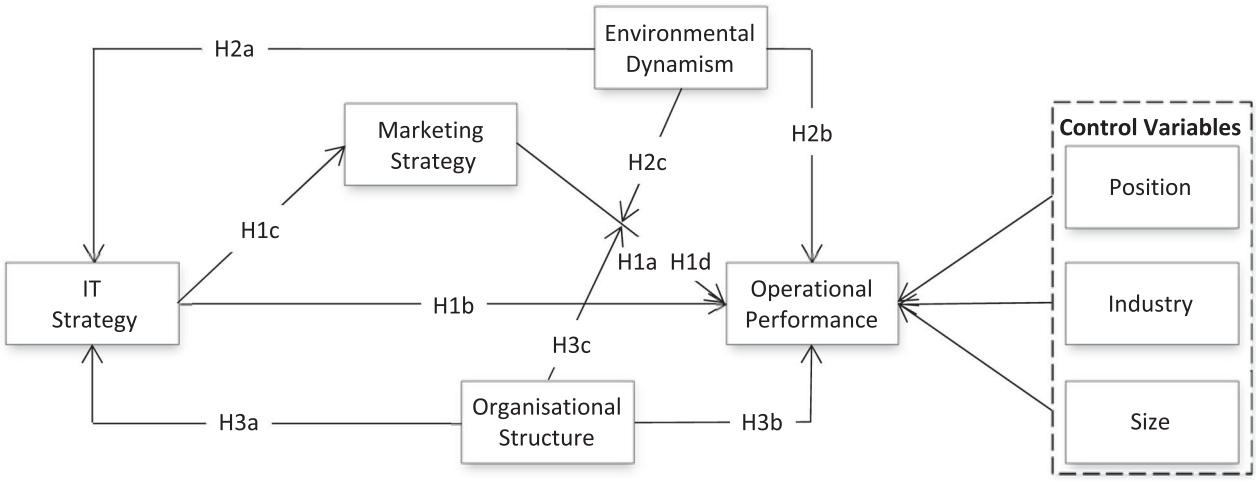



**Figure 2.** SEM research model.

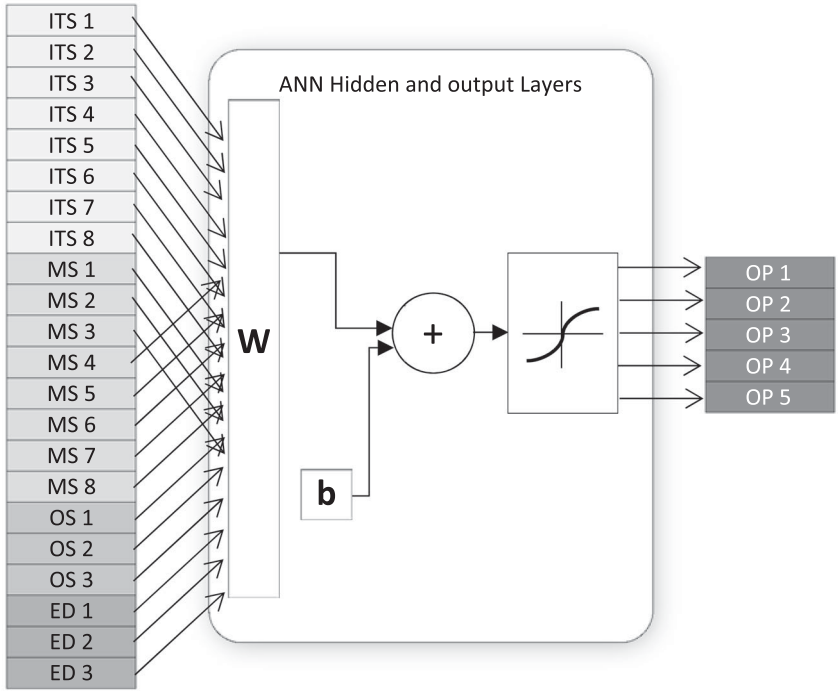



**Figure 3.** ANN model for the structural equation modelling.

### *4.3. Measurements*

To empirically test the above hypotheses, twenty-seven measurements of marketing strategy, IT strategy, environmental dynamisms, organisational structure and operational performance were adopted from the strategic alignment literature listed in Table 3. The measurements have been extracted from Al-Surmi (2016). A seven-point Likert scale ranging from 'strongly disagree' to 'strongly agree' was used to assess the degree of change.

IT strategy was measured using eight indicators obtained from Sabherwal and Chan (2001) and Dong, Liu, and Yin (2008). The measures indicate the employed IT strategy (i.e. flexibility, efficiency or comprehensiveness) in the organisation according to the established IT strategy dimensions.

The marketing strategy was assessed using eight items adapted from Narver and Slater (1990) and Olson, Slater, and Hult (2005). McDaniel and Kolari (1987) debated that dissimilar organisational kinds would have unlike marketing strategies, so these measures will distinguish whether the business is competitor or customer focused. The previous will be interested with openness

**Table 3.** Measurements.

| Formative constructs | Reflective constructs | Indicators | Sources |
|---|---|---|---|
| IT Strategy | Flexibility | ITS1: Our organisation uses competitive intelligence systems | Sabherwal and Chan (2001), Dong, Liu, and Yin (2008), and Al-Surmi (2016) |
| | | ITS2: Our organisation use IT for product marketing and promotion | |
| | Efficiency | ITS3: Our organisation use IT in business processes | |
| | | ITS4: Our organisation use IT to support research and development | |
| | | ITS5: Our organisation use IT to support manufacturing | |
| | Comprehen-siveness | ITS6: Our organisation use IT to support strategic planning and decision-making | |
| | | ITS7: Our organisation use IT in risk analysis of processes | |
| | | ITS8: Our organisation use IT in human resource management | |
| Marketing Strategy | Customer-focused | MS1: Our organisation continuously tries to discover additional needs of our customers of which they are unaware | Olson, Slater, and Hult (2005) and Narver and Slater (1990) |
| | | MS2: Our organisation incorporates solutions to unarticulated customer needs in our new products and services | |
| | | MS3: Our organisation brainstorms on how customers use our products and services | |
| | | MS4: Our organisation innovates even at the risk of making our own products obsolete | |
| | Competitor-focused | MS5: Our organisation rapidly responds to competitive actions | |
| | | MS6: Our organisation's top management discusses competitor's strategies | |
| | | MS7: Our organisation targets opportunities for competitive advantage | |
| | | MS8: Our organisation's salespeople collect competitor information | |
| Environmental Dynamism | | ED1: Product/services quickly become obsolete in our industry | Baum and Wally (2003), and Al-Surmi (2016) |
| | | ED2: Actions of competitors are quite easy to predict | |
| | | ED3: Consumer tastes are fairly easy to forecast in our industry | |
| Organisational Structure | | OS1: There can be little actions taken here until a supervisor approves a decision | Stathakopoulos (1998), and Al-Surmi (2016) |
| | | OS2: I have to ask my boss before I do almost anything | |
| | | OS3: Any decision I make has to have my boss's approval | |
| Operational performance | | OP1: The sales growth position is much better than our principal competitors | Croteau and Bergeron (2001), and Kearns and Sabherwal (2006) |
| | | OP2: The market share gains are much better than our principal competitors | |
| | | OP3: The return on investment position is much better than our principal competitors | |
| | | OP4: The net profit position is much better than our principal competitors | |
| | | OP5: The financial liquidity position is much better than our principal competitors | |

to information about the articulated and latent requirements of both potential and current customers (Kohli and Jaworski 1990), while the final would be more interested with openness to information about strategies and competitors (Slater and Narver 1995).

Operational performance was measured using five items obtained from Croteau and Bergeron (2001) and Kearns and Sabherwal (2006). This construct is linked to the applied information gathered from the participants. It mirrors the respondents' view of organisational market share, sales growth, and return on investment (Venkatraman 1989). Environmental dynamism was measured using three indicators adapted from Baum and Wally (2003) to assess the level of the dynamic environment. Organisational structure as measured using three items adapted from Stathakopoulos (1998) to assess the level of centralisation.

## 5. Analysis and results

In this section the gathered 242 questionnaire data across various industries are interpreted through the applications of SEM and ANN.

### 5.1. Sample and data collection

To analytically assess the hypotheses, a questionnaire survey of private businesses listed in the Ministry of Industry and Trade in the MENA region from different sectors were randomly chosen with participants consisting of marketing and IT managers, which assist in avoiding the likely bias in single-sided self-reported data (Wu, Straub, and Liang 2015). Because the sample included a variety of industries, there was thus a reasonably similar context for respondents and the sample was broad enough

for the results to be generalisable (Olson, Slater, and Hult 2005).

### 5.2. Descriptive statistics

At first the sample frame consisted of 1,201 firms from the public and private sectors. To choose a final sample, all public sectors firms were omitted because this research concentrated on how organisations can improve their market growth through strategic alignment, which is less appropriate in the public sector. Businesses recognised not to have IT foundation were omitted. The remaining sample included 700 firms, and of these, 400 agreed to participate.

In total, 400 questionnaires were spread to executives and managers personally. One week later, 187 were returned and a reminder was sent to the others. In total, 257 questionnaires were collected for a response rate of 64%. Because of the high response rate, non-response bias did not pose a significant problem. The demographic results indicate that 31% of respondents were IT managers, 32% marketing managers and 37% business managers, of which 73% of all managers had 4–10 years of managerial experience, while 27% claimed to have more than 10 years of managerial experience. Moreover, 30% respondents came from the telecom industry followed by 25% from the banking and finance sector. From the entire sample, 18% were from firms with 50–249 employees, 38% from firms with 250–999 employees and 33% from firms with more than 1,000 employees.

