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THE IMPACT OF APPLYING STRATEGIC PLANNING ON IRANIAN SMES' PERFORMANCE AND EVALUATION OF STRATEGIC PLANNING MODELS USING FBWM

by

Iman Ajripour

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by

Iman Ajripour

Supervisor: Viktor Molnár, PhD

Hantos Elemér Doctoral School of Business, Management and Regional Science

Head of Doctoral School: Prof. dr. Géza TÓTH

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Summary

The current cross-sectional survey study firstly examines how applying strategic planning in Iranian manufacturing small and medium-sized enterprises (SMEs) affects their performance and then in the second part of the research it evaluates strategic planning models using the Fuzzy Best Worst Method. This study evaluates the engagement of Iranian SMEs in strategic planning to ascertain if applying strategic planning affects performance. It also attempts to examine the role of some variables like innovativeness, flexibility, business objectives, etc., in applying strategic planning and business performance. Moreover, this study aims not only to stimulate discussion and raise awareness about the necessity for Iranian SMEs to have a strategic plan for continuation but also to prioritize strategic planning models using Multi-Criteria Decision-Making (MCDM) technique.

A quantitative approach was selected. Primary data for the first section were gathered through 320 questionnaires from individuals working in Iranian manufacturing SMEs. Structured interviews with 13 managers/owners of SMEs were done to collect the primary data for the second section of the current study. The analysis of data was carried out in the first part using the Partial Least Square (PLS) method, Analysis of Variance (ANOVA), and regression analysis and in the second part the Fuzzy Best Worst Method (FBWM) was exploited. Smart PLS, SPSS, Excel, and Lingo 11.0 software were used in the process of analyzing. The result represented that applying strategic planning impacts the Iranian manufacturing SMEs' performance. This is in line with research findings in developed countries. In addition, the outcomes in the second part indicated that based on managers'/owners' judgment Wright's strategic planning model got the first rank to be applied in Iranian manufacturing SMEs. Finally, the author recommends future studies use a longitudinal survey, focusing on homogeneous industries, and applying other Fuzzy MCDM techniques.

Keywords: Strategic planning, Performance, Iranian manufacturing Small and Medium-sized Enterprise (SME), Fuzzy Best Worst Method (FBWM), Multi-Criteria Decision-Making (MCDM

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1. Introduction

The effect of strategic planning on the performance of Iranian manufacturing small and medium-sized enterprises (SMEs) is examined in the first section of this study. It aims to determine whether implementing and adopting strategic planning has an impact on the performance of SMEs. In the second section, strategic planning models for SMEs are prioritized using the Fuzzy Best Worst Method (FBWM). It offers a viable strategic planning model for applying to SMEs using a Multi-Criterion Decision-Making (MCDM) approach.

This chapter's foundation is the development of the research formulation idea, which entails defining a rationale for the study by explaining the study's background, goals, research problem, and justifications for pursuing it. Additionally, it describes the theoretical foundation of the study, the general research methodology for the thesis. The study's goals are described, including how it will advance knowledge and effect the real world.

This research is interesting because it not only provides a framework for deducing actual data on the studied topic but also applies a multi-criteria decision-making technique (FBWM) to prioritize strategic planning models in Iranian SMEs.

At first, a general model is developed considering variables like innovativeness, flexibility, planning sophistication, business objectives and engagement. Questionnaire is used to collect the required data. Structure Equation Modeling (SEM) and Partial Least Square (PLS) are applied to analysis of data in the first section. The results have shown that applying strategic planning in Iranian SMEs effect the performance. Besides the main model, three more subsidiary structural models (flexibility on innovativeness, dimension of applying strategic planning on SMEs performance, and applying strategic planning on the dimension of SMEs performance.) are studied in my research to provide useful information to managers in the SMEs. In addition, the impact of individual features, organization features, and individual cultural inclusion on engagement are studied. The results of testing the general model have shown a positive relation of strategic planning and performance in Iranian manufacturing SMEs.

In the second section, I have surveyed to prioritize strategic planning models and suggest a model for the Iranian manufacturing SMEs. Doing interview with managers, the required data are collected. Fuzzy Best Worst Method and Lingo 18 software are used to reach the final results. According to the results, the Wrights' strategic planning model is recommended to be used in the Iranian manufacturing SMEs.

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1.1 Research Problem

Some researchers have concentrated on developing countries to find that applying strategic planning improved the performance of SMEs (Makkawi, 2023; Alzahrani et al., 2023; Kafidi and Kaulihowa, 2023; ; Dwikat et al., 2022; Baba and Audu, 2021; Obaje,2020). The purpose of the current study in the first section is to further explore strategic planning and performance relation from the standpoint of Iran's economy.

An investigation into the Iran as a developing country can thereby close a research gap. Hence, the research main question in the first part of the current study is: what is the impact of applying strategic planning on the Iranian manufacturing SME's performance?

Although many authors and creators of strategic planning models expressed that all kinds of models can be used depending on the situation, the fact that the nature of the application of strategic planning models is not clear and there is no guidance in this field, many organizations in the way of planning are faced with strategic problems and suffered significant losses. Even though some research has been done regarding the evaluation of strategic planning models, none of them prioritized the models and none of them recommended a model for application in Iranian manufacturing SMEs. An investigation into prioritizing strategic planning models using an MCDM technique would fill a research gap. Therefore, the research main question in the second part of the current study is: what is the rank of strategic planning models in Iranian manufacturing SMEs?

1.2 Study Background

SMEs can make a significant contribution to industrial and economic development. First, it promotes the mobilization of national resources, which leads to the creation of job opportunities, wealth, and as a result, poverty reduction (Chepkwony et al., 2009). Second, it aids in the mainstreaming of marginalized social groups such as youths and women, whose power to contribute to their country's economic development is typically limited. Third, when privatization activities are required to be done, the SME can play an essential role because SMEs are often able to absorb consequent redundancies in the workforce (Pasnicu, 2018). Fourth, SME development helps democracy and civil society by encouraging entrepreneurs to participate in the country's economic, political and social systems. Moreover, the SME has proven to be adaptable and innovative; in some industries, SMEs outperform large corporations. They are enabled to adjust more rapidly and effectively to changing and increasingly global trends (Rachmania, 2012).

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In addition, SMEs are the backbone of the private sector (Gibson, and Van der Vaart, 2008), accounting for over 90% of all businesses in the world and providing 50-60% of all jobs. This percentage is even higher in the manufacturing sector and in developing countries, where manufacturing firms account for 90-95% of all industrial firms, 70-75% of industrial employment, and 50-60% of industrial productions, respectively (Drucker, 2014; WTO, 2016; BIAC, 2016).

Small and medium-sized enterprises have made and continued to make a very significant contribution to the Iranian economy, which had been praised for its role in reducing the unemployment rate and raising the gross domestic product in Iran (Johari, 2012, Kalhor, 2016). It has been asserted that small and medium-sized businesses in Iran strengthen the country's economy by creating opportunities for employment, skill development, sources of supplemental income, and entrepreneurial spirit. It is also put forward that supporting SMEs in Iran not only will it make a contribution to innovation/technology development activities but also will strengthen greatly the supplier network in Iran (Science, Technology, and Innovation Policy Review, 2005).

Iranian SMEs are extremely important to the manufacturing industry and value chains, as well as to the country's economic growth prospects. This is in line with Suresh and Mohideen (2012), who stated SMEs play a crucial role in the improvement of business activities in a good number of economies. According to Chen (2006); Osinde (2014); Dusko (2014), the foundation of industrialization, income distribution, empowerment, and entrepreneurship is made up of SMEs. However, due to external constraints including a lack of access to financial credit and capital, infrastructural gaps, erratic policies, and enforced sanctions, Iranian SMEs must operate in an extremely unstable and challenging environment.

These factors pose a potential threat to the long-term viability of small and medium enterprises (SMEs). Confronted with such obstacles, there is a growing need for a robust and flexible SME sector to drive the economic progress of developing nations, as highlighted in the Asian SME Summit of 2009. This underscores the imperative for SMEs to adopt a proactive and innovative approach to overcoming these challenges to ensure their sustained existence. Moreover, the significance of strategic planning has become increasingly apparent within this framework. In addition to the study of Bala Sundaram (2009) and French et al. (2004) which prove the necessity of strategic planning towards the development and success of SMEs, Ihu (2009), Kraus et al. (2006), Tapino et al. (2005) and Kiriri (2005) posited that strategic planning stands out as a crucial element that enhances the performance levels of SMEs.

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According to Bracker et al. (1988), strategic planning is a key component of performance. Having a flexible (Yin, 2023) and innovative (Sandada & Chikwama, 2016) strategic plan contributes to the SMEs' involvement with the strategic plan, adaptation to change, agility in decision-making, and creation of sustainable competitive advantages. By cultivating a culture of innovation and adaptability within the strategic planning process, SMEs can improve their capacity to swiftly respond and achieve strategic goals. Consequently, this can have a beneficial influence on their performance in terms of growth, profitability, and sustainability.

The selection and implementation of specific strategic planning models and features may increase the survival of SMEs, not only in a chaotic environment but also in a competitive environment (Okwachi et al., 2014). Therefore, evaluating and prioritizing strategic planning models is another important issue that should be studied for small and medium-sized enterprises.

1.3 Theoretical Background

Since the notion of strategic planning was first presented, academics and the business world have shown a remarkable amount of interest in the importance of strategic planning for growth, development, and the effects it may have on firm's performance generally. While a few studies have reported an indifferent correlation (Kroeger, 2007; Brown, 2008), some others provided a positive correlation between applying strategic planning and SMEs' performance (Andersen, 2000; Kraus et al., 2006; Vargo and Seville, 2011; Campbell, 2010; Donkor et al., 2018; Haleem et al., 2019; Maldeniya et al., 2021; Thaher and Jaaron, 2022).

Some of the earlier theoretical frameworks and models (Bracker and Pearson, 1986; Baird, 1994; Koufopoulos et al., 2010) focused on the connections between planning sophistication, organizational features, and individual attributes. However, the current research expands these models in Iran as a new geography of study by incorporating some other variables like flexibility, innovativeness (Rudd et al., 2008; Tomášková, E., & Kaňovská,;, 2022; Martínez-Sánchez et al., 2011), business objectives (Oduor Juma Paul, 2018;), and strategic planning activities ((Chungyas & Trinidad, 2022).

Two studies have investigated the evaluation of strategic planning models in Iran. The first one has done by Khatami and Mehdizade (2008) in which a comparative study for the evaluation of strategic planning models has presented. The second one classified strategic planning models by focusing on the type of organization ("Classification of strategic planning …", 2016). Aghazadeh (2002) did a comparative study and evaluate different strategic planning models (Tylor, Wright, Hill, Bryson, Glueck, …) for small organizations. He

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proposed a conceptual model based on the comparative analysis of different models. However, the current study attempts to evaluate and prioritize strategic planning models (Bryson, Wright, Wheelen and Hunger, Hill and Jones, Bowman and Asch, and David) from a different perspective by using an FBWM as a novel decision-making technique.

1.4 The Research Goals and Objectives

On the effects and contributions SMEs make to the Iranian economy, information is available from a variety of sources. It is clear what problems Iranian SMEs face. In light of these, the study of SMEs in Iran is a tenable idea. As it is stated in section 1.1, supporting small and medium-sized businesses in Iran strengthens the country's economy by creating opportunities for employment, skill development, sources of supplemental income, and entrepreneurial spirit. SMEs make a contribution to innovation and technology development activities and strengthen greatly the supplier network in Iran (Science, Technology, and Innovation Policy Review, 2005).

Even though the majority of Iranian SMEs started with the intention of succeeding and growing, in the lack of realistic strategic and tactical plans, they are prone to resource mismanagement and productivity problems. Even though the majority of Iranian SMEs started with the intention of succeeding and growing, in the lack of realistic strategic and tactical plans, they are prone to resource mismanagement and productivity problems. Therefore, investigating the issue that applying strategic planning effects Iranian manufacturing SMEs' superior performance and determining the rank of strategic planning models for Iranian SMEs are important subjects that should be studied.

Considering the above explanation, the main goals and objectives of my study are as follows:

Main goals:

- Determining the impact of applying strategic planning on Iranian manufacturing SMEs' performance.
- Determining the rank of strategic planning models for Iranian manufacturing SMEs.

Objectives:

- To investigate the impact of dimensions of applying strategic planning (flexibility, innovativeness, planning sophistication, business objectives, strategic planning activities, and engagement with strategic planning) on SMEs performance.
- To investigate the impact of applying strategic planning on dimensions of SMEs performance (financial and non-financial).

