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The Role of Innovation in Adapting Target Costing Systems: A Quantitative Analysis in Iran Petrochemical Industry

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Abstract

This paper, aims to use contingency theory to analyze the relationships between innovation and environmental and organizational determinants of target costing adoption (TCA) and target costing use (TC). So, the determinants and perceived consequences of using different strategic cost management tools and their relationships with innovation, environment and organization in a petrochemical industry are examined. This research is descriptive in terms of method and applied in terms of objective. The required data were collected using a standard questionnaire from 78 experts in Iran petrochemical industry, including executive managers and industry experts, during 2021. This paper contributes to the complexity theory by using the multivariate regression and fuzzy-set qualitative comparative analysis (fsQCA) methods. The analysis extends the literature by illustrating that previously studied determinants (competitiveness, environment, uncertainty, and innovation) are neither sufficient nor necessary factors. The multiple configurations also illustrated the effect of economic group specifications (and its pressures) and focus on production cost control rather than product development costs. The results indicate that, the petrochemical companies, which plan to develop new services or products, need access to technology and full concentration on market (pricing) in order to take full advantage of target costing.

Keywords: Contingency theory, Target costing, Innovation, Strategic cost management, fsQCA, Variable clustering

1 Introduction

In today's business landscape, characterized by intense competitive pressures, organizations must adopt strategies to manage and reduce costs (Henri et al., 2016). With increasing pressure to control costs, customers demand products that satisfy their requirements for quality, performance, and price. Simultaneously, shareholders seek profits as a reflection of their investment risk. Indeed, Selecting an appropriate investment portfolio is the foundation of modern financial theories (Vahidpour et al., 2023).

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In this context, strategic cost management tools play a crucial role in aligning cost management with overall business strategy (Cooper & Slagmulder, 1999). Strategic cost management (SCM) aims to enhance competitive positioning while simultaneously reducing costs through the application of effective cost management techniques (Henri et al., 2016). Also, SCM involves the intentional alignment of a firm's resources and cost structure with both long-term strategies and short-term tactics (Rashid et al., 2021). This concept is part of a broader field of research focused on strategic management accounting, which encompasses various approaches to enhance organizational performance and decision-making (Cadez & Guilding, 2008). Recent studies have further explored the integration of SCM with contemporary business practices, emphasizing its critical role in achieving competitive advantage and operational efficiency (Rounaghi et al., 2021).

The evolving landscape of global economy obligates the organizations to adopt effective management accounting tools to enhance flexibility and responsiveness to market changes (Kharaghani et al., 2023). Research indicates that such tools can significantly increase organizational adaptability (Nixon & Burns, 2012). These systems are transitioning from simple planning and control mechanisms to more complex, innovation-driven frameworks (Chenhall and Moers, 2015). However, empirical evidences suggests that many organizations do not yet fully implement SCM practices (Nixon & Burns, 2012).

Target costing (TC), a crucial component of SCM, is increasingly recognized for its potential to align product development with market demands while managing costs effectively (Baraldi and Stromsten, 2024). Companies that leverage TC often do so with an emphasis on innovation, environmental considerations, and organizational context. However, some organizations misunderstand the fundamental purpose of TC, perceiving it merely as a tool focused on production costs rather than a comprehensive system for profitability planning and corporate cost management (Gopalakrishnan et al., 2015). Effective target costing not only addresses production costs but also promotes an innovative approach to product development that responds to dynamic market conditions.

According to contingency theory, managers must enhance organizational flexibility to achieve acceptable performance in various unpredictable situations. Contingency studies try to determine the most appropriate technique for a particular organization with the specific conditions they need (Chenhall and Moers, 2015). Companies face increasing global competition, and cost reductions are no longer to maintain competitive advantage. To cope with this challenge, firms use innovation to respond to market changes and achieving sustainable growth (Karimzadeh et al., 2023; Walker, 2006). This perspective positions innovation as a dual driver of short-term profitability and long-term sustainability (Roberts & Amit, 2003). Product innovation encompasses both the introduction of entirely new products and significant enhancements to existing ones. In this context, target costing facilitates the development of products that not only reflect market value but also take into account demand, efficiency constraints, and waste management (Homayounfar et al., 2018; Karimzadeh et al., 2023, Nozari and Ghahremani-Nahr, 2023).