Data screening was completed. The first step was to eliminate incomplete cases that had more than 10% missing data, because these were likely to result in biased analysis (Tabachnick and Fidell 2001). Out of the 257 cases, a total of 15 cases were omitted, leaving 242 valid cases. Little's MCAR test was then performed to determine how to replace the missing data. The test was proved not significant ($p = 0.493$), suggesting that the data in the sample were missing completely at random. Next, cases with missing data were replaced by the median using SPSS.

### 5.3. SEM analysis

This study highlighted the quality criteria and began by checking the internal consistency reliability to ensure validity. The acceptable value for the alpha coefficient is between 0.7 and 0.9 representing high reliability and between 0.5–0.7 representing moderate reliability (Kapoor et al. 2014). Table 4 shows the Cronbach's alpha values for the reflective constructs, all of which displayed high reliability, except for environmental dynamism, which showed low reliability. The construct did not improve with the deletion of any item, but was nevertheless retained for subsequent analysis.

**Table 4.** Overview of indicators and measures of reliability and validity.

| Constructs and indicators | Outer loadings | T Statistics | *P* Values |
|---|---|---|---|
| **IT Strategy ($\alpha$ = .88; AVE = .91; CR = .55)** | | | |
| ITS1 | 0.67 | 13.67 | 0.00 |
| ITS2 | 0.79 | 23.97 | 0.00 |
| ITS3 | 0.77 | 20.62 | 0.00 |
| ITS4 | 0.80 | 28.42 | 0.00 |
| ITS5 | 0.65 | 12.62 | 0.00 |
| ITS6 | 0.81 | 28.20 | 0.00 |
| ITS7 | 0.76 | 20.74 | 0.00 |
| ITS8 | 0.68 | 14.93 | 0.00 |
| **Marketing Strategy ($\alpha$ = .88; AVE = .90; CR = .54)** | | | |
| MS1 | 0.67 | 12.89 | 0.00 |
| MS2 | 0.77 | 27.42 | 0.00 |
| MS3 | 0.74 | 23.00 | 0.00 |
| MS4 | 0.72 | 21.65 | 0.00 |
| MS5 | 0.73 | 16.33 | 0.00 |
| MS6 | 0.76 | 23.02 | 0.00 |
| MS7 | 0.79 | 32.11 | 0.00 |
| MS8 | 0.69 | 17.53 | 0.00 |
| **Organisational Structure ($\alpha$ = .63; AVE = .74; CR = .50)** | | | |
| OS1 | 0.85 | 7.99 | 0.00 |
| OS2 | 0.59 | 2.76 | 0.01 |
| OS3 | 0.65 | 3.21 | 0.00 |
| **Environmental Dynamism ($\alpha$ = .44; AVE = .71; CR = .45)** | | | |
| ED1 | 0.60 | 3.96 | 0.00 |
| ED2 | 0.65 | 4.12 | 0.00 |
| ED3 | 0.74 | 5.38 | 0.00 |
| **Operational performance ($\alpha$ = .92; AVE = .94; CR = .75)** | | | |
| OP1 | 0.83 | 33.09 | 0.00 |
| OP2 | 0.91 | 68.09 | 0.00 |
| OP3 | 0.90 | 51.37 | 0.00 |
| OP4 | 0.88 | 42.87 | 0.00 |
| OP5 | 0.81 | 24.99 | 0.00 |

To ascertain the convergent and discriminant validity of the factors, the loadings of each item onto the respective factor should be above 0.6. To determine the reliability of a factor, a Cronbach's alpha of over 0.6 was specified (Hair et al. 2013). All indicators achieved good reliability, including the square multiple correlation (the square of the loadings); in this case, no indicators were eliminated Table 5.

The discriminant validity of the measurement model was determined by examining the correlations between constructs and ensuring that the square root of the AVE of a construct was greater than the correlations between the construct and other constructs (Chwelos, Benbasat, and Dexter 2001). These are shown in Table 6.

The structural model relationships are presented in Figure 4. The model shows the path coefficient and the significance and relevance of the relationships. There is a remarkable relationship among IT strategy, marketing strategy and operational performance. Based on the path coefficient and moderation effect (Table 7) and the full mediation effect (Table 8), it appears that strategic alignment of IT and marketing strategy may indeed

**Table 5.** Cross loadings.

| | Environmental dynamism | IT strategy | Marketing strategy | Operational performance | Organisational structure |
|---|---|---|---|---|---|
| ED1 | **0.60*** ** | 0.15 | 0.19 | 0.10 | 0.17 |
| ED2 | **0.65*** ** | 0.20 | 0.22 | 0.12 | 0.24 |
| ED3 | **0.74*** ** | 0.26 | 0.20 | 0.26 | 0.10 |
| ITS1 | 0.24 | **0.68*** ** | 0.43 | 0.24 | 0.29 |
| ITS2 | 0.27 | **0.80*** ** | 0.56 | 0.33 | 0.26 |
| ITS3 | 0.27 | **0.77*** ** | 0.48 | 0.23 | 0.21 |
| ITS4 | 0.21 | **0.79*** ** | 0.62 | 0.33 | 0.31 |
| ITS5 | 0.26 | **0.66*** ** | 0.46 | 0.22 | 0.25 |
| ITS6 | 0.29 | **0.80*** ** | 0.61 | 0.38 | 0.09 |
| ITS7 | 0.19 | **0.75*** ** | 0.58 | 0.40 | 0.18 |
| ITS8 | 0.10 | **0.66*** ** | 0.49 | 0.24 | 0.19 |
| MS1 | 0.21 | 0.45 | **0.65*** ** | 0.32 | 0.16 |
| MS2 | 0.22 | 0.61 | **0.76*** ** | 0.36 | 0.10 |
| MS3 | 0.22 | 0.56 | **0.72*** ** | 0.35 | 0.18 |
| MS4 | 0.30 | 0.53 | **0.73*** ** | 0.44 | 0.26 |
| MS5 | 0.13 | 0.50 | **0.74*** ** | 0.40 | 0.08 |
| MS6 | 0.27 | 0.52 | **0.79*** ** | 0.52 | 0.22 |
| MS7 | 0.23 | 0.56 | **0.81*** ** | 0.46 | 0.23 |
| MS8 | 0.15 | 0.52 | **0.68*** ** | 0.31 | 0.16 |
| OP1 | 0.26 | 0.41 | 0.52 | **0.83*** ** | 0.19 |
| OP2 | 0.28 | 0.40 | 0.55 | **0.91*** ** | 0.21 |
| OP3 | 0.19 | 0.33 | 0.46 | **0.91*** ** | 0.21 |
| OP4 | 0.20 | 0.28 | 0.42 | **0.88*** ** | 0.18 |
| OP5 | 0.24 | 0.32 | 0.40 | **0.81*** ** | 0.18 |
| OS1 | 0.23 | 0.31 | 0.29 | 0.21 | **0.85*** ** |
| OS2 | 0.09 | 0.07 | 0.01 | 0.08 | **0.59*** ** |
| OS3 | 0.10 | 0.13 | 0.06 | 0.12 | **0.65*** ** |

**Table 6.** Inter-construct correlations and square root of AVE.

| | | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|
| IT Strategy | **(1)** | **0.74** | | | | |
| Environmental Dynamism | **(2)** | 0.31 | **0.67** | | | |
| Marketing Strategy | **(3)** | 0.73 | 0.29 | **0.74** | | |
| Operational performance | **(4)** | 0.41 | 0.27 | 0.54 | **0.87** | |
| Organisational Structure | **(5)** | 0.30 | 0.23 | 0.24 | 0.22 | **0.71** |

**Table 7.** Path coefficient and moderation effect.

| | Original sample | T Statistics | *P* Values |
|---|---|---|---|
| ITS - > MS | 0.73*** | 17.12 | 0.00 |
| ITS - > OP | −0.08$^{ns}$ | 0.97 | 0.33 |
| ED - > ITS | 0.26*** | 4.15 | 0.00 |
| ED - > OP | 0.08$^{ns}$ | 1.10 | 0.27 |
| MS - > OP | 0.47*** | 5.43 | 0.00 |
| OS * MS - > OP | 0.15*** | 2.03 | 0.04 |
| ED * MS - > OP | −0.09$^{ns}$ | 1.64 | 0.10 |
| OS - > ITS | 0.24*** | 3.47 | 0.00 |
| OS - > OP | 0.06$^{ns}$ | 0.81 | 0.42 |

positively affect operational performance. The analysis also indicated that the research model explained variance in performance with an $R^2$ value (0.37) higher than the threshold of 0.33 indicated by Chin, Marcolin, and Newsted (1998).

The results shown in the table empirically indicate that the relationship of ITS to MS is positive at 0.73 and significant at 0.001, so hypothesis H1c is accepted. For the ITS variable, the relationship to OP is negative and not significant, so hypothesis H1b is rejected. The ED relationship to ITS is positive at 0.26 and significant, so hypothesis H2a is accepted. The ED relationship to OP is positive 0.08 but not significant, so hypothesis H2b is rejected. The MS relationship to OP is positive at 0.47 and significant, so hypothesis H1a is accepted. The moderation of OS on MS and OP is positive at 0.15 and significant, so hypothesis H3c is accepted. The moderation of ED on MS and OP is negative and not significant, so hypothesis H2c is rejected. The OS relationship to ITS is positive 0.24 and significant, so hypothesis H3a is accepted. The OS relationship to MS is positive 0.06 but not significant, so hypothesis H3b is rejected.

To test whether the control variables have a significant effect on performance, the direct relationship was computed using the PLS algorithm. Although the control variables have little influence on operational performance, with $R^2$ value increased from 0.36–0.37, the path coefficient revealed that the two control variables do have a significant effect (see Figure 4). This suggests that industry configuration and manager's job position do explain variance in all of the performance components (Jabbour et al. 2015). For industry configuration, there is a negative significant effect on operational performance, while the manager's job position has a weak positive effect.

Table 9 summarises the testing results of all hypotheses. This study empirically tested 10 hypotheses and only 6 were accepted.