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- To investigate the impact of flexibility on innovativeness.
- To explore the impact of SMEs features (size and age) on engagement with strategic planning, planning sophistication, and innovativeness.
- To explore the impact of individuals' cultural inclusion and faith on engagement with strategic planning.

1.5 The Applied Methods

A survey with cross-sectional strategy is selected for the current study because the data is collected once. A questionnaire and a structured interview are used to collect the primary data for the first and second parts of the research, respectively.

By applying Smart PLS, SPSS, and excel software, the analysis of data in the first part is done using the partial least square (PLS) method, Analysis of Variance (ANOVA), and regression analysis. The analysis of data in the second part is carried out using Ling 18.0 software and the Fuzzy Best Worst method (FBWM).

1.6 The Study's Rationale

The effect of strategic planning on business performance has been studied all around the world, particularly for SMEs and mainly in developed countries (Hoffman, 2007; Campbell, 2010; Vargo and Sevill, 2011). Scientifically, there is also no empirical research on the prioritization of strategic planning models using the fuzzy best-worst method for SMEs.

Despite the fact that Iran is extremely interested in research on the topics, there is little actual evidence available. Thus, one of the key rationales for this study is the shortage and lack of empirical studies on strategic planning, SME performance, and evaluations of strategic planning models in Iran.

The manufacturing sector will be the subject of the present study in Iran. The choice of manufacturing SMEs was made in light of the significant contribution that this industry has made to the Iranian economy, particularly in recent years.

By emphasizing strategy, planning concepts, and performance, this study seeks to address the situation facing Iranian SMEs. The current study aims to spark discussion about the necessity for Iranian SMEs to develop a strategic plan. There is a lack of empirical data on the significance of strategic planning for Iranian SMEs, necessitating a critical examination of the topic.

Despite the findings of the relationship between strategic planning and performance mostly focusing on developed economies, it is necessary to investigate the relationship in a different setting, namely developing countries in general and Iran in particular, to determine

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whether similar results will be provided. So, the current study is notable because: 1. It provides a framework for deducing actual data on the relationship between strategic planning and the performance of Iranian SMEs 2. It applies a multi-criteria diction-making technique (FBWM) to prioritize strategic planning models in Iranian SMEs.

This study may also serve as a benchmark for measuring strategic planning's effectiveness and the benefits it can bring to Iranian manufacturing SMEs. It may also help the body of knowledge, by investigating the improvement in strategic planning procedures in Iran as a developing country.

The novelty of the current research is not only considering Iran as a developing country in assessing applying strategic planning and its impact on SME's performance by taking into account the different variables but also using a multi-criteria decision-making technique (Fuzzy Best Worst Method) in the evaluation of strategic planning models.

The rest of the thesis is structured as follows. In chapter 2, a review of the literature is offered. The research methodologies are discussed in chapter 3. Chapter 4 represents of the results analysis of study. Conclusion and recommendation are provided in chapter 5.

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2. Literature Review

This chapter will focus on other research areas conducted related to the research topic. This review aims to examine the previous studies to comprehend the context of the present research, as well as gap identification and comprehension of many perspectives and features described by previous authors.

The first part of this study has tried to find the impact of strategic planning on the performance of SMEs. While some studies like Falshaw et al. (2006), and Kroeger (2007) stated that there is no correlation between strategic planning and organizational performance, some others represented that there is a positive correlation between strategic planning and performance (Andersen, 2000; Gibson and Cassar, 2005; Kraus et al., 2006; Campbell, 2010; Wilson and Eilersten, 2010; Vargo and Seville, 2011; Haleem et al., 2019; Maldeniya et al., 2021). Hoffman (2007) believes that the planning and performance relationship depends on geographical culture. For example, planning and performance have positive relation in Anglo culture while Germanic has a negative relation. Most of the previous studies investigated the relationship between strategic planning and the performance of SMEs in developed countries, so there is a gap release to do the study in a developing country like Iran.

There are no empirical studies in assessing and evaluating strategic planning models. The only studies in Iran presented a comparative study for the evaluation of strategic planning models and classified strategic planning models by focusing on the type of organization (Khatami and Behzadzade, 2008; 2016). So, In the second part, this study intends to evaluate strategic planning models in the SMEs using fuzzy best worst multi-criteria decision-making technique.

Therefore, this chapter includes two sections. The first section begins with the theory of strategic planning, the basics, the concept of strategic planning, the overall evolution of strategic planning, and the importance of business planning in small enterprises. Following is a review of empirical studies including both qualitative and quantitative growth assessments in small enterprises. Generally, the first part of this chapter covers the following areas: planning definitions, planning types, planning methods, strategy definitions, strategic planning concepts, strategic planning definitions, strategic planning processes, the pros and cons of strategic planning, strategic planning, and organization performance in SMEs. Then, the definition of SMEs in the geography of the study location, and the economic contribution of SMEs are described. Finally, a theoretical framework on the relationship between strategic planning, SMEs, and performance is discussed. In the second section, six strategic planning models are

introduced to be prioritized using the Fuzzy Best Worst Method technique. Prioritization of strategic planning models is studied due to proposing a proper strategic planning model to be executed in Iranian SMEs. Hence, in this part of the literature review, six strategic planning models (Bryson, Wright, Wheelen and Hunger, Hill and Jones, Bowman and Asch, and David) are introduced after a brief description of decision-making, and multi-criteria decision-making. Further review of the literature on evaluation criteria of strategic planning models in the previous studies is also stated. Finally, some previous empirical research integrating strategic planning and multi-criteria decision-making techniques in SMEs is put forward.

2.1 Planning

Planning involves predicting the future and taking action to prepare for it (Fayol, 2016). Planning is the ongoing process of making entrepreneurial decision systematically, with the best sense of "futurity". Organizing the necessary work to carry those decisions through, and comparing the outcomes to expectation (Drucker, 2012).

2.1.1 Planning Definition

Mintzberg (1994) stated that planning is not thinking or controlling the future. It is a process for doing tasks. Planning is not ordinary decision-making, it is a set of coordinated decisions that are made in the form of a process.

Planning is a process that includes specific and interconnected steps, to create a coherent output in the form of a coordinated system of decisions (Rahman Seresht, 2004).

Although planning school is famous approach in strategic management, it has some limitations.

1- Focusing excessively on formal process
2- Flexibility absence (pay no attention to the need for adaption)
3- The role of politics and power dynamics is ignored.
4- The significance of learning through experience and adapting strategies is underestimated.
5- The role of intuition and creativity is overlooked (Mintzberg et al., 2008).

2.1.2 Planning Types

In terms of nature, planning could be divided into physical planning (such as city planning), organizational planning (such as developing a structure of work), process planning (like production planning), financial planning that provides financial services, functional planning which is related to the permanent task of organizations, and general planning that provides coherence for functional plans besides providing a framework. In terms of time, planning is

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categorized as short-term planning (operational and tactical), medium-term, and long-term planning (Alidoosti, 1999).

2.1.3 Planning Method

Planning includes plans, actions, and resources. Changing the environmental conditions, politics, attitudes, structures, systems, etc. may affect the goals in planning. Changing the goals due to turbulence in the environment paves the way for the development of strategic planning. The goal of planning in enterprises is to formulate and innovate strategies which assist to reach the short-term and long-term goals of the organization (Ejigu and Desalegn, 2023). Ansoff and McDonnell (1990) stated strategic planning is a modified form of long-term planning. Ansoff (1984); Ansoff and McDonnell (1990) proposed a firm need to make sure its strategy and capabilities to fit the environment to be as competitive and profitable as possible. They proposed that four characteristics help to the turbulence of the environment: complexity, novelty, rapidity of change, visibility of the future.

Table 2.1 Planning Method Based on Turbulence Level (Ansoff and McDonnell, 1990)

Predictability Changeability	Level of Turbulence	1	2	3	4	5
	Environmental Turbulence	Repetitive	Expanding	Changing	Discontinuous	Surprising
	Complexity	National Economic		Regional Technological		Global Sociopolitical
	Familiarity of events	Familiar	Extrapolable		Discontinuous Familiar	Discontinuous Novel
	Rapidity of change	Slower than response		Comparable to response		Faster than response
	Visibility of future	Recurring	Forecastable	Predictable	Partially Predictable	Unpredictable surprises

Level 1 means the environment is "stable" and there are no major problems. Tomorrow will be like today, so planning for tomorrow is extrapolative.

Level 2 is expanding. Change is slow, gradual, visible, and predictable at this level. Planning at this level is extrapolative.

Level 3 is "Change". Change is rapid, but continuous and tangible. Level three shows environment where customers' demands different things and have different amounts of money to spend. It's important to do good marketing in order to succeed in these places.

Level 4 is different from what we expected and is called "discontinuous". To succeed, a firm need to let go of its old ways of doing things and come up with new plans. This means

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not being too focused on certain customers, technologies, or products, and being open to change (Kariuki et al., 2011; Kurtz and Varvakis, 2016).

2.2 Strategy

A high-level plan to accomplish one or more goals in the face of uncertainty is called a strategy (from Greek). The phrase first used in 6th century East Roman terminology to refer to the "art of the general," which covered numerous subsets of talents such as tactics, siege craft, logistics, etc (Barad, 2018).

Strategy is a terminology with different understanding by various people in diverse fields of study. It is a difficult task to agree on a basic definition of strategy. Many people use the words strategy, program, policy, and goals interchangeably (Obolensky, 2001). However, this study has attempted to describe the strategy in the context of business.

Strategy is derived from the Greek root *strategema* meaning "*army commander"* consisting of "*stratos"* meaning "*army"* and "*ago"* meaning *"leadership"*. The concept of strategy was firstly used in the military (Shad and Fallahi, 2015).

Strategy in Britannica dictionary means "the art of planning and operational guidance." The strategy includes three characteristics that distinguish it from tactics: 1. a wider range of operations 2. a longer period 3. the mass movement of forces (Aghazadeh, 2003).

The Boston Consulting Group states that strategy is related to the organization's position in the competitive field (Stern and Deimler, 2006). According to the Makinsey Consulting Group, strategy is a method of thinking about your company, not a collection of guidelines or framework (Makinsey, 2018).

Strategy determines the context of an active and dynamic environment. It is a tool that drives people to move into an organizational system (Davari and Shanehsaz zadeh, 2000).

The strategy has been defined as a long-term direction and scope of an organization to achieve competitive advantage in a turbulent environment by organizing resources and competencies and to satisfying stockholder expectation (Johnson et al., 2009, p.3).

Obolensky (2001) stated that Chandler and Hofer (1979) defined strategy as a mediating force between an organization and its environment.

Grant (2021) put forward that an individual's or an organization's activities and decisions are given coherence and direction by strategy, which works as a link between the business goals and objections of the organization and its external environment.

Strategy is introduced as five approaches including strategy as a plan, strategy as a ploy, strategy as a pattern, strategy as a perspective, and strategy as position (5-Ps) (Mintzberg et al., 2003). The Porterian positioning school asserted that in any given industry, only specific

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strategies or market positions that can be effectively protected against competitors, are considered advantageous. This school views strategy as an intentional and regulated process that generates purposive strategies. Michel Porter the leading scholar in positioning schools recommended generic strategies (cost leadership, differentiation, focus) that are easily recognized in the competitive marketplace (Mintzberg et al., 2009).

To achieve a sustainable competitive advantage, organizations could exploit strategic resources (valuable, rare, imperfectly imitable, non-substitutable (VRIN resources)). Barney (1991) developed the Resource-Based View (RBV) theory. He explained resources in different organizations could be one of the reasons behind the success of the organizations and their competitive advantages (Newbert, 2008). Mishra et al. (2019) have put forward that an organization's strategic management forms the foundation for its capabilities and resources. RBV concentrates on the use of internal resources to achieve competitive advantage in the marketplace. In the approach, there is a primary focus on internal resources, and it falls upon the management to develop and execute the strategic planning procedure (Alzahrani et al., 2023; Gomera, 2018). There is a strong connection between RBV and firm performance (Armstrong and Shimizu, 2007) when an organization has a competitive advantage strategy by using VRIN resources (Adnan et al., 2018). As a complementary perspective to the industry and resource-based view, Peng (2002) posited that the institution-based view (IBV) is the third leg of strategy. The IBV concentrates on societal aspects like cultural differences and possibilities. One of the challenges of the IBV paradigm in strategic management is to emphasize the significance of institutional factors in enhancing our comprehension of competitive advantages (Garrido et al., 2014). The IBV perceives strategic decisions as being influenced by the dynamic interaction between organizations and the formal as well as informal institutional environment (Peng, 2002). The two fundamental ideas form the basis of IBV: 1) managers and firms act in their best interests and make strategic options within a specific institutional framework to reduce uncertainty 2) the governance of firm behavior is influenced by a combination of formal and informal institutions. Informal restrictions are more significant in decreasing uncertainty, offering advice, and giving authority and benefits to executives and companies while formal restrictions are ambiguous or ineffective (Sun and Ding, 2015).