The concept of "limited rationality," introduced by Simon, has paved the way for behavioral management accounting research, emphasizing how individuals make decisions based on accounting information. While various accounting tools have been studied for behavioral implications, target costing remains an underexplored area with significant potential for further research. The process of target costing is prone to errors in reasoning, motivational deficiencies, and limitations in information processing, all of which can substantially affect decision-making (Gazheli et al., 2015). These factors are critical when considering how activity stimuli influence individual and employee behaviors, particularly when performance is being evaluated. Improper allocation of costs, for example, can distort market responses like customer demand, underscoring the need to address both positive and negative behavioral impacts on systems such as activity-based costing.

Given this context, research on target costing is particularly relevant in industries like petrochemicals, where the intersection of cost management, innovation, and external constraints—such as sanctions—creates unique challenges. The petrochemical industry faces increasing production costs and quality demands due to limited access to raw materials. Despite these pressures, strategic cost management, including target costing, has not been widely adopted, leaving a significant gap between theoretical advancements and practical implementation. Additionally, limited researches investigated the role of contingency theory in supporting target costing systems based on innovation within this sector. Due to the strategic importance of petrochemical industry and the growing need for more flexible

and innovative management accounting tools in the industry, this research aims to achieve to a comprehensive understanding of strategic cost management system. So, in this paper contingency theory is used to analyze the relationship between innovation and environmental and organizational determinants in the adoption of target costing in Iran petrochemical industry.

The remainder of the paper is organized as follows. In Section 2, we briefly examine the target costing process and information uncertainty, and review the previous studies. The research methodology and the proposed research framework are presented in Section 3. Section 4 described the developed model in a real case study and the results are discussed. The conclusions and some future research directions are presented in section 5.

2 Theoretical foundations and research background

2.1 Target costing process

Traditional target costing process is typically structured into five key stages, each requiring specific sets of information and methodologies to calculate and manage costs. These stages are integral to ensuring that costs are aligned with both market demands and internal operational goals (Figure 1). Several approaches can be employed to define and calculate target costs. The first two approaches, market to company and outside competitors, represent market-based calculation methods. The remaining two, outside the company and outside standard costs, are internally focused. Additionally, a hybrid approach, combining both external and internal perspectives, is often utilized for more comprehensive cost management (Brünger & Faupel, 2010; Cooper & Slagmulder, 1999).