### 5.4. ANN application

In this research, the outputs were selected as a 242∗5 matrix including 242 samples and 5 output variables (OP1–OP5); the input variables were ED1–3, ITS1–8, MS1–8, OS1–3. We used the ANN fitting to make a proper ANN with 22 input and 5 output variables with the presence of a ten hidden layer and one output layer, as depicted in Figure 5. To construct the network,

**Table 8.** Mediation effect.

| | Direct effect | T Statistics | *P* Values | Indirect effect | T Statistics | *P* Values | Mediation effect |
|---|---|---|---|---|---|---|---|
| ITS - > OP | −0.08$^{ns}$ | 0.97 | 0.33 | 0.34*** | 5.35 | 0.00 | Full |
| ED - > OP | 0.08$^{ns}$ | 1.10 | 0.27 | 0.07*** | 2.70 | 0.01 | Full |
| OS - > OP | 0.06$^{ns}$ | 0.81 | 0.42 | 0.06*** | 2.50 | 0.01 | Full |

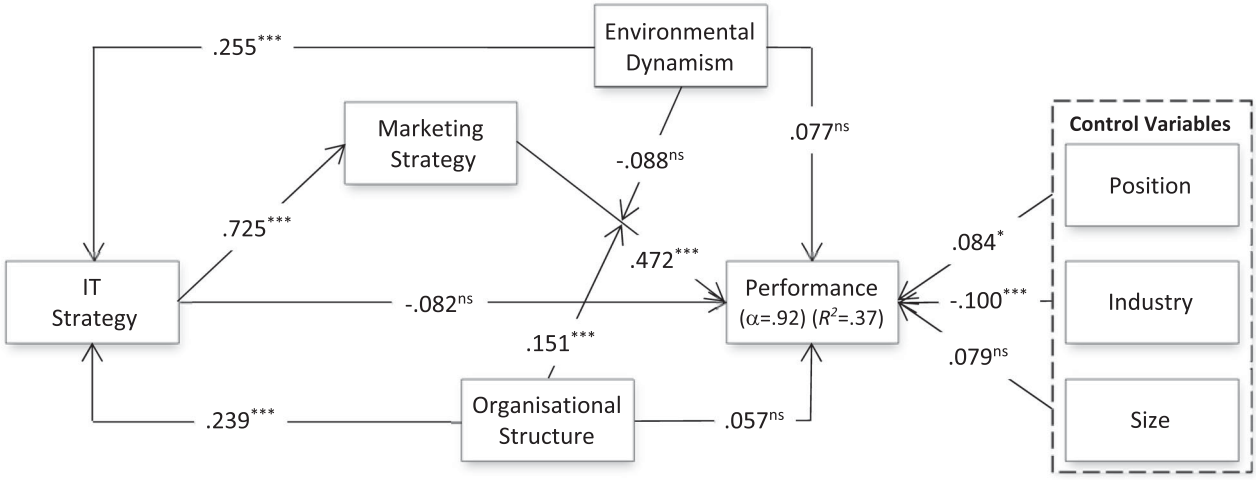



**Figure 4.** Full SEM model.

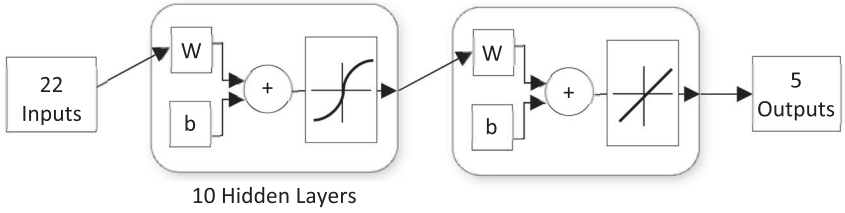



**Figure 5.** The structure of the applied neural network for OP.

**Table 9.** Summary results of hypotheses testing.

| Hypothesis | Empirical evidence |
|---|---|
| H1a: Marketing strategy is positively associated with performance | Yes |
| H1b: IT strategy is positively associated with performance | **No** |
| H1c: IT strategy is positively associated with marketing strategy | Yes |
| H1d: The impact of IT strategy on performance is positively mediated by marketing strategy | Yes |
| H2a: Environmental dynamism is positively associated with IT strategy | Yes |
| H2b: Environmental dynamism is positively associated with performance | **No** |
| H2c: Environmental dynamism moderates the mediation of marketing strategy on performance | **No** |
| H3a: organisational structure is positively associated with IT strategy | Yes |
| H3b: organisational structure is positively associated with performance | **No** |
| H3c: organisational structure moderates the mediation of marketing strategy on performance | Yes |

according to the available data (242 collected data) we used 170 samples for training, 36 samples for validation and remaining 36 samples for testing which are equivalent of 70%, 15% and 15% for training, validation and test, respectively. This utility function is commonly used in the strategic management and operations management literature. The training set ratio used has been used by previous researchers such as Tsai and Wu (2008) and Kashani et al. (2020).

To construct the most suitable network we examined the different number of hidden layers from 1–10 and also we examined 12 learning algorithms: Levenberg–Marquardt algorithm, BFGS Quasi-Newton, Bayesian regularisation, Resilient back-propagation, Conjugate gradient with Powell/Beale restarts, Scaled conjugate gradient, Fletcher–Powell conjugate gradient, One step secant, Polak–Ribiére conjugate gradient, Gradient descent with momentum, Variable learning rate gradient descent, and Gradient descent. All training algorithms were tested for each number of hidden layers in the network, and performance measures were considered to select the proper network. To calculate the performance measure, because of the type of output variables, the mean squared error (MSE) was not considered only, so we constructed another proper measure which was calculated by the following equation:

$$\text{Aggregated error} = \sum_{i=1}^{n}\sum_{j=1}^{J}|O_{ij} - T_{ij}|$$

where $O_{ij}$ and $T_{ij}$ are the output and expected target value of $i$th sample for $j$th variable, respectively. The |||| shows the rounding function. After performing the experiments, the achieved results are reported in Table 10.

The neural network with 10 Hidden layers and Bayesian Regularisation performed much better than the

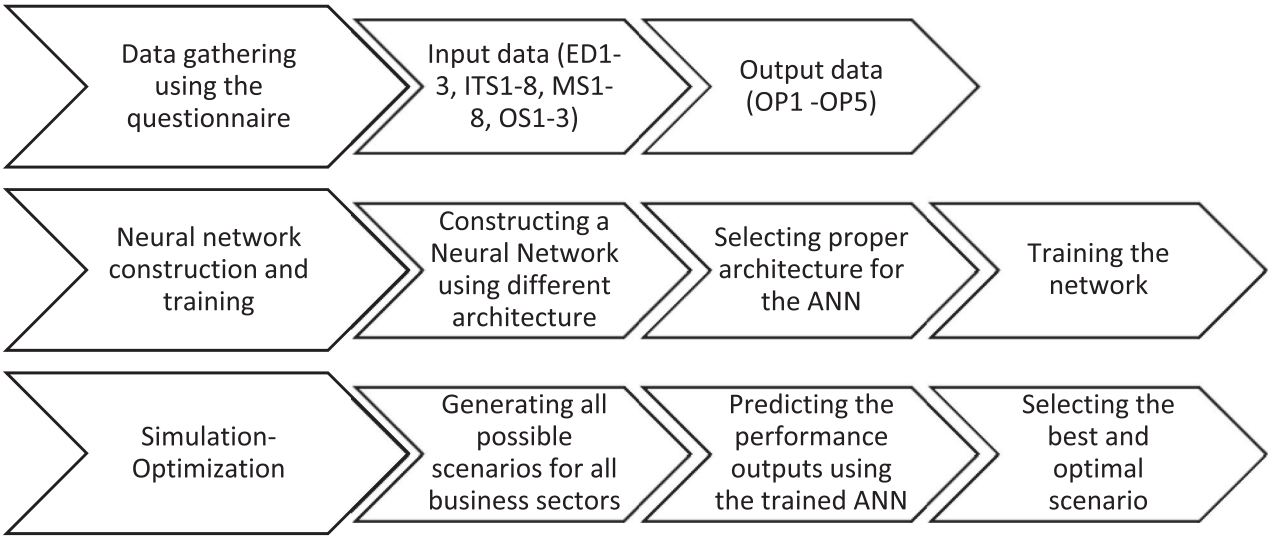



**Figure 6.** A schematic flowchart of processes to extract the optimal strategy for each business sector based on the neural network.

**Table 10.** Experiments result to construct a proper neural network.

| Learning Algorithm | | Best number of layers | Aggregated error | MSE |
|---|---|---|---|---|
| Levenberg-Marquardt | (1) | 8 | 956 | 1.2 |
| **Bayesian Regularization** | **(2)** | **10** | **600** | **0.8** |
| BFGS Quasi-Newton | (3) | 8 | 1035 | 1.4 |
| Resilient Backpropagation | (4) | 5 | 1055 | 1.4 |
| Scaled Conjugate Gradient | (5) | 9 | 1052 | 1.3 |
| Conjugate Gradient with Powell/Beale Restarts | (6) | 8 | 1019 | 1.2 |
| Fletcher-Powell Conjugate Gradient | (7) | 8 | 999 | 1.3 |
| Polak-Ribiére Conjugate Gradient | (8) | 5 | 1064 | 1.4 |
| One Step Secant | (9) | 5 | 1037 | 1.4 |
| Variable Learning Rate Gradient Descent | (10) | 9 | 1032 | 1.5 |
| Gradient Descent with Momentum | (11) | 3 | 1081 | 4.5 |
| Gradient Descent | (12) | 5 | 1042 | 1.4 |

others and has the lowest aggregated error. This was considered the best structure for the neural network. The extracted network was capable of predicting the performance based on any value given as inputs.