So, the industry-based view prioritizes the analysis of an industry's external factors to gain a competitive advantage through either cost leadership or differentiation. It can also select to concentrate on either a wide market or a specific market (a narrow market). The resource-based view (RBV) use internal resource to gain competitive advantage. The main focus of the RBV approach lies in the efficient use of firm's resources and capabilities to compete with

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competitors. The institution-based view which is a supplement to the industry and resource-based view focuses on institutional aspects such as societal aspects. The combination of all three approaches could shape a strong strategy for a firm.

2.3 Strategic Planning

After World War II, thanks to turbulence in businesses, the necessity of strategic planning became more important. Strategic planning is a framework for implementing strategic thinking that leads to the realization of planned outcomes.

Martin (2014) considered strategic planning as a big lie. The phrase "Big Lie" refers to the notion that conventional methodologies employed in strategic planning frequently fall short of yielding the anticipated outcomes. Rather than furnishing a lucid and precise course of action for the forthcoming period, strategic plans may at times exhibit excessive idealism or disconnection from the actualities of the corporate milieu. It explores the issue of organizations that may find themselves in the predicament of overly depending on inflexible, extended-term strategic plans that fail to consider the ever-changing nature of markets and competitive environments. In general, the constraints of planning school, as demonstrated in the article "The Big Lie of Strategic Planning," consist of the misconception of having control, an erroneous feeling of safety, overlooking the inherent strengths of an organization, and an absence of adaptability to address changing market conditions. These obstacles require a strategic method that is more adaptable and responsive than what conventional planning methodologies offer (Martin, 2014).

Table 2.2 indicates the comparison and contrast to strategic planning in the previous studies.

Table 2.2 Strategic planning comparison and contrast

Author	Year	Comparison	Author	Year	Contrast
Porter	1980	Strategic planning must be purposeful and planned.	Mintzberg	1994	Strategic planning must be left to come into view.
Jennings and Disney	2006	A general management practice, to reach superior financial and strategic performance, allocate resources,	Cunningham and Harney	2012	A reason for action, to cement emerging initiatives, a benchmark for

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		overcome environmental changes, and protect core expertise			evaluating performance
Mintzberg	1994	Hhelp in gaining a competitive advantage, guarantees the future, today's decisions and action plans are fitted to the future	Karnani	2008	Emphasizes the integration of information, places a premium on innovation and strategic thinking, encourages an open-participatory approach to decision-making
Fry et al.	1999	Compete with the projected changes in the environment, analyze the environment, clarify the current state of the company, and identify key factors	Wasilewski and Motamedi	2007	The capacity to eliminate immaterial intended ideas and accept new value-adding plans

2.3.1 Strategic Planning Advantages

According to Pearce et al. (2000) and David (2011), strategic planning offers numerous advantages, including goal setting, policy implementation, effective problem-solving, adaptability to environmental changes, improved decision-making. Kaufman (2016) and Melero (2018) also added enhanced financial and competitive advantages.

2.3.2 Strategic Planning Limitations

Although strategic planning has numerous advantages, it also has certain drawbacks (Mintzberg et al., 2009):

- It is costly for small and medium-sized businesses.
- It has a complex process.
- The rate of success in implementation is low.

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- It fails to understand customers' problems.
- The nature of marketing research is not so strong.
- It cannot develop cooperation between human and non-human resources.

2.3.3 Strategic planning in SMEs and its Operationalization

Strategic planning in small and medium-sized enterprises (SMEs) involves the process of defining an organization's goals, determining the actions required to achieve those goals, and allocating resources effectively to implement those actions. It is a systematic approach that enables SMEs to align their internal capabilities with external opportunities and challenges in order to achieve sustainable growth and competitive advantage. Strategic planning provides a roadmap for decision-making and helps SMEs adapt to changing market conditions while staying true to their core mission and values (Kraus et al,2007).

Operationalization of strategic planning in SMEs involves turning the strategic objectives and goals into actionable steps and measurable outcomes. It involves a balance between long-term vision and short-term execution. It requires a collaborative effort from all levels of the organization to ensure that strategic goals are translated into tangible results (Gumel, 2019).

2.4 Strategic Planning Compared to the Long-term Planning

In the past, managers believed that goals could be determined by accurate predictions for the long-term periods. This belief due to environmental changes, technological development, and innovation is no longer valid. So, managers should find an appropriate solution. Strategic planning is introduced to solve the problem.

Table 2.2 indicated the differences between strategic planning and long-term planning (Alidoosti, 1999).

Table 2.3 The Differences Between Strategic and Long-term Planning

	Strategic Planning	Long-term Planning
Assumptions	Assumes that the system is open, and if the environment changes, the organization must adapt accordingly.	Assumes that the system is frozen, with a focus on short-term programs and plans.
Focus on	Focuses on the planning process, mission determination, external environment, organizational capacity, and employee training.	Focuses on the final plan and internal analysis.
Planers	Involves a small group of planners and stakeholders.	Is typically carried out by a planning department that includes professional experts.
Decision Making	Decision making is based on current and specific tendencies and trends.	Decision making is based on the available information.
Emphasis on	Emphasizes current changes and trends.	Emphasizes intra-organizational changes, methods of planning, and

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	Strategic Planning	Long-term Planning
		intra and extra organization planning.
Futurism	Decisions are made based on the understanding of the current situation over the next five years.	Focuses on long-term and short-term goals from now until the next five years.
Based on	Is based on creative and insightful decision-making. It seeks to direct an organization based on the changing future environment, with decisions often based on universal agreement.	Is based on a set of related detailed organizational information, different department plans, and the current budgets.
Planning Process	Typically involves planning from top to bottom and occurs at the top levels of strategic management within an organization.	Involves planning from bottom to top and occurs at the lower levels of an organization.
View	Considering the best and the worst situation, it tries to be more realistic in planning	Is to some extent optimistic in planning.
Variability	Has less variability and is more compatible with detailed plans due to its integrated and holistic view.	The long-term planning process is rarely fixed and is less coordinated with detailed plans.
Tendency	Planning and targeting are qualitative and flexible.	Planning and targeting are qualitative with less flexibility and realistic conditions.

2.5 The role of strategic and operational planning in the strategic process

Kaplan and Norton have made noteworthy contributions to the comprehension of strategic and operational planning within the strategic process. Their works accentuate the significance of harmonizing operational activities with overarching strategic objectives. They introduced the Balanced Scorecard framework, which furnishes a comprehensive approach for incorporating strategic and operational planning. This framework empowers organizations to convert their strategic goals into distinct operational actions and measures, thereby guaranteeing alignment and concentration throughout the organization. Kaplan and Norton's focus lies in establishing a connection between strategy and operations, with the aim of attaining a competitive advantage (Robert et al. 2008). The authors present a methodical framework for formulating and executing a viable strategy, which incorporates tools such as SWOT analysis, vision formulation, and strategic change agendas. They underscore the significance of incorporating operational tools like process dashboards, rolling forecasts, and activity-based costing to effectively implement the strategy.

Kaplan and Norton highlighted the significance of aligning strategic objectives with operational activities. According to their perspective, strategic planning establishes the general direction and objectives, while operational planning concentrates on the particular actions and resources required to attain those objectives. Strategic planning furnishes the structure for critical decision-making, while operational planning guarantees that day-to-day activities

bolster the strategic objectives. The fusion of strategic and operational planning is imperative for the prosperous execution of the strategic process (Kaplan and Norton, 2008).

2.5 Organization Performance

Trieu et al. (2023) stated that performance is the result of a management and operating system that provides information about the use of internal and external resources. Performance measurement often focuses on evaluating organizational effectiveness and efficiency through a set of indicators, emphasizing process-oriented approaches that can be used to bring up business proceeds (Gu et al., 2021; Martínez-Caro et al., 2020). Performance measurement assists to the planning and control cycle by providing data and feedback and monitoring strategy execution (Ravichandran,2018)

According to Larcker (2003), performance measurement is used to evaluate organizational performance, help drive resource allocation, and monitor and convey progress toward strategic objectives.

Organizational performance in small and medium-sized enterprises (SMEs) refers to the measurement and evaluation of how effectively the company achieves its objectives, utilizes its resources, and delivers value to its stakeholders. It encompasses various aspects such as financial results, operational efficiency, customer satisfaction, innovation, employee engagement, and market competitiveness. The evaluation of organizational performance provides insights into the SME's overall health, sustainability, and ability to achieve long-term success (Brown,2008).

2.6 Strategic Planning and Organization Performance

Given the pivotal role that strategic planning plays in attaining organizational performance, contingency theory proffers a multifaceted framework. Contingency theory, an analytical framework, explicates the manner in which organizations engage with their constituents and effectively address conflicts in practical circumstances. The theory underscores the significance of an appropriate alignment between variables associated with contingencies and organizational design parameters to achieve optimal performance. Scholars are urged to concentrate on multiple contingencies and elucidate the relationships between them. Contingency theory enables organizations to adapt to uncertainty by formulating strategic plans that account for alternative scenarios. It posits that different management approaches and leadership styles may be suitable in diverse situations. The theory endeavors to establish an ideal congruence between the demands imposed by the external context and the organization's capacity to respond, including its structure, planning process, and leadership

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style. Contextual elements such as the external environment, technology, structure, culture, size, and strategies have the potential to impact the organization's structure and the configuration of its accounting information system (Pang et al, 2023).

In the current study, I am focusing to find the impact of applying strategic planning on SMEs' performance in Iran as a developing country. The correlation between strategic planning and organization performance has been criticized by some scholars despite the empirical research. While advocates have believed that there is a positive relationship between strategic planning and organization performance, critics have stated that there is no evidence to show a positive correlation between strategic planning and organization performance (Rudd et al., 2008). The positive relationship between strategic planning and performance has been highlighted in the studies of Skokan et al. (2013), Aldehayyat and Twaissi (2011), Gaál and Fekete (2011), and Kraus et al. (2006).

Table 2.4 shows a summary of previous studies on the effect of strategic planning on organizations' performance especially in the SMEs.

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Table 2.4 The impact of strategic planning on organizations performance

Author	Main findings	Study design	Population characteristics	Region	Limitations	Data Analysis
Alzahrani et al. (2023)	A significant relationship between strategic planning and firm performance, a relationship between strategic planning and strategic flexibility, and the mediating role of strategic flexibility on the relationship between strategic planning and firm performance	Quantitative	380 Saudi owners and managers of medium sized enterprises	Saudi Arabia	Collecting data only from SMEs employed, few sample size	PLS-SEM
Kee-Luen (2013)	Strategic planning improves the competitiveness of business firms and eventually their performances.	quantitative research approach, using questionnaires	small and medium sized manufacturing enterprises in Malaysia	Malaysia	Relies on self-reported data from the SMEs, dose not investigate possible confounding variables or alternative rationales for the identified correlation between strategic planning and business performance, potential impact of external factors, such as economic conditions or industry trends is not considered	Correlation analysis and regression analysis
Garg and Goyal (2012)	IT strategy with corporate strategy has significant effect on performance	a survey based approach	23 Indian IT SMEs	India	Limited number of software developing SMEs	-
Maldeniya et al. (2021)	The main findings are related to the influence of Strategic Management practices on SME performance, the positive relationship between strategic management elements and SME performance, and the implications for owners and managers of SMEs in Sri Lanka.	Online structured questionnaire	80 Gender (male and female), Size of SMEs (e.g., 51-100 employees)	Sri Lanka	Controversial definitions, Lack of detailed methodology, Reliance on self-reported data	Descriptive statistics and correlation analysis
Yousef and Jaaron (2022)	SSPM had a positive effect on the three dimensions of organizational sustainable performance in a developing country context. The	Mixed method approach; qualitative and quantitative	131 SMEs	Palestine	The limitations include the time-consuming nature of the methodology, single case study design, scarcity of	thematic analysis and PLS-SEM