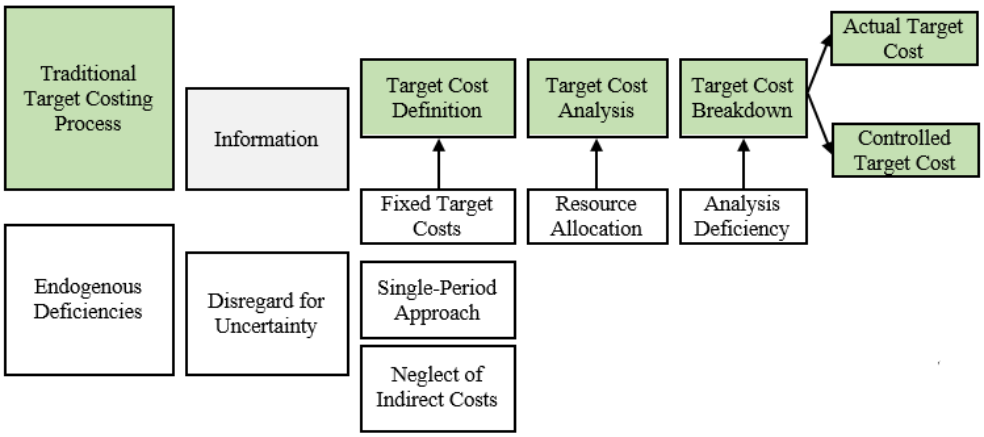

Figure 1. Endogenous deficiencies of traditional target costing

The overall goal of the target costing phase is to ensure that the standard costs of the final product match the target costings while simultaneously meeting market needs (Ax et al., 2008). This goal is pursued by using cost engineering techniques and value engineering (Park et al., 2016). Cooper and Slagmulder (1999) describe value engineering as "a multidisciplinary approach to product design that maximizes customer value, increases performance and quality while reducing cost." Value engineering activities begin in parallel with the first stages of production. Here, the potential capacity to influence is an excellent opportunity to coordinate performance and target costings (Newman & McKeller, 1995). The intensity of value engineering activities should be high, especially before plans are proven (Yasukata et al., 2013). As Table1 shows, this step is somewhat different from the previous steps because the target costing breakdown occurs during the production period, and these steps are constantly complementary (Martinez Ramos, 2004). Ideally, the process of achieving the target costing not only leads to standard costs for the product equal to or less than the target costing so that the product can be transported to the market stage, but also to the cost of the set target. Also arrives (Seidenschwarz, 2003). Monitoring and reporting are particularly important activities of target costing control, which are carried out in parallel with the realization of the target costing to ensure that the entire product development process remains on track (Everaert & Swenson, 2016). The standard deviation of the costs from the target costings is calculated. The insights gained can be used to compare, evaluate and monitor the progress of achieving the target costing (Baraldi and Stromsten, 2024).

Table 1. Further developments of the traditional method of target costing

Treatment of Endogenous Deficiencies	1. Information uncertainity
	2. Dynamic target costing
	3. Multi period approach
	4. Considering indirect costs
Expansion of Program Horizon	5. Contineous resource allocation
	6. Precision and Analysis
Expansion of Organizational Scope	7. Total Cost Management
	8. Life cycle concentration
	9. Inter-organizational costing

2.2 Information Uncertainty

Uncertainty in information refers to situations where information, changes, impacts, and governance measures is incomplete, ambiguous, or difficult to judge accurately (Zhang and Xiang, 2024). To address information uncertainty, Götze & Linke (2008) call for more methodological support to better predict product specifications, sales volumes, sales prices, and other key data. They propose a price-demand performance to maximize projected turnover (Bauer et al., 1994). Using this method, simulations for different product and price settings can be detected to identify the most profitable combination. Information about the input target costing is subjective rather than objective, because it is based more on personal experience as well as estimates (Ehrlenspiel, 2014). Thus, Koonce et al. (2007) proposed calibration analysis and risk analysis as methods to deal with information uncertainty.

Calibration analysis is a method of quantifying estimation errors by contrasting calculated and actual cost data. Variation in historical patterns can be seen to correct future production estimates. Risk analysis enables companies to better assess the impact of uncertainties, which in turn improves decision-making processes (He et al., 2020). Target costing usually definitively condenses the results of market analysis into aggregate figures, but this method leads to inaccuracies and misinterpretations (Baraldi and Strömsten, 2024). To address this weakness, Krapp & Wotschofsky (2000) developed the concept of random variables to incorporate uncertainties resulting from deviations in customer performance expectations. Therefore, the range of heterogeneous value needs can be considered to actually guide target costin effectiveness activities. The goal is to reduce the standard deviation and increase the probability value distribution to shorten the target distance as much as possible.

2.3 Literature review

The core features of target costing, as identified by researchers, are market orientation, proactive cost management during early development stages, and cross-functional collaboration (Henri et al., 2016). These elements are seen as essential for aligning product development processes with market demands while maintaining profitability. Market orientation ensures that customer needs and competitive pressures are integrated into cost targets. Initial cost management emphasizes the importance of setting cost parameters early in the design phase to prevent cost overruns later in the process. Lastly, joint efforts highlight the collaborative nature of target costing, involving not only internal teams but also external partners such as suppliers to achieve cost efficiency. Initially developed in the 1960s, target costing has evolved into a widely recognized and researched methodology, with numerous empirical studies affirming its global application and relevance. Recent literature has expanded the scope of target costing to address contemporary challenges such as sustainability and digital transformation. For instance, Zhang and Xiang (2024) explored how environmental uncertainty and new media surveillance influence corporate cost management strategies, emphasizing the need for

dynamic and adaptable approaches. Similarly, Stadtherr and Wouters (2021) studied the expansion of target costing, including the objectives of R&D costs and manufacturing investments for the modular product portfolio. This article provides a way to expand the scope of traditional target costing.