Different possible scenarios were then extracted based on the possibility in the business environment among the twelve selected industries (marketing and advertisement, education, manufacturing, banking and finance, healthcare, electronics, retail, service, transport, telecommunication and other). A simulation-optimisation scheme was then employed to extract the best strategy for each business sector. The flowchart of the proposed mechanism is depicted in Figure 6.

According to the proposed approach, the optimal strategy was extracted for each business sector with low, medium, or high performance level using the trained ANN. The results of the extracted optimal strategy for each sector are reported in Tables 11 and 12. As reported in Table 12, each industry can perform much better using suitable, well-thought-out strategies. As an example, according to the collected data, for the marketing and advertising industry, applying a combination IT strategy, customer and competitor based strategy and hierarchical structure in a competitor advantage environment will improve performance and effectiveness. Optimal strategies for different business sectors in the considered area are defined, and this scheme can be used to extract the best IT and marketing strategies in different areas with more variables.

To analyse the results of the optimal strategies, they were compared and the percentage of each strategy in the various business sectors is depicted in Figure 7. This confirms that the IT strategy of flexibility/combination will be more beneficial in most industries in the sample (i.e. in two-thirds of the sampled sectors). Competitor-based strategies are usually the best marketing strategy in most of the industrial sectors (90%). A hierarchical and combination structure will lead to better performance in most industries (50% and 40%, respectively) and, finally, competitor advantage is always the environment for optimal performance.

A follow-up questionnaire was distributed among some of the business sectors and data were collected regarding the industries' selected strategies. We also used the trained ANN to extract the output variables based on the declared strategy. The results of performance variables for the current declared and recommended optimal

**Table 11.** Optimal strategy for each industry according to their performance level using the trained ANN.

| Industry | Performance | ITS 1 | ITS 2 | ITS 3 | ITS 4 | ITS 5 | ITS 6 | ITS 7 | ITS 8 | MS 1 | MS 2 | MS 3 | MS 4 | MS 5 | MS 6 | MS 7 | MS 8 | OS 1 | OS 2 | OS 3 | ED 1 | ED 2 | ED 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (A) | M | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 7 | 7 | 7 |
| (A) | H | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 7 | 7 | 7 |
| (B) | L | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 7 | 7 | 7 |
| (B) | M | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (C) | L | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (C) | M | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (C) | H | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (D) | L | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (D) | M | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (D) | H | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 7 | 7 | 7 |
| (E) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (E) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (F) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (F) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (G) | L | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (G) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (G) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (H) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (H) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (I) | L | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 5 | 5 | 5 |
| (I) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 5 | 5 | 5 |
| (J) | L | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 5 | 5 | 5 |
| (J) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 5 | 5 | 5 |
| (J) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 5 | 5 | 5 |
| (K) | L | 6 | 6 | 1 | 1 | 1 | 6 | 6 | 6 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (K) | M | 6 | 6 | 1 | 1 | 1 | 6 | 6 | 6 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (K) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (L) | L | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (L) | M | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |
| (L) | H | 7 | 7 | 2 | 2 | 2 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 5 | 5 | 5 |

**H:** High Performance; **M:** Medium Performance; **L:** Low Performance

**Table 12.** Optimal marketing and IT strategy for each industry based on its performance level.

| Industry | | IT | Marketing | Structure | Environment |
|---|---|---|---|---|---|
| Marketing & Advertising | **(A)** | Combination | Customer & Competitor | Hierarchical | Competitor advantage |
| Education | **(B)** | Combination | Customer & Competitor | Hierarchical | Competitor advantage |
| Manufacturing | **(C)** | Combination | Competitor | Combination | Competitor advantage |
| Banking & Finance | **(D)** | Combination | Competitor | Combination | Competitor advantage |
| Hospital | **(E)** | Flexibility /Combination | Competitor | Central | Competitor advantage |
| Electronics | **(F)** | Flexibility /Combination | Competitor | Central | Competitor advantage |
| Retail | **(G)** | Flexibility /Combination | Competitor | Central | Competitor advantage |
| Service | **(H)** | Flexibility /Combination | Competitor | Central | Competitor advantage |
| Transport | **(I)** | Flexibility /Combination | Competitor | Combination | Competitor advantage |
| Property | **(J)** | Flexibility /Combination | Competitor | Combination | Competitor advantage |
| Telecommunication | **(K)** | Flexibility /Combination | Competitor | Central | Competitor advantage |
| Other | **(L)** | Flexibility /Combination | Competitor | Central | Competitor advantage |

strategies are reported in Table 13. As there are five performance variables, multivariate ANOVA was used to test the equality of means between the two group (current and optimal strategy) and the extracted $P$-value ($6.92\times10^{-7}$), which showed that the null hypothesis is rejected, so optimal strategies in different sectors may lead to better performance.

## 6. Discussion and conclusion

We investigated ongoing studies on operations management to address marketing and IT strategic alignment. The ultimate objective of this study was to investigate how production and operations decision makers can use marketing and IT strategies to improve operational performance using AI. The impact of marketing and IT strategic alignment on operational performance has rarely been researched in the literature (Hooper, Huff, and Thirkell 2007). This study considered the moderating and mediating effects on the alignment and its relation to operational performance. This study is one of the few to provide production and operations decision makers a model to select the optimal marketing and IT strategy under environmental dynamism and organisational structure constraints. A three-phase decision-making framework was proposed to extract the