	study concludes that the Palestinian case is likely to be beneficial from economic, social as well as environmental performance point of view for organizations in the developing world.	data collection and analysis methods; interviews and survey;			literature in developing countries, and the need for further research on strategic leadership and comparative studies on SSPM frameworks. The paper also suggests that the Palestinian perspective may offer unique insights but does not explicitly state this as a limitation.	
Auka (2016)	Strategic planning significantly influences organizational performance, and SMEs that engage in strategic planning are more likely to achieve higher sales growth, higher returns on assets, higher margins on profit, and higher employee growth.	Quantitative research approach, structured questionnaires	47 top management of medium sized enterprises	Nakuru	-	Pearson correlation analysis, two-tailed Pearson correlation
Donkor et al. (2018)	The positive impact of strategic planning on SME performance, the significant positive relationship between market dynamism and firm performance, and the influence of market dynamism on SME performance only in the presence of strategic planning.	Quantitative approach using purposive sampling	200 Owners and managers or chief executive officers of SME	Ghana	Findings are limited to the SMEs in Ghana, the study of market dynamism, strategic planning and performance is a very complex activity	Hierarchical multiple regression analysis
Maldeniya et al. (2021)	The positive relationship between strategic management elements and SME performance, and the implications for owners and managers of SMEs in Sri Lanka.	Online structured questionnaire	80 Gender	Sri Lanka	Controversial definitions, Lack of detailed methodology, Reliance on self-reported data	Descriptive statistics and correlation analysis
Maroa and Muturi (2015)	Strategic management practices, had a significant influence on the performance of flower firms to a moderate extent. Firms that had strategic plans, implemented them, evaluated and exercised control over their strategies mainly had good	Descriptive survey design	50 farm managers	Kiambu County, Kenya	Focus on a specific geographic area, the possibility of rushed responses from some participants, and the narrow scope of the strategic management practices	Chi-Square test

	financial performance for the last five years.					
Sandada et al. (2014)	Strategic planning has a positive association and predictive relationship with the performance of SMEs.	observational, cross-sectional	200 SMEs	Gauteng province, South Africa	Data gathered from a limited number of respondents and SMEs, inability to generalize the results to all SMEs in the country, reliance on the subjective views of SME owners/managers, need for further understanding of strategic planning dimensions.	Descriptive statistics and factor analysis
Skokan et al. (2013)	The positive impact of a full strategic document on business performance, and the empirical evidence supporting the benefits of thorough strategic planning.	observational study based on a questionnaire survey	667 enterprises	Czech Republic, Slovakia	Limited geographical scope of obtained data, inability to cover all regions of Czech Republic and Slovakia with comparable sample size, relatively large size of data group, shortcomings in the frequency of size groups, mostly micro and small enterprises (10 to 50 employees).	Pearson's chi-squared test
Owolabi and Makinde (2012)	A significant positive correlation between strategic planning and corporate performance.	survey design.	Babcock University	Nigeria	Focuses on Babcock University which limits the generalizability of the findings, relies on primary and secondary data collected through questionnaires, which may introduce biases and limitations in terms of the accuracy and reliability of the information obtained.	descriptive statistics and Pearson's Product Moment Correlation Coefficient
Aldehayyat and Twaissi (2011)	A significant relationship between strategic planning dimensions and corporate performance.	Cross-sectional observational study	105 small industrial firms	Jordan	Limiting the generalizability of the finding, response bias which may affect the representativeness of the sample, social desirability bias and inaccuracies in	Chi-square test

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					respondents' perceptions due to self reported data.	
Glaister et al. (2008)	A strong and positive relationship between formal strategic planning and firm performance The relationship between formal strategic planning and firm performance is stronger for firms in high environmental turbulence, more organic structures, and larger firms.	Questionnaire survey	135 Turkish manufacturing companies, CEOs, Vice Presidents, planning executives, finance executives, and other senior executives as respondents.	Turkey	The complexity of strategic planning, the need for additional performance measures, the incorporation of additional moderators, and the necessity for comparison studies in emerging country contexts.	Using LISREL structural equation modeling
Oduor (2018)	The organization's objectives are positive significant predictors of corporate performance, implying that business objectives have a positive impact on strategic planning.	Correlational research design	49 NHIF staff.	Kenya	-No previous studies on strategic planning in NHIF and Busia, Western Kenya. -Small sample size	Descriptive statistics (percentage) and inferential statistics, Content analysis was used to analyze quantitative data
Falshaw et al. (2006)	There is no relationship between the formality of strategic planning and subjective company performance.	Postal questionnaire for primary data collection	113 companies	UK	Measurement validity may be a problem. Causal linkages among variables cannot be firmly established.	Multivariate analyses to test hypothesized relationships
Kroeger (2007)	A firm's entrepreneurial orientation is positively related to firm performance, but the relationship between strategic planning practices and firm performance was not supported.	Survey	owners and principal managers of small businesses in	Northeastern Ohio	Sample population and individual participants may limit generalizability of results. Strategic planning variables were not supported in relation to firm performance.	Desciptive statistics, coding technique
Brown (2008)	No significant correlation between strategic planning and growth in the MS&T industry. There was no significant difference in growth for small businesses that employed a written business plan versus those that did not in the MS&T industry .	web-based survey	100 small businesses	Central Florida MST industry	The voluntary participation of leaders from small businesses in MST industry may introduce potential self-selection bias, weaknesses in self-reporting and potential issues with honesty in responses.	Cluster analysis, ANOVA with Scheffe's tests

Hoffman (2007)	Strategic planning plays a crucial role in improving company performance in cross-cultural contexts. There were significant differences in planning processes across the Anglo, Germanic, and Nordic cultural groups.	Questionnaire	150 manufacturing firms	European countries and the United States.	Small sample size, not capture the full range of cultural diversity, relies on subjective measures and self-reported data	ANOVA, MANCOVA, Fisher's Z test
Campbell, R. H. (2010)	Positive impact of strategic planning on business performance in, especially in a volatile economic environment. Companies with high revenue and profit growth displayed a greater focus on the utilization of strategic planning tools compared to low-growth firms.	Survey instrument	139 CEOs and/or business owners	U.S.	Use of self-reported data and the lack of external validation for financial data	ANOVA
Wilson and Eilertsen (2010)	Strategic planning has been identified as a crucial element within organizational structures, showing a strong correlation with enhanced business outcomes.	Online questionnaire	190 mangers and staff	U.S. cities	-	Descriptive ststistics
Schwenk and Shrade (1993)	There is a strong and meaningful connection between formal strategic planning and the performance of small businesses. The significant effect size clearly shows that engaging in strategic planning is advantageous for small firms.	meta-analysis	Small firms fewer than 100 employees and less than $3 million in annual sales	U.S.	Small number of studies limit the generalizability	t-tests and F-tests
Elbanna (2009)	Strategic planning practice increase the effectiveness of strategic planning in Arab countries, there is a favorable correlation between the implementation of strategic planning and the efficiency of strategic planning.	Questionnaire	112 public and private sector organizations	UAE	Cross-sectional data limits the ability to firmly establish causal relationships between variables, focus only in Arab speaking countries	Multiple regression analyses
Dibrell et al. (2007)	The form of strategic planning adopted by firms in the forest products industry has a notable impact on their financial performance.	Interviews	6 executives in forest products industry	Pacific Northwest U.S.	-	Cross-case analysis

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	Companies that achieve the highest level of financial success are those that implement a dynamic strategic planning system that integrates both formalized and informal strategic planning processes.					
Al-Shammari, and Hussein (2007)	Firms participate in strategic planning demonstrate superior financial and behavioral performance in comparison to those that neglect to adopt this particular approach.	Quantitative	28 Jordanian manufacturing organizations	Jordan	Not focus on other dimensions of performance that may be influenced by strategic planning, small sample	-
Glaister et al. (2008)	A strong and positive relationship between formal strategic planning and firm performance	Postal survey questionnaire	135 Turkish manufacturing companies	Turkey	Sample size is small, neglect other aspects of performance, like quality or employee satisfaction	LISREL causal modeling
Haleem and Ullah (2019).	SMEs have the capability to improve their performance in both financial and non-financial aspects through the implementation of effective strategic planning.	Survey questionnaire	245 manufacturing SMEs	Pakistan	Limited financial resources and restricted access to participants, coupled with the gathering of subjective and cross-sectional data.	Path analysis, Multi-group analysis
Thaher and Jaaron (2022)	Sustainability strategic planning and management positively impacted the three dimensions of organizational sustainable performance, namely social, ecological, and economic.	Interview and a survey	126 manufacturing organization	Palestine	-	PLS-SEM
Kroeger, J. W. (2007)	A strong correlation exists between a company's entrepreneurial mindset and its overall performance. Nevertheless, the correlation between strategic planning procedures and organizational performance did not receive empirical backing. It was observed that the level of environmental unpredictability influenced the connection between entrepreneurial orientation and performance.	Questionnaire	300 small business enterprises	Northeast Ohio In U.S.	A sample population was selected from a particular segment, sample size was small	Factor analysis, Correlation analyses

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The positive relationship between strategic planning and European and American firms' performance in a cross-cultural condition has been proved in the study by Hoffman (2007). In the study, culture is considered a moderator variable in the planning-performance relationship.

The effect of strategic planning on U.S. organizations' performance during the turbulent economic depression (2008-9) has been investigated by Campbell (2010). Those organizations using strategic planning have performed better in terms of revenue and profit growth in comparison to the organizations that did not accept strategic planning.

According to Vargo and Seville (2011), crises are unavoidable aspects of life. Through strategic planning and enablers (leadership, organizational culture, decision-making, and business environment awareness), businesses especially small and medium-sized businesses can survive economic turbulence and manage unexpected crises. Businesses that employ strategic planning will be better positioned to explore growth possibilities in times of crisis and small businesses are more presumably than large businesses to utilize strategic planning for this aim (Wilson and Eilersten, 2010).

The study of Robinson and Pearce (1984) brought about the start of research in surveying the impact of strategic planning on micro and SME business performance. The study is thorough in the context of this research, as it concentrated future research on the topic and made the study of strategic planning and its impact on organization performance a worthwhile experience for small enterprises. Although the study of Robinson and Pearce was done in the early stage of strategic planning development and exclusively focused on developed countries, the study provides an excellent explanation of the subject area, which opens up various beneficial research avenues, including the current study. The study identified that strategic planning has a positive impact on small firms' performance even if the firms do not have formal strategic planning.

Several studies such as Aldehayyat and Twaissi (2011), Wilson and Eilertsen (2010), Elbanna (2009), Dibrell et al. (2007), Al-shammari and Hussein (2007), Glaister et al. (2008), Donkor et al. (2018), Haleem et al. (2019), Thaher and Jaaron (2022) have shown strategic planning have a positive and significant impact on the SMEs performance.

In contrast to the above studies regarding the positive relationship between strategic planning and SMEs performance, some scholars have proposed that there is no significant relationship between strategic planning and SME performance (Falshaw et al., 2006; Kroeger, 2007; Brown, 2008).

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Finding related empirical studies on the relationship between strategic planning and SME performance for developed economies is not so difficult, but finding empirical research on this subject for Iran as a developing country is not easy. There are a few studies like Haghighinasab et al. (2013) that investigated the effect of entrepreneurial orientation on a firm's performance via innovation or Kamyabi and Devi (2011) examined the impact of outsourcing accounting on Iranian manufacturing SMEs performance. Valmohammadi (2011) studied the effect of total quality management on Iranian manufacturing SMEs' performance. Moreover, Pashutan et al. (2022) analyzed the effect of IT resources and strategic alignment on the performance of Iranian small and medium-sized IT organizations. Jabarzadeh, et al. (2019) investigated the impact of participatory strategic planning and strategic flexibility on the implementation of strategy in Iranian SMEs industries.

This research focuses on applying strategic planning and its impact on Iranian manufacturing small and medium-sized enterprises' performance. Iranian manufacturing SMEs still struggle with having strategic plans since they are not sure if strategic planning, in reality, affects the organizations' performance. Therefore, this study tries to shed more light on this issue.

2.7 SMEs in Iran

The SME sector accounts for the majority of enterprises in Iran, with around 80% being small and medium businesses (Share of SMEs, 2022). SMEs provide approximately 70% of career opportunities and 50% of the gross domestic product in Iran. The contribution of Iranian SMEs to the economy in 2014 was 98% (Kalhor, 2016). Although a significant portion of employment is imposed on SMEs, only 24% of the industrial investment accounts for them. The three main business sectors of SMEs in Iran are services, manufacturing, and mining. Around 67.5% of SMEs run in the service sector, 29.5% in manufacturing, 2% mining and 1% other sectors (SCI, 2020).

The focus of this research will be on the Iranian manufacturing-related sector since manufacturing SMEs in Iran play an important role in the economy, especially in recent years. With regards to the general policy of the Iranian regime, the SMEs manufacturing and industry section should be developed because they boost economic growth, create employment, reduce inflation, increase per capita income, improve public welfare, and neutralize sanctions.

2.8 Small and Medium-sized Enterprises (SMEs) Definition and Concept

In the European Union and by international institutions such as the World Bank, the United Nations, and the World Trade Organization, the abbreviation "SME" is used for small

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and medium-sized enterprises. Small businesses outnumber large businesses by a huge percentage and employ significantly more people. In many economic sectors, SMEs are claimed to be responsible for driving innovation and competition (Kalhor, 2016).