Kheradyar et al. (2020) investigated the relationship between the adoption of activity-based costing and organizational performance, focusing on the influence of selection bias and the issue of endogeneity. The results revealed that, when using the Heckman correction method and the two-stage least squares instrumental variable (2SLS-IV) approach, the performance benefits of activity-based costing were significantly higher compared to traditional least-squares methods. Li et al. (2020) studied the optimization of the production inventory system at the target costing. They found that the optimal inventory decisions to minimize the probability of loss are the same for both models, and the optimal inventory decisions to minimize the expected loss have the same structure for both models. Baharudin & Jusoh (2019) examined the implementation of target costing management in a non-Japanese environment. Their findings show that although the company is subject to the basic TCM steps defined in the literature, it has modified the details of the TCM steps to some extent to align with the company's resources, business processes, and strategic routines. Ahn et al. (2018) conducted a comprehensive study on the evolution of target costing, analyzing its past, present, and future trajectories. They identified nine distinct research streams that highlight advancements in traditional target costing methodologies. These streams were categorized into three overarching research areas, showcasing both the progress achieved and the challenges that remain for future exploration.

Navissi and Sridharan (2017) identified key determinants influencing the acceptance of target costing systems (TCA) within organizations. Their study posits that managers may resist adopting target costing due to high information asymmetry, as their stock-based compensation tends to increase with earnings volatility and stock performance. In contrast, proponents of target costing benefit from enhanced cash-based compensation, which can lead to improved profitability for the company. Similarly, Jamei et al. (2017) investigated the impact of the corporate life cycle on social responsibility, emphasizing the moderating effects of organizational resources and financial capabilities among companies listed on the Tehran Stock Exchange. Their findings indicate that Iranian companies are more likely to invest in social responsibility initiatives during the growth and maturity stages of their life cycle, aiming to create competitive advantages, build public trust, and attract essential capital and resources.

A literature review revealed that current sudies tend to evaluate cost management techniques without adequately addressing how specific organizational and environmental conditions affect the adoption of target costing. This gap underscores a lack of comprehensive studies that connect contingency theory with the acceptance of target costing in innovative settings. So, our research innovatively aims to utilize contingency theory to analyze this relationship, identifying the critical factors that influence the adoption of target costing in various organizational and environmental contexts. This approach not only enhances our understanding of how new cost management techniques are embraced but also provides valuable insights into their alignment with specific organizational circumstances. The research hypotheses are presented as following:

- ***Hypothesis 1:*** *Product and service innovation has a direct relationship with target cosing adoption (TCA) in the petrochemical industry.*
- ***Hypothesis 2:*** *Competitive environment has a direct relationship with target cosing adoption (TCA) in the petrochemical industry.*
- ***Hypothesis 3:*** *Environmental uncertainty has a direct relationship with target cosing adoption (TCA) in the petrochemical industry.*
- ***Hypothesis 4:*** *Organizational capabilities (management commitment and focus on production/ development) has a direct relationship with target cosing adoption (TCA) in the petrochemical industry.*
- ***Hypothesis 5:*** *Organizational configuration has an inverse relationship with the target cosing adoption (TCA) in the petrochemical industry.*

3 Research Methodology

This study utilized the survey developed by Afonso et al. (2008), which is part of the Ernst & Young global questionnaire titled "Roles and Practices in Management Accounting Today" (Garg et al., 2003). Additional items were adapted from Cadez and Guilding (2008) and Juras (2014). To ensure clarity and

avoid the use of technical jargon, the main steps for each management accounting technique were carefully outlined. A total of 182 experts initially accessed the survey, but only 78 completed it in full and were included in the final analysis. The respondents comprised 30% heads of accounting, 38% financial staff, 20% planning and production staff, and 10% operations staff. Notably, 77% of the respondents indicated that their petrochemical company had launched a new product within the past three years. The internal consistency of the binary questions was measured using a Likert scale, with a Cronbach's alpha of 0.81, indicating good reliability. To examine the relationship between target costing adoption (TCA) and innovation, we employed two regression models: a logit regression to test the effect of innovation on TCA and a linear regression to assess the impact of innovation on target costing (TC).