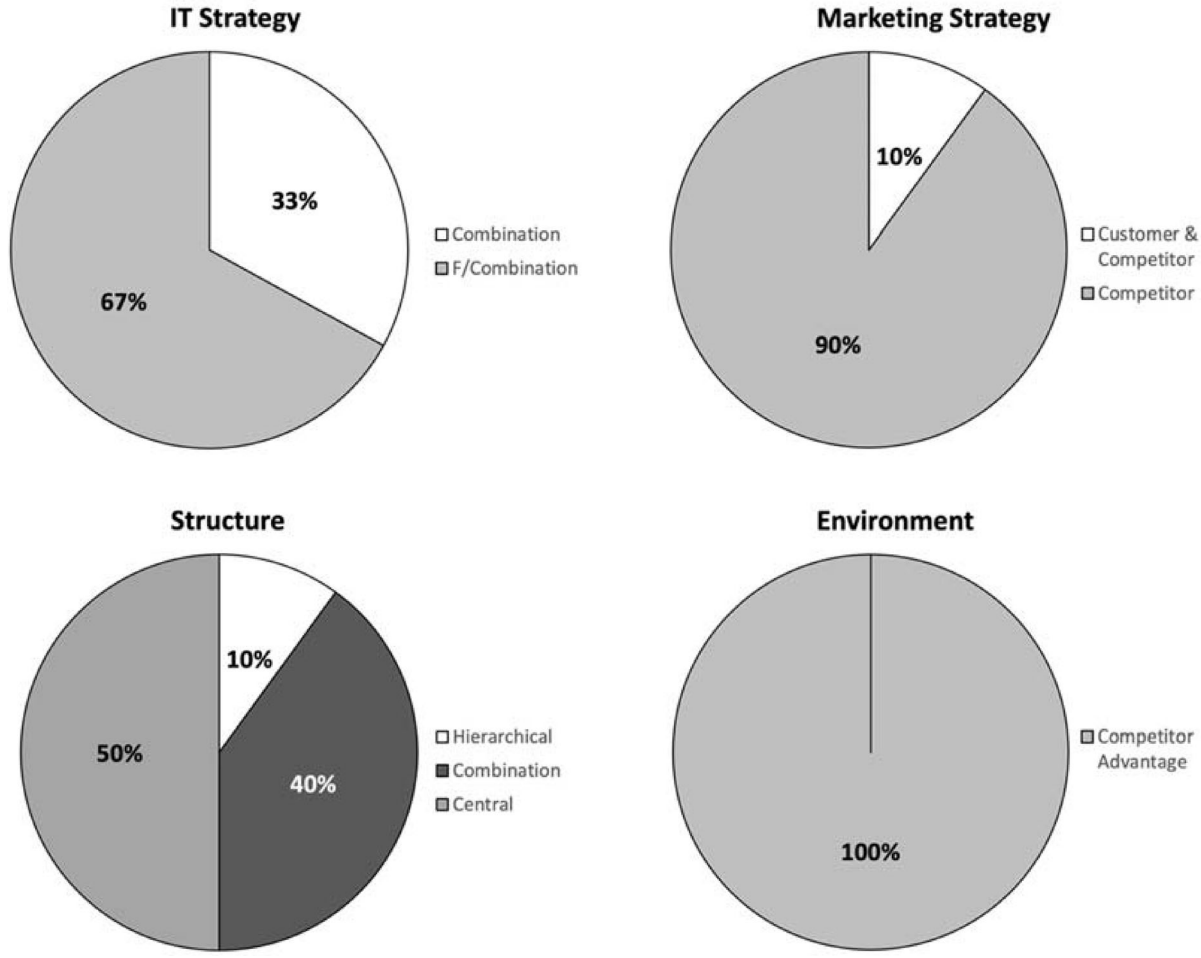



**Figure 7.** The percentage of the best strategy among business sectors.

**Table 13.** Current and optimal strategies in the follow-up analysis among selected industries.

| | | Existing | | | | | Recommended | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector | Size | OP1 | OP2 | OP3 | OP4 | OP5 | OP1 | OP2 | OP3 | OP4 | OP5 |
| Education | 3 | 3.74 | 4.01 | 4.16 | 4.52 | 4.96 | 6.35 | 7.00 | 7.00 | 7.00 | 7.00 |
| Education | 1 | 4.66 | 4.42 | 3.34 | 2.84 | 5.51 | 6.35 | 7.00 | 7.00 | 7.00 | 7.00 |
| Education | 1 | 5.75 | 5.98 | 6.16 | 5.64 | 4.99 | 6.35 | 7.00 | 7.00 | 7.00 | 7.00 |
| Education | 2 | 3.69 | 2.97 | 3.27 | 2.99 | 2.40 | 6.35 | 7.00 | 7.00 | 7.00 | 7.00 |
| Banking | 2 | 5.30 | 4.12 | 5.43 | 3.92 | 6.18 | 3.66 | 4.10 | 4.31 | 4.68 | 5.07 |
| Banking | 4 | 3.98 | 3.67 | 3.61 | 3.58 | 2.09 | 3.66 | 4.10 | 4.31 | 4.68 | 5.07 |
| Hospital | 1 | 7.00 | 6.05 | 6.17 | 5.99 | 5.86 | 4.31 | 4.28 | 5.02 | 5.05 | 6.55 |
| Retail | 2 | 6.35 | 5.97 | 6.19 | 6.21 | 5.85 | 4.31 | 4.28 | 5.02 | 5.05 | 6.55 |
| Retail | 1 | 1.15 | 1.66 | 1.65 | 1.41 | 1.70 | 4.31 | 4.28 | 5.02 | 5.05 | 6.55 |
| Transport | 1 | 7.00 | 2.94 | 4.54 | 5.09 | 4.65 | 3.53 | 3.73 | 4.42 | 4.82 | 6.04 |
| Property | 1 | 3.46 | 3.30 | 3.87 | 3.22 | 3.49 | 3.53 | 3.73 | 4.42 | 4.82 | 6.04 |
| Property | 1 | 3.54 | 5.52 | 5.20 | 3.00 | 3.18 | 3.53 | 3.73 | 4.42 | 4.82 | 6.04 |
| Other | 2 | 1.12 | 1.03 | 1.29 | 1.09 | 1.36 | 4.31 | 4.28 | 5.02 | 5.05 | 6.55 |

optimal marketing and IT strategies among different business sectors providing theoretical, methodological and practical contributions.

### 6.1. Theoretical contribution

This study contributes theoretically to the literature in three ways. First, it contributes to operations management and strategic management by extending the optimal strategy selection literature. Second, the strategic alignment of business and IT has been the main focus in several prior studies (Bergeron, Raymond, and Rivard 2004; Sabherwal and Chan 2001; Schniederjans and Cao 2009; Zheng, Yang, and McLean 2010), and this study conceptualised and operationalised the strategic alignment of marketing and IT strategy in a context

of environmental dynamism and organisational structure. Third, this study considered other factors – namely, environmental dynamism and organisational structures – in line with the recommendations of prior studies (Al-Surmi, Cao, and Duan 2019; Gartlan and Shanks 2007; Hooper, Huff, and Thirkell 2007; Yeow, Soh, and Hansen 2018). The developed model emphasises the importance of aligning marketing strategy and IT strategy while considering organisational structure and dramatic changes in the business environment.

### 6.2. Methodological and empirical contributions

This study also made several methodological and empirical contributions. First, it considered the integration of both moderation and mediation interaction effects in the first phase. The results of the SEM analytical approach reveal that hypotheses H1a and H1c are empirically validated and in line with prior studies' claim that marketing and IT strategies, separately, have a positive impact on operational performance (Hooper, Huff, and Thirkell 2007; Sabherwal and Chan 2001). This paper validates the strategic alignment relationship between marketing and IT strategies on operational performance through the mediation effect developed by Venkatraman (1989). In addition, it has been confirmed that environmental dynamism and organisational structure have a positive effect on operational performance, as theorised by Walker and Ruekert (1987). This paper contributes to the literature by empirically validating the moderation effect of organisational structure on the relationship of the mediating role of marketing strategy in IT strategy and operational performance. This suggests that marketing and IT strategies influence the output performance measures with mediating and moderating effects for organisational structure. Although some hypothesised theories were not empirically validated, most showed that the structural model is confirmed based on the collected data from selected industries.

Second, achieving and confirming the conceptualised model facilitates the development of an ANN model for the second phase. According to the effective extracted factors, an ANN was constructed and trained with a training set data. The proper ANN design was selected, including the appropriate number of layers and an efficient learning algorithm to ensure better network performance. Using the findings of the SEM reduced the tuning time of the ANN by extracting the more efficient input variables. This combined method will also lead to an increase in ANN accuracy.

Third, a phased approach was used to extract optimal strategies for each industrial sector. This paper thus contributes methodologically by integrating a multi-phased analytical technique of SEM and ANN application to achieve the aforementioned results. The proposed AI-based methodology can be used in other operations management areas to for its analytical capabilities, while machine learning can be used to extract the proper model for system behaviour. In line with above published papers in Tables 1 and 2, the current study creates a new direction for researchers and readers in two different aspects: (1) the proposed approach can be strengthened by using other types of AI-based methods and (2) the suggested integrated SEM/ANN–based method can be used by researchers who use SEM for modelling a problem. Both avenues will open a new area for researchers to continue and strengthen this streamline. Equipping decision makers with this decision support tool will help them to make robust decisions more efficiently. Although we used it for strategy selection, the proposed AI-based decision support system can also be used for optimal decision-making in other stages of operations management.

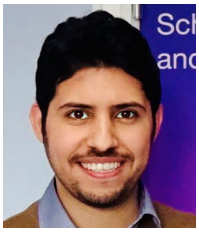
### 6.3. Practical contribution

In reconciling the research findings with previous theoretical and empirical work, potential practical implications can be drawn. First, our findings suggest that decision makers should consider external factors such as environmental dynamism when developing marketing and IT strategies. It is also worth noticing that each industry type tends to have a favourable organisational structure that fosters marketing and IT strategic alignment. Hence, decision makers should consider their organisation's structure when formulating their strategies to achieve competitive advantages. Second, decision makers should carefully develop executable marketing and IT strategies under the conditions of the existing market to maximise this the linkage effect on operational performance. Third, the proposed decision support tool based on a machine learning approach can be used to achieve better performance in the researched industries. However, the proposed approach can also be used for other industries to extract optimal strategies. Applying the proposed AI-based method – including machine learning and simulation optimisation – in other operations management decisions could be one direction for future research. Moreover, another direction for future study would be considering more factors in the model that could help companies to achieve their integrated targets.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Notes on contributors



*Dr Abdulrahman Al-Surmi* has a particular interest in strategic management, artificial intelligence, and data analytics (business analytics and marketing analytics) disciplines and have contributed to a couple of conferences presenting full papers. He is extensively involved in teaching Business Analytics, Business and Management Statistics, Quantitative Methods for Business, Applied Marketing Analytics, Business Analytics and Intelligence, and Business Decision Making modules to undergraduate and postgraduate students.

*Dr Mahdi Bashiri* has over 16 years of academic experience with a particular interest in operations and supply chain management, operations research, transportation planning, Heuristic and Matheuristic algorithms. Also, he has participated in industrial and business projects in different levels. He has been involved in two UKRI funded projects. He has supervised more than 5 PhD students and more than 60 MSc students. He is an active reviewer for reputable academic journals. He is a recipient of the 2013 young national top scientist award from the Academy of Sciences of the Islamic Republic of Iran.

*Dr Ioannis (Yannis) Koliousis* is an Associate Professor of Logistics & Supply Chain Management and the Director of Executive Education for Supply Chain Management in the School of Management in Cranfield University. He has over 20 years of academic, entrepreneurial, and industrial experience in the fields of operations and supply chain management, transport management, shipping, transport planning, cargo and freight logistics, public transport, urban logistics, project appraisal and finance, transport policy and renewable energy. He is regularly advising senior leadership on these topics as well as participating in and leading over 25 EU wide research projects, funded indicatively from FP7, IEE, Horizon2020, TEN-T and INTERREG.

## ORCID

*Abdulrahman Al-Surmi* http://orcid.org/0000-0002-6928-8837
*Ioannis Koliousis* http://orcid.org/0000-0002-4522-6930

## References

Adebanjo, Dotun, Pei-Lee Teh, and Pervaiz K. Ahmed. 2018. "The Impact of Supply Chain Relationships and Integration on Innovative Capabilities and Manufacturing Performance: the Perspective of Rapidly Developing Countries." *International Journal of Production Research* 56 (4): 1708–1721. doi:10.1080/00207543.2017.1366083.

Ahituv, Niv, Seev Neumann, and Moshe Zviran. 1989. "Factors Affecting the Policy for Distributing Computing Resources." *MIS Quarterly*, 389–401.

Al-Surmi, A. M. 2016. "The Impact of Triadic Strategic Alignment on Organisational Performance in Yemen." PhD Thesis.

Al-Surmi, Abdulrahman, Guangming Cao, and Yanqing Duan. 2019. "The Impact of Aligning Business, IT, and Marketing Strategies on Firm Performance." *Industrial Marketing Management* 84: 39–49. doi:10.1016/j.indmarman.2019.04.002.

Alavi, Maryam, and Ira R Weiss. 1985. "Managing the Risks Associated with end-User Computing." *Journal of Management Information Systems* 2 (3): 5–20.

Alexander, Judith W, and W. Alan Randolph. 1985. "The fit Between Technology and Structure as a Predictor of Performance in Nursing Subunits." *Academy of Management Journal* 28 (4): 844–859.

Allen, R. S., and R. H. Kilmann. 2001. "The Role of the Reward System for a Total Quality Management Based Strategy." *Journal of Organizational Change Management*.

Andrews, Rhys, George A Boyne, Jennifer Law, and Richard M Walker. 2009. "Centralization, Organizational Strategy, and Public Service Performance." *Journal of Public Administration Research and Theory* 19 (1): 57–80.

Argote, Linda. 1982, September. "Input Uncertainty and Organizational Coordination in Hospital Emergency Units." *Administrative Science Quarterly* 27 (3): 420–434.

Bag, Surajit, Shivam Gupta, Ajay Kumar, and Uthayasankar Sivarajah. 2021. An Integrated Artificial Intelligence Framework for Knowledge Creation and B2B Marketing Rational Decision Making for Improving Firm Performance." *Industrial Marketing Management* 92: 178–189.