For different nations, regions, economic blocks, and business sectors around the world, the word SMEs has diverse meanings. The classification of a corporation as a small or medium-sized enterprise varies from country to country, and even within states with similar geographic and economies (Nefedov, 2023).

According to the European Commission, small and medium-sized enterprises are described as follows:

> Small companies are those that have ≤ €10 million turnovers or ≤ €10 million total balance sheet, and <50 employees. A medium-sized company is a business that has ≤ €50 million turnover or ≤ €43 million total balance sheet, and <50 employees (European Commission, 2020).

With regard to the United Kingdom federation of small businesses, a small enterprise is:

> a business that has < £5.6 million turnover, < £2.8 million total balance sheet, and <50 employees. A medium-sized enterprise has < £22.8 million turnover, < £11.4 million total balance sheet, and <250 employees (Lee-Ross and Lashley, 2009).

The United States also has its definition of SMEs based on the industry in which they operate. For instance, a company in the manufacturing industry can be categorized as an SME if it employs no more than 500 workers, whereas a company in the wholesale trade is only considered an SME if it has less than 100 employees (Corporate Finance Institute, 2020).

The institute for SMEs in Germany has provided a qualitative definition of SMEs. Management is the focus of this qualitative definition. One of the characteristics of SMEs is that the CEO owns or holds a significant portion of the company's stock; accordingly, businesses are considered SMEs if they own less than 300 employees in the European Union and 500 in the United States (Acs, 1999).

When it comes to the concept of SMEs in Iran, there is little agreement among various institutions and organizations involved with SMEs. They have defined their standards for describing, categorizing, and defining small and medium-sized enterprises. For example, the ministry of industry and mines and the ministry of agriculture posited that SMEs are enterprises with less than 50 employees. The Central Bank of Iran (CBI) categorized businesses into four

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classes: businesses with 1-9 employees, 10-49 employees, 50-99 employees, and more than 100 workers. Businesses with less than 100 employees are considered SMEs. However, the Statistical Center of Iran (SCI) classifies organizations with less than 10 employees as SMEs, whereas those businesses exceeding 10 employees are categorized as large industrial firms (Kalhor, 2016; United Nations Industrial Development Organization, 2003). Iran Small Industries and Industrial Parks Organization (ISIPO) have determined SMEs as enterprises that own less than 150 employees (SME definition, n.d). In this study, the ISIPO definition of SMEs is considered.

2.9 A Brief Description of Iran and Its' Economy

Iran, or the Islamic Republic of Iran, is a western Asian country. The country has a total area of 1,648,195 km^2. Iran is Asia's fourth-largest country and the second-largest country in western Asia. Iran has an estimated population of 84.4 million people (SCI, 2022). Having a geographically significant location makes Iran a regional and middle power. Iran has the world's second-largest reserves of natural gas and fourth-largest reserves of crude oil (Economic Freedom, 2022). The hydrocarbon, small-scale private businesses, agriculture, and service sectors, as well as a noticeable state presence in manufacturing and financial services, define Iran's economy. According to the World Bank report, the gross domestic product (GDP) of Iran in 2020 was $203.47 billion. Iran also is classified as a lower-middle-income country by World Bank (Worldbank, 2022). The gross domestic product (GDP) in Iran was projected to exhibit a persistent growth trend from 2024 to 2029, with a cumulative increment of 112.1 billion U.S. dollars (+24.15 percent). Following a sequence of nine successive years of expansion, the GDP is anticipated to attain a milestone of 576.24 billion U.S. dollars by the year 2029 (Statista, 2023). Among the Middle East countries, Iran boasts the most advanced manufacturing industries in automobiles, transportation, construction materials, home appliances, food and agriculture products, medicines, information technology, and petrochemicals.

The economy of Iran is heavily influenced by huge state and quasi-public enterprises. This is especially true in the case of companies that exploit, process, and trade crude oil, petroleum products, and natural gas, which account for around 80% of Iran's export incomes and 40-50% of the government budget. Since oil revenues are the government's primary source of income, the energy sector is the country's largest industrial sector (Promoting and upscaling innovative SMEs in the Islamic Republic of Iran, 2019). Although non-oil export is expanding, they are doing so slowly. The Iranian government sees diversification and expansion of non-

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oil export as a crucial issue in strengthening the economy and reducing its reliance on oil and gas export. Therefore, the expansion of existing and new export markets is seen as a major strategy for job creation (United Nations Industrial Development Organization, 2003). A brief economic statistics of Iran is shown in table 2.5.

Table 2.5 Economic statistics of Iran

Currency	Iranian Rial
Trade organizations	ECO, OPEC, GECF, WTO (observer), SCO and others
Country group	Developing/Emerging, Lower-middle income economy
GDP	$402 billion (Dec 2023)
GDP rank	43rd (2023)
GDP growth	4.6% (Jun 2024)
GDP per capita	$5740 (Dec 2023)
GDP by sector	Agriculture: 87890 IRR Billion (2024), Industry: 881678 IRR Billion (2024), Services: 1156212 IRR Billion (2024)
Inflation Rate	31.2% (2024)
Gini coefficient	38.8 medium (2023)
Unemployment	7.50% (Sep 2024)
Gross savings	27% of GDP (2023)

Source: Retrieved from Trading Economics (Iran Indicators, 2024 September)

2.10 A Theoretical Framework of Strategic Planning and Organization Performance

Strategic planning could be an impressive tool for small and medium-sized organizations which desire to be successful in their business and be prepared for future unpredictable economic crises and turbulent times (Vargo and Seville, 2011). Wilson and Eilersten (2010) demonstrated how strategic planning creates chances for growth.

Strategic planning aids SMEs in managing change and unpredictability by allowing them to develop acceptable strategic options (Verreynne et al., 2016).

Campbell (2010) posited that there is a positive correlation between strategic planning and performance, especially financial performance. Companies that exhibited high revenue and profit growth were noted to have a stronger emphasis on employing strategic planning tools in comparison to firms with low-growth rates.

Some scholars like Andersen (2000) pointed out that applying strategic planning causes adaptive strategic thinking among managers, synchronize functional actions over an extended period, facilitate prompt adaptive reactions and tactical modifications which all positively impact firm performance. Kraus et al. (2006) believed strategic planning formalization and controls motivate employees contributing to the growth and success of enterprises. Gibson and Cassar (2005) mentioned firms that participate in strategic planning demonstrate superior performance compared to those that do not engage in such activities, underscoring the importance of strategic planning in achieving organizational success. Al-shammari and Hussein (2007) posited that firms that engage in planning perform better than those that do not

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plan, emphasizing the significance of strategic planning for organizational success. So, the researchers believe that there is a positive correlation between adopting strategic planning and profitability for SMEs, and accepting strategic planning not only helps SMEs continue existence in a turbulent environment but also makes growth in market share, while other researchers like Falshaw et al. (2006), Kroeger (2007), Brown (2008) have suggested that an increase in profitability may not be usually as a result of applying strategic planning.

This research is in line with Lipitakis and Phillips (2016) studies that link strategy and performance measurement. They considered both financial and non-financial factors like profitability, turnover, growth in sales, and market share.

Different interconnection and interdependencies between strategic planning and organization performance in the research of Bracker and Pearson (1986), Mintzberg (1994), Brown (2008), Glaister et al. (2008), Hoffman (2007), Boohene et al. (2008), Rudd et al., (2008), Campbell (2010), Koufopoulos et al. (2010), Wilson and Eilertsen (2010), Vargo and Sevill (2011), Gkliatis and Koufopoulos (2013), Skokan et al., (2013), Dibrell et al., (2014), Sandada et al. (2014), Lipitakis and Phillips (2016), Thaher and Jaaron (2022) have been studied.

Table 2.6 indicates the previous research that studied interconnections and interdependencies between dimensions of applying strategic planning (innovativeness, flexibility, planning sophistication, strategic planning activities, engagement with strategic planning, business objectives) and the organization's performance briefly.

According to the Hashi and Krasiqi (2011), size, age, type of ownership, access to human capital, export orientation, and level of innovation are the features form SMEs differently. Some other features which have a significant effect on the SMEs' performance are proactivity, risk-taking status, and intention to invest in growth (Cassia and Colombelli, 2010).

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Table 2.6 Interconnections and interdependencies between dimensions of applying strategic planning and the organization's performance.

Author	Main findings	Study design	Population characteristics	Region	Limitations	Data Analysis
Saqib et al. (2018)	Insignificant impact of innovativeness on performances of manufacturing SMEs in Oman	An empirical approach	91 manufacturing SMEs	Oman	Doing study single-point-in-time	PLS-SEM
Kapasuwan et al. (2007)	Synergy between strategic flexibility and technological resources had a positive and significant effect upon firm performance	A survey questionnaire	87 small and medium sized manufacturing firms in the fabricated metal products sector	Washington State Manufacturers Directory	objective performance measures	Ordinary least squares regression
Wijewardena et al. (2004)	Planning sophistication is positively related to performance in small businesses	Questionnaire survey	262 SMEs	Sri Lanka.	Lack of attention to the control aspect of planning and its impact on performance, as well as the reliance on speculation and opinion for understanding the impact of planning and control on enterprise performance.	a chi-square test, ANOVA
Rosenbusch et al. (2011)	Innovation performance relationship is context dependent	A meta-analysis	range from 40 to 2999 entrepreneurs and small business managers	-	Potential publication bias, survival bias, and variance in firm sizes	bivariate and meta-regression
Subrahmanya et al. (2010)	SMEs across different industries participate in technological advancements, particularly emphasizing on enhancing product development. This strategic focus consequently results in an increase in revenue generation, capital infusion, and workforce expansion.	A semi-structured questionnaire	79 SMEs in manufacturing and service sectors	Bangalore in India	- Relied on self-reported data from SMEs, which could introduce bias or inaccuracies in the responses	estimating correlation, conducting one-way ANOVA, and performing multiple regression analysis
Hodges and Kent (2006)	Perceptions of enhanced intricacy in their strategic planning endeavors exhibit a modestly positive association with perceptions of	A 1 on 1 interview with closed ended questions	Small businesses	Charleston, South Carolina metropolitan area	The research concentrated on enterprises within the Charleston metropolitan region that have less than 100 employees, with	Kurskal-Wallis test, Spearman correlation

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	enhanced organizational performance.				the exception of the hospitality and tourism industry.	
Ebrahimi et al. (2018)	There is a direct and significant correlation between entrepreneurship, innovation, and quality performance. Each aspect of entrepreneurship exhibits a notable correlation with the innovation and quality performance of Small and Medium Enterprises (SMEs). The innovation of SMEs has a direct positive impact on their quality performance, while the size of the firm does not hold significant influence in the correlation between entrepreneurship and quality performance.	Observational study, quantitative research design	114 SMEs managers	Rasht-Iran	adopt a cross-sectional study over a specific time period	structural equation modeling
Rudd et al. (2008)	The innovation of SMEs has a direct positive impact on their quality performance, while the size of the firm does not hold significant influence in the correlation between entrepreneurship and quality performance.	cross-sectional, single respondent approach	366 Medium/large manufacturing organizations - Respondents targeted were CEOs, Managing Directors, and General Managers - Excluded organizations with less than fifty employees	U.K	The limitations of the study include the cross-sectional approach to data collection, uncertainty about the generalizability of the results, and potential issues with establishing causality using the SEM approach.	structural equation modeling in LISREL 8.50
Chungyas and Trinidad (2022)	There is a positive correlation between strategic management strategies and the financial as well as operational performance of cooperatives. This finding underscores the significance of engaging in strategic planning activities.	survey	Multi-purpose Cooperatives	Ifugao, Philippines	The investigation relies on data supplied by the cooperatives, a approach that may lead to partial or erroneous results in evaluating strategic management practices and performance measures.	simple regression analysis