$$TCA = a + b_1\, innovation + b_2\, uncertE + + b_3\, uncertC + b_4\, uncertG + b_5\, competition + \varepsilon \quad (1)$$
$$TC = a + b_1\, innovation + b_2\, uncertE + + b_3\, uncertC + b_4\, uncertG + b_5\, competition + \varepsilon \quad (2)$$

TCA is the probability of accepting TC and is a binary variable that is equal to one if it is approved by TC and otherwise zero. TC variable is adapted from the question that describes the use of the technique, which generally describes the purpose of the TC and is measured by the five main characteristics of the TC. Innovation is a binary variable that is considered 1 if the company has launched a new product in the last three years, otherwise it is considered zero (Bisbe & Otley, 2004). Both models control the effect of environmental uncertainty and competition on the rate of acceptance and the rate of TC (e.g. Ax et al., 2008).

To develope of new products, the target costing is usually calculated as the potential market price minus the expected profit for the product, which is determined on a Likert scale from strongly agree to strongly disagree TC usage. Before making objective measurements, we focus on managers 'perceptions of uncertainty and competition. Perceptions of the external environment are what really influence organizations' decisions (Duh et al., 2009). We measure uncertainty with three tools:

- UncertE, which deals with the economic and technological environment;
- UncertC, which deals with the customer needs;
- UncertG, which deals with group pressure.

Competition is defined as the time to enter new market products compared to competitors. Finally, cluster analysis will be used to classify the research variables.

4 Discussion

4.1 Multivariate regression analysis

Table 1 reveals a positive relationship between innovation and Target Costing Acceptance (TCA) across both models. The findings indicate that the likelihood of TCA increases with innovation, while it decreases in response to competitive environmental uncertainty (UncertE). These results align with the studies by Afonso et al. (2008), Ax et al. (2008), and Gonçalves and Gaio (2021). Additionally, the intensity of Target Costing (TC) is found to increase alongside innovation, whereas it decreases with economic uncertainty and environmental technology (UE). Notably, no direct relationships were observed between customer uncertainty (UncertC) or group pressure uncertainty (UncertG) and either TCA or TC intensity.

Table 2. Linear regression and logit results

Multi Variate Model	***TC***		***TCA***	
Variable	**Statistics t**	**b**	**Parent**	**b**
Innovation	3.626**	0.344	11.524**	3.467
Competitiveness	-0.649	-0.660	1.083	1.454
Uncertainty of competition environment	4.549**	-0.475	2.165	-1.407
Uncertainty of customer needs	-0.056	-0.005	0.599	-0.697
Uncertainty of economic group pressures	0.205	0.019	1.083	1.454

** p-Value<0.05.

4.2 Fuzzy-set Qualitative Comparative Analysis results

Table 2 presents the fsQCA solutions that examine various causal combinations. The table compares both mean and empirical solutions for the classification of variables. A fundamental causal condition is identified in both solutions, as it exhibits a very strong causal relationship. In contrast, an environmental condition, characterized by a weaker causal relationship, is present only in the intermediate solution. The unique coverage analysis—assessing the extent to which a causal combination exclusively accounts for a specific outcome—indicates that all causal combinations must demonstrate empirical relevance. The raw coverage result is 0.72, suggesting that the majority of variables are represented across four distinct combinations.