Baker, Michael J. 2008. *The Strategic Marketing Plan Audit*. Cambridge: Cambridge Strategy Publications Ltd.

Baryannis, G., S. Validi, S. Dani, and G. Antoniou. 2019. "Supply Chain Risk Management and Artificial Intelligence: State of the art and Future Research Directions." *International Journal of Production Research* 57 (7): 2179–2202.

Baum, J. Robert, and Stefan Wally. 2003. "strategic Decision Speed and Firm Performance." *Strategic Management Journal* 24 (11): 1107–1129.

Benjamin, Robert I, and Michael S Scott Morton. 1988. "Information Technology, Integration, and Organizational Change." *Interfaces* 18 (3): 86–98.

Benzidia, Smaïl, Blandine Ageron, Omar Bentahar, and Julien Husson. 2019. "Investigating Automation and AGV in Healthcare Logistics: a Case Study Based Approach." *International Journal of Logistics Research and Applications* 22 (3): 273–293.

Bergeron, Francois, and Louis Raymond. 1992. "Planning of Information Systems to Gain a Competitive Edge." *Journal of Small Business Management* 30 (1): 21.

Bergeron, François, Louis Raymond, and Suzanne Rivard. 2004. "Ideal Patterns of Strategic Alignment and Business Performance." *Information & Management* 41 (8): 1003–1020. doi:10.1016/j.im.2003.10.004.

Berry, W. L., T. Hill, and J. E. Klompmaker. 1999. "Aligning Marketing and Manufacturing Strategies with the Market." *International Journal of Production Research* 37 (16): 3599.

Bevilacqua, Maurizio, Filippo Emanuele Ciarapica, and Ilaria De Sanctis. 2017. " Lean Practices Implementation and Their Relationships with Operational Responsiveness and Company Performance: an Italian Study." *International Journal of Production Research* 55 (3): 769–794. doi:10.1080/00207543.2016.1211346.

Bi, J. W., Y. Liu, Z. P. Fan, and E. Cambria. 2019. "Modelling Customer Satisfaction from Online Reviews Using Ensemble Neural Network and Effect-Based Kano Model." *International Journal of Production Research* 57 (22): 7068–7088.

Blau, Peter M, Cecilia McHugh Falbe, William McKinley, and Phelps K Tracy. 1976, March. "Technology and Organization in Manufacturing." *Administrative Science Quarterly* 21 (1): 20–40.

Borges, Mauro, Norberto Hoppen, and Fernando Bins Luce. 2009. "Information Technology Impact on Market Orientation in e-Business." *Journal of Business Research* 62 (9): 883–890. doi:10.1016/j.jbusres.2008.10.010.

Broadbent, M., and P. Weill. 1993. "Improving Business and Information Strategy Alignment: Learning from the Banking Industry." *IBM Systems Journal* 32 (1): 162–179. doi:10.1147/sj.321.0162.

Bullinger, H.-J., and W. Schweizer. 2006. "Intelligent Production-Competition Strategies for Producing Enterprises." *International Journal of Production Research* 44 (18-19): 3575–3584.

Buttle, Francis. 1996. *Relationship Marketing: Theory and Practice*. London: Sage.

Canhoto, Ana Isabel, and Fintan Clear. 2020. "Artificial Intelligence and Machine Learning as Business Tools: A Framework for Diagnosing Value Destruction Potential." *Business Horizons* 63 (2): 183–193.

Cao, Qing, Jeff Baker, and James J Hoffman. 2012. "The Role of the Competitive Environment in Studies of Strategic Alignment: a Meta-Analysis." *International Journal of Production Research* 50 (2): 567–580.

Cao, Qing, and James J Hoffman. 2011. "A Case Study Approach for Developing a Project Performance Evaluation System." *International Journal of Project Management* 29 (2): 155–164.

Cao, Jin, Zhibin Jiang, and Kangzhou Wang. 2016. "Customer Demand Prediction of Service-Oriented Manufacturing Incorporating Customer Satisfaction." *International Journal of Production Research* 54 (5): 1303–1321.

Cavusgil, S. Tamer, and Shaoming Zou. 1994. "Marketing Strategy-Performance Relationship: An Investigation of the Empirical Link in Export Market Ventures." *Journal of Marketing* 58 (1): 1–21.

Chen, Qiyang, Qiang Tu, and Binshan Lin. 2002. "Global IT/IS Outsourcing: Expectations, Considerations and Implications." *American Society for Competitiveness* 10 (1): 100–111.

Chin, Wynne W., Barbara L. Marcolin, and Peter R. Newsted. 1998. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study." *Information Systems Research* 14 (2): 189–217.

Chong, Alain Yee-Loong, Felix T.S. Chan, Mark Goh, and M. K. Tiwari. 2013. "Do Interorganisational Relationships and Knowledge-Management Practices Enhance Collaborative Commerce Adoption?" *International Journal of Production Research* 51 (7): 2006–2018. doi:10.1080/00207543.2012.701776.

Chwelos, Paul, Izak Benbasat, and Albert S Dexter. 2001. "Empirical Test of an EDI Adoption Model." *Information Systems Research* 12 (3): 304–321.

Clemons, Eric K. 1986. "Information Systems for Sustainable Competitive Advantage." *Information & Management* 11 (3): 131–136.

Croteau, Anne-Marie, and François Bergeron. 2001. "An Information Technology Trilogy: Business Strategy, Technological Deployment and Operational Performance." *The Journal of Strategic Information Systems* 10 (2): 77–99. doi:10.1016/S0963-8687(01)00044-0.

Dhamija, Pavitra, and Surajit Bag. 2020. "Role of Artificial Intelligence in Operations Environment: a Review and Bibliometric Analysis." *The TQM Journal* 32 (4): 869–896.

Dogru, Ali K, and Burcu B Keskin. 2020. "AI in Operations Management: Applications, Challenges and Opportunities." *Journal of Data, Information and Management* 2: 1–8.

Dong, Xiaoying, Qianqian Liu, and Dezhi Yin. 2008. "Business Performance, Business Strategy, and Information System Strategic Alignment: An Empirical Study on Chinese Firms." *Tsinghua Science & Technology* 13 (3): 348–354. doi:10.1016/S1007-0214(08)70056-7.

Dou, Runliang, Yubo Zhang, and Guofang Nan. 2017. "Iterative Product Design Through Group Opinion Evolution." *International Journal of Production Research* 55 (13): 3886–3905.

Dubey, Rameshwar, Angappa Gunasekaran, Stephen J. Childe, Samuel Fosso Wamba, David Roubaud, andCyril Foropon. 2021. "Empirical Investigation of Data Analytics Capability and Organizational Flexibility as Complements to Supply Chain Resilience." *International Journal of Production Research* 59 (1): 110–128. doi:10.1080/00207543.2019.1582820.

Ein-Dor, Phillip, and Eli Segev. 1982. "Organizational Context and MIS Structure: Some Empirical Evidence." *MIS Quarterly* 6: 55–68.

Fahy, John, and Alan Smithee. 1999. "Strategic Marketing and the Resource Based View of the Firm." *Academy of Marketing Science Review* 10 (1): 1–21.

Foo, P. Y., V. H. Lee, G. W. Tan, H. Ooi. 2018. "A Gateway to Realising Sustainability Performance Via Green Supply Chain Management Practices: A PLS–ANN Approach." *Expert Systems with Applications* 107: 1–14.

Foss, Bryan, and Merlin Stone. 2001. *Successful Customer Relationship Marketing: new Thinking, new Strategies, new Tools for Getting Closer to Your Customers*. London: Kogan Page Publishers.

Gartlan, Jovita, and Graeme Shanks. 2007. "the Alignment of Business and Information Technology Strategy in Australia." *Australasian Journal of Information Systems* 14 (2): 113–139.

Grover, Purva, Arpan Kumar Kar, and Yogesh K Dwivedi. 2020. "Understanding Artificial Intelligence Adoption in Operations Management: Insights from the Review of Academic Literature and Social Media Discussions." *Annals of Operations Research*, 1–37.

Gurbaxani, Vijay, and Seungjin Whang. 1991. "The Impact of Information Systems on Organizations and Markets." *Communications of the ACM* 34 (1): 59–73.

Hair, J. F., G. T. M. Hult, C. Ringle, and M. Sarstedt. 2013. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Los Angeles: SAGE Publications.

Han, Allen M. 1998. Computer output device. Google Patents.

Henderson, John C, and Michael E Treacy. 1986. "Managing end-User Computing for Competitive Advantage." *Sloan Management Review (1986-1998)* 27 (2): 3.

Henderson, J. C., and N. Venkatraman. 1989. *Strategic Alignment: a Framework for Strategic Information Technology Management*. Cambridge, MA: Center for Information Systems Research, Sloan School of Management, Massachusetts Institute of Technology.

Henriques, Mónica, José Braga de Vasconcelos, Gabriel Pestana, and Álvaro Rocha. 2019. "IT-Business Strategic Alignment in Social Era." 2019 14th Iberian Conference on Information Systems and Technologies (CISTI).

Heracleous, Loizos, and Katrin Werres. 2016. "On the Road to Disaster: Strategic Misalignments and Corporate Failure." *Long Range Planning* 49 (4): 491–506.

Hooper, Val, Sid Huff, and Peter C Thirkell. 2007. "IS-Marketing Alignment: Its Impacts on Marketing Performance and on Business Performance."

Hou, J., H. Pan, T. Guo, I. Lee, X. Kong, and F. Xia. 2019. "Prediction Methods and Applications in the Science of Science: A Survey." *Computer Science Review* 34: 100197.

Hrebiniak, Lawrence G, and William F Joyce. 1985, September. "Organizational Adaptation: Strategic Choice and Environmental Determinism." *Administrative Science Quarterly* 30 (3): 336–349.