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Oduor (2018)	Strategic planning activities such as defining goals and establishing policies have a constructive impact on organizational performance.	Correlational research design- questionnaire	49 National Hospital Insurance Fund staff	Kenya	No previous studies on strategic planning in NHIF and Busia, Western Kenya.	Cronbach's Alpha coefficient, Content analysis
Kafidi and Kaulihowa (2023)	Engagement in strategic planning has a favorable effect on the financial performance of Small and Medium-sized Enterprises (SMEs) in Namibia, thereby improving their business results and long-term viability.	quantitative research design- a survey questionnaire	SME owners/managers	Nambia	Lack of strategic planning among many SMEs Majority of SMEs lack optimal mix of strategic planning elements	Issue-based strategic planning
Dwikat et al. (2022)	Engagement in systematic strategic planning and strategic business innovation has a beneficial effect on sustainable performance within manufacturing small and medium enterprises, as observed within the Palestinian setting.	Quantitative research design /survey questionnaire	377 manufacturing SMEs	Palestinian	-	Partial Least Squares Structural Equation Modeling (PLS-SEM)
Hasan Makkawi (2023)	Engagement with strategic planning has a beneficial effect on the sustainable business performance of Palestinian small and medium enterprises (SMEs), as elucidated in the research focusing on the influence of risk management and strategic planning.	Qualitative and quantitative approaches- questionnaire	50 owners or managers of SMEs	Palestine	Lack of management steps and improper management styles Use of autocratic management style	analytical descriptive
Chukwuka and Ese (2022)	Engagement with strategic planning has a beneficial influence on the performance of Small and Medium Enterprises (SMEs), as evidenced in Delta State, Nigeria. This influence is demonstrated by the enhancement of market share, profitability, and customer satisfaction.	Quantitative approach	102 SMEs	Delta State	Conflicting findings on strategic planning and performance association. Limited sample size of 120 questionnaires for analysis.	descriptive and regression analysis
Lohana et al. (2023)	Engagement with strategic planning has a beneficial effect on the performance of Small and Medium Enterprises (SMEs) by improving	Descriptive survey research design	146 SMEs	Kuala Lumpur, Selangor,	Low financial planning and knowledge are major limitations for SMEs.	SMART-PLS

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	financial sustainability. This improvement is achieved through various factors such as financial planning, diversification of income, and enhancing financial literacy.			and Johor in Malaysia	The study only covered three states in Malaysia.	
Obaje (2020)	Engagement with strategic planning has a beneficial effect on the performance of SMEs, as evidenced in the service-related sector in Nigeria, underscoring the importance of structured reorientation and governmental assistance.	Questionnaires and semi-structured interviews	136 SMEs owner	Nigeria	Low level of strategic planning adoption among Nigerian SMEs Social factors such as patronage culture and corruption hamper adoption	Deceptive statistics, correlation coefficient, and regression analysis
Gomera et al. (2018)	Strategic planning has a positive relationship with the financial performance of the SMEs	Qquantitative research approach	225 small, micro and medium scale businesses	Buffalo City Metropolitan Municipality in the Eastern Cape Province of South Africa	restricting data collection to 1 region, considering only a single respondent in an organization, and the potential for respondents to respond in a socially desirable way	Regression analyses
Wijetunge and Pushpakumari (2014)	There is a positive relationship between strategic planning and business performance in SMEs	Questionnaire	275 manufacturing	Western province of Sri Lanka	limited time availability, sample size, and the vastness of the SME sector	correlation analysis

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Some scholars (Bracker and Pearson, 1988; Berman et al., 1997) have suggested that strategic planning is different for large businesses than small enterprises since the latter do not have enough resources and knowledge to execute viable strategic planning. However, some management experts believe that strategic planning is a necessary tool for all businesses (Robinson and Pearce, 1984).

According to Vargo and Seville (2011) strategic planning assists SMEs to cope with crisis and survival.

There are four levels of planning complexity: unstructured plans, intuitive planning, structured strategic planning, and structured operational planning (Bracker and Pearson, 1986). Due to lack of resources, expertise, and experience, small businesses are more likely to engage in short-term intuitive or unstructured planning (Moreno et al. 2010).

Davila et al., (2003) noted that age, size, management structure, and ownership are the key features for the growth, direction, state, and performance of SMEs.

Planning complexity and its relation with business features (age, size, and strategic posture) and individual features (age, academic qualifications) are investigated in the study of Koufopoulos et al. (2010), The authors stated that the business features and individual features impact the level of planning complexity.

Ikävalko et al., (2010) have represented that the psychology of individuals in SMEs should be seen as substantial impact on strategic behavior. According to these studies, individuals' intellectual capacity defines how seriously they consider adopting a strategic planning approach and how they would employ the long-term plan to boost their enterprise's performance. The higher an individual in the SME has academic qualification, the more she/he tries to ameliorate the business by accepting the planning process. Individuals' intellectual capacity also may affect planning sophistication and give SMEs an edge over competitors.

A key element that should be considered in the relationship between strategic planning and SMEs' performance, is innovation. In line with this statement, Fitriatia et al. (2020) put forward that there is a positive association between innovation and SME performance. Meutia and Ummi (2017) proposed innovation, proactiveness, and risk-taking are the three elements of strategic posture to make up a fundamental, unidimensional orientation. Innovativeness behaviors in SMEs reflect the managers'/owners' innovation intensity. Managers/owners with innovativeness intensity, tend to use more sophisticated strategic planning (Matthews and Scott, 1995).

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Based on previous studies, the more the age of an SME, the more it accepts strategic planning and the more it has complex planning. In addition, the greater the age of an individual (owner, manager, etc.) within an SME, the higher the likelihood of accepting and executing strategic planning (Koufopoulos et al., 2010). Cordeiro (2013) put forward that SMEs are different from large businesses in terms of planning sophistication. While large businesses have detailed strategic planning, SMEs have short-term plans. Unlike this study, Muhammad (2015) provided the results that planning sophistication increases if the age and size of a business increases. Raymond and St-Pierre (2005) stated that regardless of business size or age, sophisticated planning significantly helps SMEs' performance.

Robinson and Pearce (1984) posited that in order to determine how SMEs might engage in strategic planning, the following issues should be surveyed:

- The absence or presence of applying strategic planning in SMEs
- The value of strategic planning to SMEs through empirical evidence
- The acceptability of various aspects of the strategic planning process
- The content of SMEs' strategies

Setting missions and visions, goals and objectives, environmental scanning, formulations of strategies, assessments, and controls are the indicators of strategic planning activities (Brown, 2008). The indicators would be tested through the questions in the questionnaire to determine whether SMEs apply strategic planning.

Pearce and Robinson (2000) stated that instead of being planned, strategic planning should be emergent, synthesized, informal and visionary. A successful SME that engaged in strategic planning follows the procedure and places a strong emphasis to set missions and objectives. Scholars have stressed that effective strategic planning is correlated with complex strategic planning, which has an impact on performance.

Table 2.7 shows the relation of SMEs features on innovativeness, engagement, and planning sophistication.

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Table 2.7 SMEs feature on innovativeness, engagement, and planning sophistication

Author	Main findings	Study design	Population characteristics	Region	Limitations	Data Analysis
Gledson and Phoenix (2017)	The innovativeness of SMEs is influenced by both their organizational maturity and internal design capabilities.	Web-based questionnaires	101 SME construction sector	UK	Non probability sampling and the inability to identify the effect of moderating variables in some tests of association	Descriptive and inferential statistical methods
Martínez-Román and Romero (2017)	Two distinct dimensions exist within the innovativeness of Spanish small and medium-sized enterprises (SMEs), pertaining to the capacities for core/internal innovation and the capacities for the assimilation of technology.	A survey	1583 SMEs	Spain	The research centers on particular facets of innovativeness, specifically core/internal innovation capabilities and technology adoption capabilities, which may neglect other facets of innovation within small and medium-sized enterprises.	Factor analysis, linear regression
Radas and Božić (2009)	Subsidies, firm age, and proportion of employees engaged in RD were found to be not significantly related to innovation.	A postal survey	448SMEs	Croatia	The study does not take into account the influence of external factors such as global economic fluctuations or political instability on the innovativeness of SMEs, which may impact the outcomes.	ANOVA analysis and the Pearson $\chi 2$
Civelek et al. (2021)	SMEs' innovativeness differs depending on their size, industry, and area activity. However, there were no differences in innovativeness concerning succession involvement	A structured self-administered questionnaire	350 family-owned SMEs	Czechia	Sample size and regional focus,.	Skewness-Kurtosis and Levene's normality tests, T-test
Carlos and Fernández-Jardón (2012)	Internal and external factors influence innovativeness in SMEs, and that the company can build core competencies to improve their innovativeness.	A sample survey	236 companies	Vigo and its metropolitan area, located in the northwest of Spain and more specifically in the southwest of Galicia	Lack of temporal causality between variables due to data collection at a single point in time, and the potential influence of the economic expansion on the choice of competitive advantages.	Partial least squares (PLS)

Rosenbusch et al. (2011)	The relationship between innovation and performance is negatively impacted by the age of the firm, with new ventures experiencing greater benefits from innovation when compared to mature small and medium enterprises.	A meta-analysis	21270 entrepreneurs and small business managers	-	potential publication bias, survival bias, and variance in firm sizes	Meta-analysis
Heimonen (2012)	Larger enterprises may possess greater resources and capacities to allocate towards innovation, consequently resulting in a higher level of innovativeness. Smaller and medium-sized enterprises (SMEs) of an older age bracket, specifically between 5 and 19 years old, exhibited a reduced likelihood of achieving short-term success if they were categorized as innovative growth SMEs.	Longitudinal	348 continuously growing SMEs located in 2 diverse regions in Finland	Finland	small sample size, skewness of the data and the method	Logistic regression analysis
Cleyn and Braet (2012)	The size of a company's board exhibits a substantial favorable correlation with its level of innovativeness. Business-to-customer sectors generally display greater levels of innovativeness compared to business-to-business sectors. There was an absence of any noteworthy correlation detected between the type of investor and a company's degree of innovativeness.	Survey	49 SMEs manufacturing industries	Belgium	Limitations in the sample composition, lack of diverse industry sectors	Chi-Square test, t-test
Booyens (2011)	The rate of innovation among SMMEs demonstrates a notable level of prominence, particularly as small-scale establishments exhibit the most substantial innovation rate. Furthermore, a discernible inverse correlation exists between the likelihood of engaging in innovative activities and the size of the	Observational study	- Small, medium- and micro-sized enterprises (SMMEs) - Entrepreneurs and micro enterprises	South Africa	-	basic uni- and bi-variant descriptive statistics regression

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	enterprise, suggesting that SMMEs do not surpass larger corporations in terms of innovation.					
Laforet (2008)	The dimensions of size, strategic focus, and market orientation have been found to be linked to innovation within small and medium-sized manufacturing enterprises that operate outside of the high-technology sector. Companies categorized as prospectors, a group that encompasses medium-sized enterprises, tend to exhibit higher levels of innovation and market focus compared to defenders, which consist of small-scale businesses.	Mail survey	60 Small and medium-sized enterprises (SMEs) in the non-hi-tech manufacturing sector, specifically in South Yorkshire	South Yorkshire, UK	- Findings may not be generalizable to hi-tech manufacturing SMEs or other industries - Weaknesses identified may not be applicable to all SMEs	descriptive statistics
Subrahmanya (2006)	Expenditure on innovation and the number of innovation personnel tend to rise as the size of the firm increases. There is a direct correlation between innovation expenditure and the overall value of output. A reverse correlation observed between innovation intensity and firm size.	Questionnaire-based survey approach	The population characteristics relevant to the study are firm size, innovation expenditure, innovation personnel, innovation intensity, and labour and capital expenditure.	India	Limited to the SME sector in Karnataka, ocused on the period 1997-1999, did not consider external factors such as market conditions, regulatory environment, or access to funding	Correlation analysis, One-way ANOVA, Multiple regression analysis
McAdam et al. (2004)	Different sizes of SME organizations have a notable impact on the integration of innovation concerning various aspects.	Questionnaire survey	396 SMEs in Northern Ireland, including their size, industry, and location.	Northern Ireland	The limitations of the study include a lack of direct studies on innovation incorporation in SMEs, reliance on related but indirect studies, and a paucity of studies and data on innovation incorporation in different organizational size categories within SMEs.	Pearson's correlation coefficient
Uhlaner et al. (2011)	The tangibility of the industry, the size of the organization, its innovative focus, the impact of family involvement, and the perceived	Observational study design	689 SMEs	Netherlands	Cross-sectional nature of the survey, potential common method bias due to self-reports	Ordinary least squares hierarchical

	financial advantages of adopting energy-saving measures have been identified as key determinants influencing the extent of SMEs involvement in environmental initiatives.					multiple regression
Yusuf and Saffu (2005)	Economic challenges do not foster a conducive environment for firms to engage in thorough strategic planning. The correlation between planning and enhanced performance is not always evident, particularly outside of the manufacturing industry. A notable disparity in planning sophistication based on gender exists, indicating that businesses managed or owned by males tend to exhibit more advanced planning strategies than those managed or owned by females. The size of a firm did not have a moderating effect on the effectiveness of its planning strategies. Companies that experienced the most significant growth in sales tended to have lower levels of planning sophistication.	Face-to-face interviews	297 small firms	Ghana	The emphasis is placed on a particular nation undergoing economic changes, a dearth of investigation into the factors contributing to specific results, and possible concerns regarding gender inclusivity.	ANOVA

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Culture can be displayed in different forms encompassing values, beliefs, rituals, ceremonies, etc. (David, 2011). It can also be considered in terms of corporate or organizational culture (Pinho et al., 2014).