Table 3. fsQCA Results: Configuration for TC Consistency

	1	2	3	4
TC intensity of use		●	■	○
TC Golden Rules (con)	●			○
Production focus (dev)	●		●	○
Capital cost (custfin)		●		○
Consistency	0.972	0.958	0.807	0.894
Raw coverage	0.719	0.727	0.982	0.061
Unique coverage	0.976	0.882	0.789	0.061
Solution coverage	0.793			
Solution consistency	0.976			

Absence of main variable ○ , Presence of the main variables of the causal condition ■ , Presence of environmental condition ●

But the analysis of solution 4 shows the contradiction in the principles of TC. This is due to the lack of management-focused management accounting tools, ignoring budget expenditures on product and service costs, which leads to costs being below the target cost threshold.

4.3 Variable cluster analysis results

Table 4 illustrates the membership outcomes from variable clustering, where we evaluated solutions ranging from two to four clusters. Given that all variables are binary, cluster membership and distance were established using a four-point correlation and aggregation based on the mean of the connections. To ascertain the optimal number of clusters, we employed three criteria: theoretical and empirical reasoning related to the dataset, dendrogram analysis (illustrated in Figure 2), which indicates that the final solution should reflect the greatest increase in heterogeneity, and the "elbow criterion." The elbow criterion identifies the final number of clusters just before a notable decrease in absolute margin distance occurs. Ultimately, our analysis resulted in a definitive solution comprising three clusters.

Table 4. Results of clustering of variables

Variables	Cluster 1	Cluster 2	Cluster 3
Innovation (INNO)	1	2	1
Management commitment (MANAGE)	5	3	1
Adequacy of technology (TECHNO)	1	1	2
Uncertainty about economics (UE)	1	5	3
Uncertainty about customer (UC)	1	3	1
Uncertainty about group (UG)	1	3	1
Focus on production (DEV)	3	3	1
Focus on development (DEV2)	3	3	1
Market prices in the development phase (PM)	1	2	1
Market price in production phase (PF)	1	2	2

Cluster 1 considers innovation, market-based pricing, adequacy of technology, and uncertainty as reasons for using cost management tools and focusing on product development. This cluster shows

evidence of the similarity of determinants and characteristics of companies more relevant to the focus on new product development. Cluster 2 combines management commitment and the group pressure as the most relevant to cost management practices. The focus of these tools is on production and trade costs, which are more common in the petrochemical industry. The next cluster represents the variables that are more involved in post-production cost control rather than strategic cost management in the development phase like the previous cluster. The third cluster finds similar data from variables related to service and customer pressure for commitment to cost management.

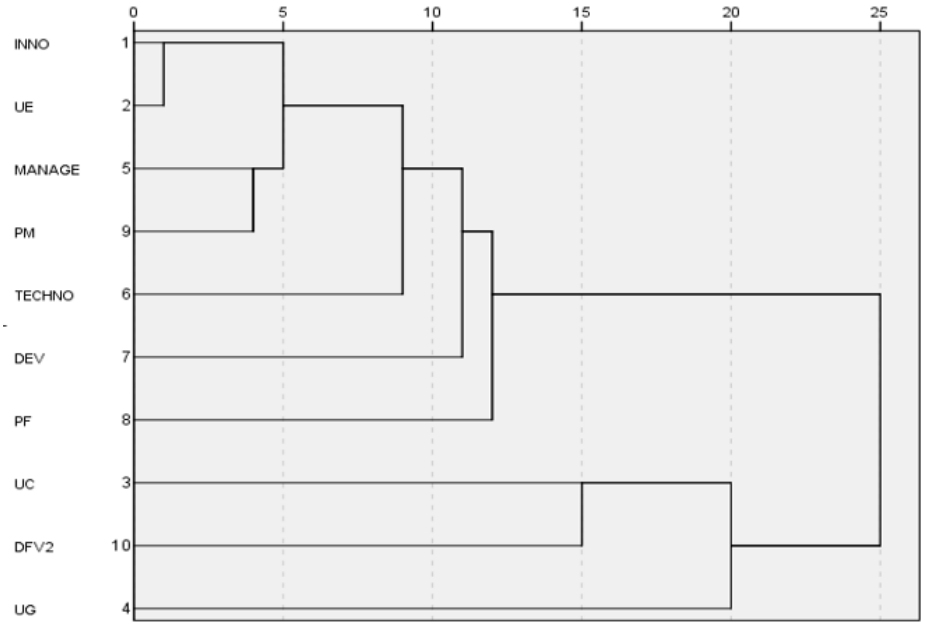

Figure 2. Hierarchical clustering using average linkage (Between Groups)