Huber, George P. 1984. "The Nature and Design of Post-Industrial Organizations." *Management Science* 30 (8): 928–951.

Huber, George P. 1990. "A Theory of the Effects of Advanced Information Technologies on Organizational Design, Intelligence, and Decision Making." *Academy of Management Review* 15 (1): 47–71.

Huo, Baofeng, Muhammad Zia Ul Haq, and Minhao Gu. 2021. "The Impact of Information Sharing on Supply Chain Learning and Flexibility Performance." *International Journal of Production Research* 59 (5): 1411–1434. doi:10.1080/00207543.2020.1824082.

Isabella, Lynn A, and Sandra A Waddock. 1994. "Top Management Team Certainty: Environmental Assessments, Teamwork, and Performance Implications." *Journal of Management* 20 (4): 835–858.

Ivanov, Dmitry, Ajay Das, and Tsan-Ming Choi. 2018. "New Flexibility Drivers for Manufacturing, Supply Chain and Service Operations." *International Journal of Production Research* 56 (10): 3359–3368.

Jabbour, Charbel Jose Chiappetta, Daniel Jugend, Ana Beatriz Lopes de Sousa Jabbour, Angappa Gunasekaran, and Hengky Latan. 2015. "Green Product Development and Performance of Brazilian Firms: Measuring the Role of Human and Technical Aspects." *Journal of Cleaner Production* 87: 442–451.

Jain, Subhash C. 2000. *Marketing Planning & Strategy*. 6th ed. South-Western College Publishing.

Jaworski, Bernard J., and Ajay K. Kohli. 1993. "Market Orientation: Antecedents and Consequences." *Journal of Marketing* 57 (3): 53.

Jemison, David B. 1984. "The Importance of Boundary Spanning Roles in Strategic Decision-Making [I]." *Journal of Management Studies* 21 (2): 131–152.

Joshi, Maheshkumar P., Ravi Kathuria, and Stephen J. Porth. 2003. "Alignment of Strategic Priorities and Performance: an Integration of Operations and Strategic Management Perspectives." *Journal of Operations Management* 21 (3): 353–369. doi:10.1016/S0272-6963(03)00003-2.

Kapoor, Kawaljeet, Yogesh K. Dwivedi, Niall Piercy, and Banita Lal. 2014. "RFID Integrated Systems in Libraries: Extending TAM Model for Empirically Examining the Use." *Journal of Enterprise Information Management* 27 (6): 1–23.

Kashani, Hamid Reza Khayat, Shirzad Azhari, Hossein Nayebaghayee, Sohrab Salimi, and Hasan Reza Mohammadi. 2020. "Prediction Value of Preoperative Findings on Meningioma Grading Using Artificial Neural Network." *Clinical Neurology and Neurosurgery* 105947.

Kearns, Grover S., and Rajiv Sabherwal. 2006. "Strategic Alignment Between Business and Information Technology: A Knowledge-Based View of Behaviors, Outcome, and Consequences." *Journal of Management Information Systems* 23 (3): 129–162.

King, William R. 1978. "Strategic Planning for Management Information Systems." *MIS Quarterly* 2 (1): 27–37.

Kohli, Ajay K., and Bernard J. Jaworski. 1990. "Market Orientation: The Construct, Research Propositions, and Managerial Implications." *Journal of Marketing* 54 (2): 1–18.

Kumar, V., D. Holt, A. Ghobadian, and J. A. Garza-Reyes. 2015. "Developing Green Supply Chain Management Taxonomy-Based Decision Support System." *International Journal of Production Research* 53 (21): 6372–6389. doi:10.1080/00207543.2014.917215.

Kusiak, A. 2020. "Convolutional and Generative Adversarial Neural Networks in Manufacturing." *International Journal of Production Research* 58 (5): 1594–1604.

Kwong, C. K., Huimin Jiang, and X. G. Luo. 2016. "AI-based Methodology of Integrating Affective Design, Engineering, and Marketing for Defining Design Specifications of new Products." *Engineering Applications of Artificial Intelligence* 47: 49–60.

Lee, Hakyeon, Sang Gook Kim, Hyun-woo Park, and Pilsung Kang. 2014. "Pre-launch new Product Demand Forecasting Using the Bass Model: A Statistical and Machine Learning-Based Approach." *Technological Forecasting and Social Change* 86: 49–64.

Leifer, Richard. 1988. "Matching Computer-Based Information Systems with Organizational Structures." *Mis Quarterly* 12: 63–73.

Leitch, Robert Alan. 1974. "Marketing Strategy and the Optimal Production Schedule." *Management Science* 21 (3): 302–312.

Leong, Lai-Ying, Teck-Soon Hew, Keng-Boon Ooi, Voon-Hsien Lee, and Jun-Jie Hew. 2019. "A Hybrid SEM-Neural Network Analysis of Social Media Addiction." *Expert Systems with Applications* 133: 296–316.

Li, Eldon Y. 1994. "Artificial Neural Networks and Their Business Applications." *Information & Management* 27 (5): 303–313.

Li, Der-Chiang, Wen-Chih Chen, Che-Jung Chang, Chien-Chih Chen, and I-Hsiang Wen. 2015. "Practical Information Diffusion Techniques to Accelerate new Product Pilot Runs." *International Journal of Production Research* 53 (17): 5310–5319.

Likert, Rensis. 1961. "New patterns of management."

Lingle, John H, and William A Schiemann. 1996. "From Balanced Scorecard to Strategic Gauges: is Measurement Worth it?" *Management Review* 85 (3): 56.

Luftman, J. N. 2003. "Assessing Strategic Alignment Maturity." In *Competing in the Information age: Align in the Sand.*

2nd edn., edited by Michael J. Earl, 15–48. Oxford: Oxford University Press.
Matsuno, Ken, John T Mentzer, and Ayşegül Özsomer. 2002. "The Effects of Entrepreneurial Proclivity and Market Orientation on Business Performance." *Journal of Marketing* 66 (3): 18–32.
McDaniel, Stephen W., and James W. Kolari. 1987. "Marketing Strategy Implications of the Miles and Snow Strategic Typology." *Journal of Marketing* 51 (4): 19–30.
Mendes, Luis, and José Machado. 2015. "Employees' Skills, Manufacturing Flexibility and Performance: a Structural Equation Modelling Applied to the Automotive Industry." *International Journal of Production Research* 53 (13): 4087–4101. doi:10.1080/00207543.2014.993772.
Mia, Lokman, and Brian Clarke. 1999. "Market Competition, Management Accounting Systems and Business Unit Performance." *Management Accounting Research* 10 (2): 137–158.
Miao, Rui, Hui Zhang, Qi Wu, Jie Zhang, and Zhibin Jiang. 2020. "Using Structural Equation Modeling to Analyze Patient Value, Satisfaction, and Loyalty: a Case Study of Healthcare in China." *International Journal of Production Research* 58 (2): 577–596. doi:10.1080/00207543.2019.1598595.
Migdadi, Mahmoud Mohammad, and Mohammed Khair Saleem Abu Zaid. 2016. "An Empirical Investigation of Knowledge Management Competence for Enterprise Resource Planning Systems Success: Insights from Jordan." *International Journal of Production Research* 54 (18): 5480–5498. doi:10.1080/00207543.2016.1161254.
Min, Soonhong, Seokwoo Song, and James S. Keebler. 2002. "an Internet-Mediated Market Orientation (IMO): Building a Theory." *Journal of Marketing Theory & Practice* 10 (2): 1.
Mollenkopf, Diane A, Robert Frankel, and Ivan Russo. 2011. "Creating Value Through Returns Management: Exploring the Marketing–Operations Interface." *Journal of Operations Management* 29 (5): 391–403.
Narver, John C., and Stanley F. Slater. 1990. "The Effect of a Market Orientation on Business Profitability." *Journal of Marketing* 54 (4): 20–35.
Nishant, Rohit, Mike Kennedy, and Jacqueline Corbett. 2020. "Artificial Intelligence for Sustainability: Challenges, Opportunities, and a Research Agenda." *International Journal of Information Management* 53: 102104.
Noble, Charles H., Rajiv K. Sinha, and Ajith Kumar. 2002. "Market Orientation and Alternative Strategic Orientations: A Longitudinal Assessment of Performance Implications." *Journal of Marketing* 66 (4): 25–39.
Oliver, Christine. 1991, January. "Strategic Responses to Institutional Processes ." *The Academy of Management Review* 16 (1): 145–179.
Olson, Margrethe H, and Norman L Chervany. 1980. "The Relationship Between Organizational Characteristics and the Structure of the Information Services Function." *Mis Quarterly* 4: 57–68.
Olson, Eric M., Stanley F. Slater, and G. Tomas M. Hult. 2005. "The Performance Implications of Fit Among Business Strategy, Marketing Organization Structure, and Strategic Behavior." *Journal of Marketing* 69 (3): 49–65.
Papadopoulos, T., and Konstantina Spanaki. 2017. "Exploring Industry 4.0 and Smart Manufacturing Concepts."
Peck, H., A. Payne, M. Christopher, and M. Clark. 1999. *Relationship Marketing: Strategy and Implementation*. Oxford: Butterworth-Heinemann.
Pereira-Moliner, J., E. Claver-Cortés, J. F. Molina-Azorín, and J. J. Tarí. 2012. "Quality Management, Environmental Management and Firm Performance: Direct and Mediating Effects in the Hotel Industry." *Journal of Cleaner Production* 37: 82–92.
Piercy, Nigel F, Lloyd C Harris, Linda D Peters, and Nikala Lane. 1997. "Marketing Management, Market Strategy and Strategic Management: Domain Realignment and Redefinition." *Journal of Strategic Marketing* 5 (1): 51–63.
Porter, Michael E., and Victor E. Millar. 1985. "How Information Gives you Competitive Advantage." *Harvard Business Review* 63 (4): 149–160.
Priyadarshinee, Pragati, Rakesh D Raut, Manoj Kumar Jha, and Bhaskar B Gardas. 2017. "Understanding and Predicting the Determinants of Cloud Computing Adoption: A two Staged Hybrid SEM-Neural Networks Approach." *Computers in Human Behavior* 76: 341–362.
Raut, Rakesh D, Pragati Priyadarshinee, Bhaskar B Gardas, and Manoj Kumar Jha. 2018. "Analyzing the Factors Influencing Cloud Computing Adoption Using Three Stage Hybrid SEM-ANN-ISM (SEANIS) Approach." *Technological Forecasting and Social Change* 134: 98–123.
Raymond, Louis. 1990. "Organizational Context and Information Systems Success: a Contingency Approach." *Journal of Management Information Systems* 6 (4): 5–20.
Raymond, Louis, G. Pare, and F. Bergeron. 1995. "Matching Information Technology and Organizational Structure: an Empirical Study with Implications for Performance." *European Journal of Information Systems* 4 (1): 3–16.
Ritson, N. 2011. "The Levels and Formulation of Strategy." *Strategic Management*. Ventus Publishing ApS.
Robey, Daniel. 1981. "Computer Information Systems and Organization Structure." *Communications of the ACM* 24 (10): 679–687.
Sabherwal, Rajiv, and Yolande E. Chan. 2001. "Alignment Between Business and IS Strategies: A Study of Prospectors, Analyzers, and Defenders." *Information Systems Research* 12 (1): 11.
Sahoo, S., and S. Yadav. 2017. "Entrepreneurial Orientation of SMEs, Total Quality Management and Firm Performance." *Journal of Manufacturing Technology Management*.
Schniederjans, M., and Q. Cao. 2009. "Alignment of Operations Strategy, Information Strategic Orientation, and Performance: an Empirical Study." *International Journal of Production Research* 47 (10): 2535–2563. doi:10.1080/00207540701673465.
Shmueli, Galit, and Otto R Koppius. 2011. "Predictive Analytics in Information Systems Research." *MIS Quarterly* 35: 553–572.
Sipior, Janice C, and Edward J Garrity. 1992. "Merging Expert Systems with Multimedia Technology." *ACM SIGMIS Database: the DATABASE for Advances in Information Systems* 23 (1): 45–49.
Skinner, Wickham. 1969. "Manufacturing-Missing Link in Corporate Strategy."
Skinner, Wickham. 1974. "The Focused Factory." *Harvard Business Review*, 114–121.
Slack, N., and M. Lewis. 2014. *Operations Strategy*. Pearson.
Slater, Stanley F., and John C. Narver. 1995. "Market Orientation and the Learning Organization." *Journal of Marketing* 59 (3): 63.