Organizational culture is a model of behavior to cope with the problem of an organization's external adaptation and internal integration (David, 2011). Johnson et al. (2009) put forward that culture plays a notable influence on the execution of strategies, impacting the organizational structure, managerial procedures, and strategic changes. There is a relationship between strategy and an organization's culture (Cheng, 2023; Maheshwari, 2022; Mehmood, 2022). Winkler and Zerfass (2016) stated that without considering culture, strategies cannot be executed. Johnson et al. (2014) posited that culture (beliefs system, values, attitudes, lifestyle, economic status, etc.) impacts any business performance and growth. Laforet (2016) manifested that there is a positive relationship between organizational culture and performance.

Pearson and Chatterjee (2001) stated that small and medium-sized enterprises underpin entrepreneurship, and entrepreneurial capabilities depend on the culture.

Parboteeah et al. (2005) stated that national cultures are associated with organizational and social behavior, owners' attitudes, and ethics. Education, longevity, enterprise type and gender are the variables bolded by Graham and Nafukho (2007) as organization culture indicators. Individuals cultural inclusion, religion, and faith may have an impact on not only the decision for accepting strategic planning but also on the perfect result of strategic planning. Table 2.8 shows a summary of previous studies focused on cultural inclusion and engagement with strategic planning.

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Table 2.8 Cultural inclusion and engagement with strategic planning

Author	Main findings	Study design	Population characteristics	Region	Limitations	Data Analysis
Nwachi (2021)	Participation in the plan-making process has a direct impact on various aspects of social inclusion, and there is a strong and significant relationship between participation and different dimensions of social inclusion.	Quantitative Analysis Approach- questionnaires	90 Diverse socio-cultural, ethnic, and religious groups - Individuals involved in urban planning and governance processes	Abuja, Nigeria	Concentrating on a case study approach using the Metropolitan Area of Abuja.	correlation coefficient
Abok et al. (2013)	The organizational culture plays a crucial role in shaping the execution of strategic initiatives within these entities.	Quantitative and qualitative data collection methods and analysis (questionnaire and interviews)	258 NGOs	Kenya	-	regression analysis - Cronbach's Alpha coefficient
Johnson (2000)	Managers' understanding of organizational culture influences strategy development and strategic change. In addition, organizational culture impacts collective cognition, organizational routines, and strategic change management.	Interactive approach- a qualitative methodology	Managers	-	Subjectivity and potential researcher bias	thematic analysis or content analysis
Raida Abu Bakar, F. Cooke, N. Muenjohn (2018)	The influence of religiosity on work engagement yields a beneficial effect, underscoring the significance of regarding religious beliefs as a valuable asset within the realm of Human Resource Management (HRM). This particular viewpoint is essential in the effective management	qualitative approach using semi-structured interviews	41 Mid-ranking professionals from the finance sector	Malaysia	Limited consideration of institutional and social environments, a scarcity of research examining religious faith as a professional or personal asset within the realm of Human Resource Management, and the	Content analysis using NVivo 9 software

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	of a heterogeneous workforce comprising individuals from various religious backgrounds.				imperative requirement for heightened attention to environments and extensive qualitative explorations into personal dynamics relating to religious devotion and professional commitment.	
Jafar Aghazadeh, Reza Mahmoudoghli (2017)	The level of religiousness is directly correlated with Political Behavior. Greater Political Behavior is anticipated within populations residing in religiously oriented societies.	Questionnaire survey method	360 people	Isfahan-Iran	Reliance on the survey method, utilization of small sample sizes, employment of cluster-sampling in participant selection, and the presence of potential methodological errors.	Regression Analysis
Abu Bakar et al. (2018)	Religiosity is a noteworthy determinant that exerts influence on the level of work engagement manifested by individuals. The research underscores the favorable effects of religiosity on the outcomes of human resources and organizations, providing insight into the function of religion in molding the beliefs and actions of individuals within various life and work settings. The significance of religiosity lies in its potential to significantly elevate the levels of work engagement displayed by employees operating within organizations characterized by a variety of religious affiliations.	Qualitative approach using semi-structured interviews	41 Mid-ranking professionals	Malaysia	Lack of emphasis on institutional and social contexts, with a scarcity of research examining religious faith as a professional or personal asset from the viewpoint of Human Resource Management (HRM). Furthermore, there is a necessity for increased attention to contexts and more thorough qualitative inquiries into the individual dynamics related to religiosity and engagement in the workplace.	Content analysis using NVivo 9 software

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Oboh (2021)	Culture plays a substantial role in shaping the management strategies of multinational enterprises. Moreover, the influence of foreign cultures on managerial practices is considerable. Additionally, the promotion of effective management techniques in multinational corporations is heavily reliant on the impact of culture.	Observational study, cross-sectional design	375 Individuals	Nigeria	The research predominantly employed descriptive and Chi-square analyses, potentially lacking in capturing the complete intricacy of the correlation between culture and management approaches within multinational enterprises. Limiting the generalizability of the findings to other industries or regions due to focusing in oil and gas industry in Nigeria.	Descriptive statistics, Chi-square

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Rudd et al. (2008) stated flexibility as the extent to which new and alternative decisions are made during the strategic planning process and providing organizational transformation and adaptability to external turbulence. Organizations identify environmental turbulence through strategic planning and devote resources accordingly. Being flexible generates various decision-making options (Evans, 1991). As environmental change occurs, flexible organizations will quickly modify, and provide a valuable path to superior performance. Tomášková. and Kaňovská. (2022) put forward that there is a positive relationship between SME's flexibility and innovation. Table 2.9 represents a summary of previous studies on the relationship between flexibility and innovativeness.

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Table 2.9 Flexibility and innovativeness

Author	Main findings	Study design	Population characteristics	Region	Limitations	Data Analysis
Tomášková and Kaňovská (2022)	External cooperation flexibility and internal cooperation flexibility are related to innovation flexibility in SMEs	a pre research study	112	Czech Republic	sample size, geographical location, and the need for comparison with companies in other fields and countries	correlation and regression analysis
Arshad et al. (2018)	all hypotheses have a positive significant association	a stratified random sample	120 manufacturing SMEs	peninsular Malaysia	-	Partial Least Squares (PLS)
Martínez-Sánchez et al. (2011)	Internal flexibility practices have a positive correlation with innovativeness, while the connection between external flexibility and innovativeness is contingent upon the specific type of contingent employee.	A questionnaire survey	123 first tier automotive suppliers	Spain	-	Hierarchical regression analysis
Borch and Madsen (2007)	The categorization of four groups of dynamic capabilities essential for the entrepreneurial stance of small and medium enterprises (SMEs) is identified, along with the statistical significance of the majority of dynamic capabilities' associations with innovative strategies.	A questionnaire survey	235 small and medium sized firms	-	sample consists small firms with less than 50 employees	Multiple regression analyses

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The second part of my research is prioritizing strategic planning models using a multi-criteria decision-making technique. So, in the following sections, the author has tried to study the decision-making background, multi-criteria decision making techniques, and the strategic planning models which are selected to be prioritized.

2.11 Decision Making

Decision-making is the process of selecting alternatives among a set of alternatives (Plous, 1993). Decision-making is one of the main tasks of managers and it is an integral part of management. It is the main component of management tasks in determining organization policies, formulating goals, selecting, and evaluating all activities. Achievement of the organization's goals highly depends on the quality of the manager's decision-making (Elbanna, 2006).

The decision-making process includes the following steps (Dubois et al., 2013):

- Determining a problem and its importance
- Defining and identifying the problem
- Determining alternative solution
- Evaluating and selecting a solution
- Implementation the selected solution

2.12 Multi-Criteria Decision-Making (MCDM)

Multi-Criteria Decision-making models are divided into two general categories:

- Multi-Objective Decision Making (MODM)
- Multi-Attribute (Criteria) Decision making (MA(C)DM)

In Multi-Criteria Decision Making (MCDM), a number of alternatives are analyzed and prioritized considering several criteria. In the current study for the second part of the analysis, the MCDM technique is applied (Taherdoost and Madanchian, 2023).

2.13 Fuzzy Best Worst Method (FBWM)

FBWM is an MCDM technique that was developed by Guo and Zhao (2017). The fuzzy best-worst method is an extended version of best-worst method in the fuzzy environment. Decision makers first determine the best (most desirable, most important) and the worst (least desirable, least important) criteria. The two criteria (best and worst) are then compared against each other and other criteria. The weights of various criteria and alternatives are then determined by formulating and solving a maxmin problem. Decision makers' linguistic terms,

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which may be expressed as triangular fuzzy numbers, were used to describe the reference comparison for the best criterion and the worst criterion. The fuzzy score of alternatives can be derived by multiplying the fuzzy weights of the criteria and the fuzzy weights of alternatives concerning the various criteria. Then, using the graded mean integration representation (GMIR) method, the crisp ranking score of alternatives can be calculated. It is possible to assess the validity of fuzzy preference comparisons by using a consistency ratio (Guo and Zhau, 2017). The FBWM has recently been used in various management research for the evaluation of alternatives. For example, Karimi et al. (2020); Chen et al. (2020); Amiri et al. (2020); Moslem et al. (2020); Tavana et al. (2021).

2.14 Strategic Planning Models

In this section, six strategic planning models (John A.D. Bryson, Peter Wright, Wheelen & Hunger, Hill and Jones, Bowman and Asch, Fred R. David)), which are mostly studied by the Iranian authors in the previous research (Khatami and Mehdizade, 2008; Aghazadeh, 2002) are put forward.

Table 2.10 Comparing the six strategic planning models

Model	Key Characteristics	Applicability to SMEs
John A.D. Bryson	Emphasizes stakeholder engagement and collaboration. Focuses on strategic planning as an ongoing process. Advocates for flexibility and adaptability.	Suitable for SMEs that value stakeholder input and seek a participatory approach in their planning process. May be applicable if agility and responsiveness are essential.
Peter Wright	Emphasizes the alignment of goals and objectives. Framework for defining strategic direction and monitoring progress. Integrates financial and non-financial aspects.	Appropriate for SMEs aiming to align their strategies with clear objectives. Can be used for balanced performance measurement.
Wheelen & Hunger	SWOT analysis to assess internal and external factors. Emphasis on environmental	Useful for SMEs seeking a systematic approach to assess their competitive

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	scanning and competitive analysis. Focus on formulating strategies based on strengths and opportunities.	landscape and identify strategic options.
Hill and Jones	Strategic management framework for achieving and sustaining competitive advantage. Emphasizes core competencies and resource-based view of strategy. Focus on internal strengths and external opportunities.	Suitable for SMEs aiming to leverage their unique strengths and resources to gain a competitive edge. Applicable when resource allocation is critical.
Bowman and Asch	Emphasizes the importance of market and competitive positioning. Framework for understanding different strategic positions. Focus on choosing a clear strategic posture.	Applicable to SMEs that need to define their market position and competitive strategy. Useful for making strategic choices in positioning.
Fred R. David	Comprehensive strategic management process. Includes environmental scanning, strategy formulation, implementation, and evaluation. Emphasis on a systematic approach to planning.	Suitable for SMEs looking for a well-structured and systematic approach to strategic planning and management. Helpful for end-to-end strategic management.

2.14.1 John AD. Bryson

Bryson (1988) introduced a strategic planning model for both organizations and communities. The primary components of the Bryson strategic planning model include:

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Initiating consensus: Defining the objectives, procedures, responsibilities, and resources for the strategic planning initiative.

Recognition of mandates: Identifying and elucidating the official and unofficial external directives applied to the organization.

Formulation of mission and values: Crafting the organization's mission and clarifying its values, while taking into account the interests of key stakeholders.

Assessment of the external environment: Evaluating the opportunities and challenges posed by external elements such as clients, competitors, and broader market trends.

Appraisal of the internal environment: Analyzing the organization's strengths and weaknesses concerning its resources, existing strategies, and performance.

Identification of strategic challenges: Determining the crucial policy inquiries that influence the organization's directives, mission, products/services, etc., utilizing methodologies like direct, goal, or scenario analysis.

Development of strategies: Creating options, recognizing barriers, and devising plans to tackle the strategic challenges.

Envisioning the future: Articulating the envisioned future condition of the organization as it effectively executes its strategic blueprints.