In the above dendrogram, clusters highlight how different industries and business focuses dictate the reasons for adopting specific cost management practices, whether it's for innovation, production efficiency, or post-production cost control. Starting on the left side, the closest relationship is observed between INNO and UE, indicating these two variables share a high degree of similarity. Similarly, MANAGE and PM are clustered together early, suggesting they are also closely related. As the clustering progresses, these smaller clusters merge with one another, with TECHNO joining the combined group of INNO, UE, MANAGE, and PM at a moderate distance, signifying some level of similarity but less than the internal pairings.

Moving toward the right side of the dendrogram, UC and DFV2 form another cluster, but the larger distance at which they merge suggests a weaker similarity compared to the earlier groupings. Finally, UG joins the UC-DFV2 cluster, and this larger group is merged with the others at a significant distance, indicating that UG is quite different from the earlier variables. Overall, the dendrogram reflects the strongest relationships between INNO and UE, as well as MANAGE and PM, while highlighting that UG is relatively more distinct from the other variables.

5 Conclusion

The results from both logit and linear regression analyses confirm Hypothesis 1, that is, there is a direct relationship between Target Cosing Acceptance and its use with product and service innovation in the petrochemical industry, is confirmed. In fact, innovation has a positive effect on TCA and its intensity. According to the literature (e.g., Afonso et al., 2008) and in line with economic reasoning, the regression coefficient for innovation is statistically positive and significant. In contrast, Hypothesis 2, there is a direct relationship between increasing the competitive environment with TCA and its use in the petrochemical industry, is not supported: Competition shows no significant relationship with acceptance and TC intensity. Although the sign of regression coefficient is positive, its statistical insignificance necessitates additional analysis. Hypothesis 3, that is, there is a direct relationship

between increasing uncertainty in the environment and TCA and its use in the petrochemical industry, has a negative impact on the use of TC. These results are consistent with the results of Ax et al and Gonçalves and Gaio (2021). Other uncertainties (customer uncertainty and pressure-dependent uncertainty related to group pressure) have no significant effect on the TCA and its use in the petrochemical industry.

Organizational capabilities (such as management commitment and production / development focus) are directly related to the TCA and the extent to which it is used in the petrochemical industry. Hypothesis 4 states that organizational capabilities have a significant impact on TCA and TC. We also found evidence from a variable cluster configuration analysis that refers to TCA. In addition, TC acceptors understand the importance of considering the cost of capital. In Hypothesis 5, using fsQCA analysis of the type and importance of each variable in TCA, the results are consistent with the literature showing that organizational focus on new product and management commitment leads to TCA. However, compared to the literature, we find that companies with less focus on production and management independence adopt TC due to group pressure, which is contrary to our predictions. Duck (1971) concluded that some companies think they are using some costing techniques but are actually using an organization-friendly system. Dekker & Smidt (2003), on the other hand, identified several German manufacturing companies that use very similar TC methods without knowing the lexical content of the target costing. According to Sani and Allahverdizadeh (2012), the focus of companies at different stages of a product's life largely depends on its durability.

Companies with short- or medium-term products focus on management accounting techniques such as TC. They attach more importance to the development stage. Conversely, companies operating in mature markets with products with a long life cycle are more focused on the manufacturing phase. Also, Afonso et al. (2008) found significant differences in cost management tools for companies involved in new product development and component development. This distinction can be related to group pressure with more or less innovation. The same is true for customer pressure tested in this study. As a result, various asymmetric configurations of fsQCA emerge that are hidden from regression analysis. Variable clustering makes it possible to test the strength of these predictions. According to the fsQCA, we found data patterns that categorize different cost management techniques and organizational features. In line with the previous arguments and scarce evidence, the petrochemical company, which plans to develop a new product, needs access to technology and full attention to the market (pricing) in order to take full advantage of TC.

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