Smith, Thomas M, and James S Reece. 1999. "The Relationship of Strategy, fit, Productivity, and Business Performance in a Services Setting." *Journal of Operations Management* 17 (2): 145–161.

Spanaki, K., Uthayasankar Sivarajah, M. Fakhimi, S. Despoudi, and Zahir Irani. 2020. "Disruptive Technologies in Agricultural Operations: A Systematic Review of AI-Driven AgriTech Research." *Annals of Operations Research* 1–34.

Stathakopoulos, Vlasis. 1998. "Enhancing the Performance of Marketing Managers: Aligning Strategy, Structure and Evaluation Systems." *European Journal of Marketing* 32 (5/6): 536–558.

Tabachnick, B. G., and L. S. Fidell. 2001. *Using Multivariate Statistics*. Boston: Allyn and Bacon.

Tan, Garry Wei-Han, Keng-Boon Ooi, Lai-Ying Leong, and Binshan Lin. 2014. "Predicting the Drivers of Behavioral Intention to use Mobile Learning: A Hybrid SEM-Neural Networks Approach." *Computers in Human Behavior* 36: 198–213.

Thirupathi, R. M., and S. Vinodh. 2016. "Application of Interpretive Structural Modelling and Structural Equation Modelling for Analysis of Sustainable Manufacturing Factors in Indian Automotive Component Sector." *International Journal of Production Research* 54 (22): 6661–6682. doi:10.1080/00207543.2015.1126372.

Toorajipour, Reza, Vahid Sohrabpour, Ali Nazarpour, Pejvak Oghazi, and Maria Fischl. 2021. "Artificial Intelligence in Supply Chain Management: A Systematic Literature Review." *Journal of Business Research* 122: 502–517.

Tortorella, Guilherme, Ricardo Giglio, Flavio S Fogliatto, and Rapinder Sawhney. 2019. "Mediating Role of Learning Organization on the Relationship Between Total Quality Management and Operational Performance in Brazilian Manufacturers." *Journal of Manufacturing Technology Management* 31: 524–541.

Trappey, Amy J. C., Charles V. Trappey, Tzu-An Chiang, and Yi-Hsuan Huang. 2013. "Ontology-based Neural Network for Patent Knowledge Management in Design Collaboration." *International Journal of Production Research* 51 (7): 1992–2005. doi:10.1080/00207543.2012.701775.

Tsai, J. M., and S. W. Hung. 2016. "Supply Chain Relationship Quality and Performance in Technological Turbulence: an Artificial Neural Network Approach." *International Journal of Production Research* 54 (9): 2757–2770.

Tsai, Chih-Fong, and Jhen-Wei Wu. 2008. "Using Neural Network Ensembles for Bankruptcy Prediction and Credit Scoring." *Expert Systems with Applications* 34 (4): 2639–2649.

Tuominen, Sakari, and Anssi Pekkarinen. 2005. "Performance of Different Spectral and Textural Aerial Photograph Features in Multi-Source Forest Inventory." *Remote Sensing of Environment* 94 (2): 256–268.

Varadarajan, Rajan. 2010. "Strategic Marketing and Marketing Strategy: Domain, Definition, Fundamental Issues and Foundational Premises." *Journal of the Academy of Marketing Science* 38 (2): 119–140. doi:10.1007/s11747-009-0176-7.

Varadarajan, P. Rajan, Satish Jayachandran, and J. Chris White. 2001. "Strategic Interdependence in Organizations: Deconglomeration and Marketing Strategy." *Journal of Marketing* 65 (1): 15–28.

Venkatraman, N. 1989. "The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence." *Academy of Management Review* 14 (3): 423–444. doi:10.5465/AMR.1989.4279078.

Venkatraman, N. 1997. "Beyond Outsourcing: Managing IT Resources as a Value Center." *MIT Sloan Management Review* 38 (3): 51.

Visinescu, Lucian L, Mary C Jones, and Anna Sidorova. 2017. "Improving Decision Quality: the Role of Business Intelligence." *Journal of Computer Information Systems* 57 (1): 58–66.

Walker Jr, Orville C., and Robert W. Ruekert. 1987. "Marketing's Role in the Implementation of Business Strategies: A Critical Review and Conceptual Framework." *Journal of Marketing* 51 (3): 15–33.

Wang, J., and H.-Y. Lin. 2006. "A Fuzzy Hybrid Decision-aid Model for Selecting Partners in the Design Chain." *International Journal of Production Research* 44 (10): 2047–2069. doi:10.1080/00207540500354028.

Weill, Peter, and Margrethe H Olson. 1989a. "An Assessment of the Contingency Theory of Management Information Systems." *Journal of Management Information Systems* 6 (1): 59–86.

Weill, Peter, and Margrethe H Olson. 1989b. "Managing Investment in Information Technology: Mini Case Examples and Implications." *MIS Quarterly* 13: 3–17.

Wiseman, Charles. 1988. "Strategic Information Systems: Trends and Challenges Over the Next Decade." *Information Management Review* 4 (1): 9–16.

Wu, Shelly Ping-Ju, Detmar W. Straub, and Ting-Peng Liang. 2015. "how Information Technology Governance Mechanisms and Strategic Alignment Influence Operational Performance: Insights from a Matched Survey of Business and it Managers." *MIS Quarterly* 39 (2): 497–4A7.

Yeow, Adrian, Christina Soh, and Rina Hansen. 2018. "Aligning with new Digital Strategy: A Dynamic Capabilities Approach." *The Journal of Strategic Information Systems* 27 (1): 43–58.

Yu, Wantao, Ramakrishnan Ramanathan, and Prithwiraj Nath. 2014. "The Impacts of Marketing and Operations Capabilities on Financial Performance in the UK Retail Sector: A Resource-Based Perspective." *Industrial Marketing Management* 43 (1): 25–31.

Zanon, Celeste Jose, Alceu Gomes Alves Filho, Charbel Jose Chiappetta Jabbour, and Ana Beatriz Lopes de Sousa Jabbour. 2013. "Alignment of Operations Strategy: Exploring the Marketing Interface." *Industrial Management & Data Systems* 113: 207–233.

Zhang, Min, Hangfei Guo, and Xiande Zhao. 2017. "Effects of Social Capital on Operational Performance: Impacts of Servitisation." *International Journal of Production Research* 55 (15): 4304–4318. doi:10.1080/00207543.2016.1246764.

Zheng, Wei, Baiyin Yang, and Gary N. McLean. 2010. "Linking Organizational Culture, Structure, Strategy, and Organizational Effectiveness: Mediating Role of Knowledge Management." *Journal of Business Research* 63 (7): 763–771. doi:10.1016/j.jbusres.2009.06.005.

Zhu, Zhen, and Cheryl Nakata. 2007. "Reexamining the Link Between Customer Orientation and Business Performance: The Role of Information Systems." *Journal of Marketing Theory and Practice* 15 (3): 187–203.

# AI based decision making: combining strategies to improve operational performance

Al-Surmi, Abdulrahman

2021-08-30



Al-Surmi A, Bashiri M, Koliousis I. (2022) AI based decision making: combining strategies to improve operational performance, International Journal of Production Research, Volume 60, Issue 14, 2022, pp. 4464-4486

https://doi.org/10.1080/00207543.2021.1966540