The primary focus lies on implementing a thorough, methodical process to support organizations in making well-grounded strategic choices and plans. The Bryson strategic planning model is shown in figure 2.1 (See Appendix B)

2.14.2 Peter Wright

Wright created a hierarchical model (figure 2.2- Appendix B) at the organizational level. He has made an effort to offer a tolerant perspective on strategic planning. The offered model initially pinpoints the business environment and environmental factors. Additionally, it lists the industry analysis' strengths and weaknesses before listing the organization's threats and opportunities. The objectives and mission of a company are decided based on internal resources and external opportunities. Goal setting is followed by the definition of three levels of strategy: management, activity, and function. At the management level, macro strategies will be formulated. At the activity level, strategy into operations across departments and units will be transformed. At function levels, tasks and responsibilities of employees in the form of established plans are formulated (Dehkordi F.L; 1999).

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2.14.3 Thomas L.Wheelen, J. David Hunger

Wheelen and Hungar (2012) posited that the fundamental components of strategic planning are: environmental scanning, strategy formulation, strategy implementation, evaluation, and control. Environmental scanning involves the continuous monitoring, analysis, and dissemination of information derived from both the internal and external environment with the aim of identifying key strategic factors.

1. Strategy formulation encompasses the process of establishing the organization's mission, objectives, strategies, and policies in order to attain a competitive edge.
2. The execution of strategies and policies is carried out through the implementation phase, which involves the development of programs, budgets, and operational procedures.
3. Evaluation and control activities are designed to oversee corporate operations and performance, enabling a comparison between actual outcomes and desired results.
4. The feedback and learning process entails the adjustment or rectification of decisions made earlier in the strategic planning process
5. Figure 2.3 in Appendix B represents the Wheelen and Hunger strategic planning model.

2.14.4 Hill and Jones

Hill and Jones (2014) provided a strategic planning model that has two main phases: strategy formulation and strategy implementation. Each phase constitutes a sequential step in the process. In the first phase, a statement of the company mission and key goals is presented at the start of the round or cycle of the planning process. The company's current business model influenced this statement. The foundation of strategic thinking – external analysis, internal analysis, and strategic choice – comes after the mission statement. This model ends, in the second phase, with the design of organization structure, organization culture, and organization control systems necessary to be implemented for the organization's chosen strategy (Hill, et al., 2014). The steps in this model are as follows:

1. The initiation of strategic planning involves formulating the organization's mission statement, serving as the cornerstone for strategy development by articulating the purpose, vision, values, and a significant objective.
2. Conducting an external analysis entails scrutinizing the external operational landscape of the organization to pinpoint strategic openings and risks that could influence the

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execution of the organization's mission, encompassing industry, national, and socioeconomic contexts.

3. Internal analysis encompasses an evaluation of the organization's assets, capabilities, and proficiencies to ascertain its strong points and areas for improvement.
4. SWOT analysis involves a comprehensive evaluation of the organization's strengths, weaknesses, opportunities, and threats to devise approaches for capitalizing on opportunities, mitigating threats, leveraging strengths, and addressing weaknesses.
5. Strategies are crafted across functional, business, global, and corporate domains to foster and sustain a competitive edge.
6. The establishment of a governance framework and ethical standards is crucial to ensure lawful and ethical conduct that bolsters profitability and expansion.
7. Designing the organizational structure, culture, and control mechanisms is essential to underpin the enactment of selected strategies and competitive advantage.

Strategic planning is a continual, iterative procedure with a feedback mechanism to oversee the attainment of strategic objectives and the upholding of competitive superiority (Hill, et al., 2014). Figure 2.4 in Appendix B represents Hill and Jones strategic planning model.

2.14.5 Bowman and Asch

Bowman and Asch (1989) represented a strategic planning model in the subjective and objective conditions. In the strategic planning process, the present situation should be analyzed. Then, the strategic changes come through the interaction of objective and subjective conditions. After that, change is managed through a new strategic posture. With reference to figure 2.5, the strategic planning process in the model includes:

1. The current state of affairs: the existing position and strategic stance of the organization.
2. Strategic transformation: Any adjustment made to the prevailing strategy is categorized as a strategic transformation. These alterations can be specific to certain areas or encompass the entire organization, and they can stem from intricate corporate strategizing or impulsive executive choices.
3. The cycle of the "New strategic stance": Strategic transformation is a continuous procedure, and the strategic alterations made today mold the circumstances of tomorrow.
4. Objective circumstances: These pertain to the external surroundings of the organization, encompassing the competitive landscape, economic and technological backdrop, and political and societal framework. These objective circumstances lend

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themselves better to methodical examination in comparison to subjective circumstances.

Subjective circumstances: These involve the interpersonal, psychological, and political aspects within the organization, such as those arising from past managerial decisions, the external ambiance, leadership, and organizational setup. Subjective circumstances have the potential to impact employees' perceptions of the organization's objective conditions. The Bowman and Asch strategic planning model is shown in figure 2.5 in Appendix B.

2.14.6 Fred R. David

In David's strategic planning model, it is crucial to address the following three questions: where is the firm now? Where does the firm want to go? How is the firm going to go there?

Strategic planning logically begins with identifying organization's current vision, mission, objectives, and strategies. A firm's current state and condition may prevent some strategies or even require a certain course of action. In the model, business ethics, social responsibility, and environmental sustainability issues have an impact on all model activities. Almost all strategic decisions, especially for small businesses, are influenced by global and international challenges. The steps of strategic planning in the model are as follows (David, 2011).

1. Developing mission and vision statements serves the purpose of defining the business mission and envisaging the desired future state.
2. Conducting an external audit is essential to pinpoint crucial opportunities and threats arising from economic, social, political, technological, and competitive facets.
3. Execution of an internal audit becomes necessary to evaluate the functional strengths and weaknesses within the company.
4. The establishment of long-term objectives should be quantitative, measurable, and realistically achievable.
5. The analysis and selection of suitable strategies are paramount in attaining the mission and objectives set forth.
6. Implementation of the chosen strategies demands effective leadership, motivation, and collaboration among the team.
7. Evaluation of the strategy involves performance measurement, analysis of fundamental principles, and the implementation of corrective measures.

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8. The strategic planning process should take into account business ethics, social responsibility, and environmental sustainability.
9. Global factors and perspectives must be integrated into strategic decision-making processes.
10. The document delineates the essential steps and considerations involved in the strategic planning process for organizations.

Figure 2.6 in Appendix B indicates David Strategic Planning Model

With regard to the multi-criteria decision-making techniques, some quality criteria should be considered for evaluating/prioritizing strategic planning models in Small and Medium-sized enterprises.

2.15 Quality Criteria for Evaluation of Strategic Planning Models

Assessing strategic planning models based on qualitative criteria by applying FBWM is studied in my research since managers and owners in SMEs are trying to follow an appropriate model for their organizations.

The strategic planning process produces a tangible result, and the effectiveness of the process itself is reflected in the quality of the strategic planning that is created. A poorly designed planning process will not result in a high-quality strategic plan (Whelan and Sisson, 1993).

According to Mellalieu (1992), good planning should include a well-supported response to strategic issues and serve as a foundation for communication with people who need to know about the strategy but were not involved in the planning process. Mellalieu stated that the following factors need to be taken into account for an auditor to evaluate the quality of strategic planning:

- Strategic planning must adequately handle all strategic questions, goals, and objectives to seize crucial opportunities and defeat crucial threats.
- Strategic planning should identify and prioritize key tasks.
- A strategic planning should have sufficient flexibility to cope with risk and uncertainty.
- Strategic planning includes control systems to assure that the implementation of strategy is under control.

Richard Rumelt (1993) posited that the criteria that can be used for evaluation strategic planning are as follows:

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- Consistency: strategic planning should not consider objectives and policies that are not consistent.
- Consonance: strategic planning process should represent flexibility in response to the external environment and important problems.
- Advantage: strategic planning should take competitive advantage into account.
- Feasibility: strategic planning process should make use of organizational resources and propose solutions to pressing challenges without posing new ones.

According to Cox (1997), a useful strategic plan should have the following features:

- Priority: it enables the strategic plan to be modified in response to shifting requirements or available resources.
- Measurable: strategic planning should have the ability to measure goals.
- Flexible and responsive to changing conditions: the strategic plan should consider unexpected situations, new opportunities, or adjustments in resource availability.
- Simplicity: strategic planning should be short and simple.

Formality: The strategic planning process encompasses various essential components such as vision, mission, values, strategic issues, strategic objectives, and performance measurement as suggested by Shahin (2011), Whelan and Sisson (1993).

Clarity: The concept of clarity, as defined by the Office of Management and Budget (OMB), pertains to the necessity of presenting data and metadata in a coherent and understandable manner (Shahin, 2011). In the context of this study, clarity refers to the aspect of strategic planning that ensures strategic objectives and strategies are clearly articulated within the planning model.

Measurability: Mellalieu (1992) emphasizes the significance of measurability in strategic planning, serving as a control mechanism to ensure effective strategy implementation. Cox (1997) further suggests that strategic planning is effective when objectives are measurable, achievable, and time-sensitive, as noted by Shahin (2011). Within this study, measurability is defined as the capability of a strategic planning model to assess, monitor, and evaluate strategic objectives.

Objectivity: Objectivity, as defined by the Quality Assurance Framework, relates to the extent to which a strategic plan meets the actual needs of clients. The World Bank and the UNESCO institute also equate objectivity to reliability and serviceability. Hiraga et al. (2003) posit that objectivity lies in a strategic plan's ability to accurately represent the outcomes of

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strategic objectives, according to Shahin (2011). In this research context, objectivity is considered a criterion that reflects the reliability and serviceability of a strategic planning model.

Coverage: Coverage in strategic planning denotes how well the objectives in the plan address critical issues, opportunities, and threats identified during the analysis phase. Rumelt (1993) distinguishes coverage into feasibility and consonance dimensions, with feasibility focusing on utilizing organizational resources to address strategic issues, and consonance on the plan's adaptability to the external environment and critical issues. Mellalieu (1992) argues that strategic planning goals should leverage critical opportunities and mitigate threats adequately, as per Shahin (2011). This study defines coverage as encompassing the operating environment, strategic issues, strategies, and action plans within the strategic planning model.

Consistency: The concept of consistency in strategic planning relates to the ability to adapt to environmental changes, which is crucial for evaluating the effectiveness of a strategic planning model, as noted by Evans (1991). Consistency can aid organizations in responding to competitors' actions, reallocating capital investments, and sustaining organizational success, as suggested by Foxman et al. (1990). In this research, consistency is a criterion indicating the adaptability of a strategic planning model in the face of environmental changes**.** To assess strategic planning models using multi-criteria decision-making techniques, the assessment criteria must be defined. Reviewing the literature, the criteria for assessing strategic planning models in my study are determined as follows:

Table 2.11 Quality criteria for strategic planning evaluation

Criteria	***Description***
Formality	Strategic planning model includes all essential elements (vision, mission, values, strategic issues, strategic objectives, and strategies, performance measures).
Clarity	Strategic objectives and strategies in the model could be clearly stated.
Measurability	Strategic objectives could be measured, monitored, and evaluated.
Objectivity	Describe reliability and serviceability of strategic planning.
Coverage	The subjects such as operating environment, the strategic issues, and a set of strategies and action plans cover by SP model.
Consistency	The strategic planning model seems consistence in response to the environmental change.

2.16 Recent studies Integrating Strategic Planning and Multi-Criteria Decision-Making Techniques in SMEs

Applying MCDM techniques in evaluating and prioritizing manufacturing flexibility alternatives is provided by Mishra et al. (2017). Ramlan et al. (2016) used an MCDM technique in analyzing SWOT in Small and Medium Enterprises. An MCDM technique is used by Modak et al. (2017) to analyze the suitability of an organization's strategic decision of outsourcing in

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association with organizational performance. Shahba et al. (2017) applied strategic management and MCDM techniques to find the best strategies for waste management in iron mines. Mousavi Nasab and Sotoudeh-anvai (2017) proposed a new MCDM technique to prioritize strategies at any level including corporate, business, and functional. Applying SWOT and MCDM in ranking urban transportation system strategies based on sustainable development dimensions and adjusting energy strategies according to new and improved alternative solutions is provided by Hatefi (2018). Sadeghi (2018) used MCDM techniques to assess the performance of high-tech SMEs based on the weighted critical success factors. Selecting relevant sustainability subjects by focusing on strategic planning and management using an MCDM technique is offered by Calabrese et al. (2019). Karuppiah et al. (2020) used a combination of MCDM techniques to find the barriers to green manufacturing in SMEs. A hybrid MCDM technique is offered by Velmurugan et al. (2022) to identify the most critical factors and alternatives impacting the human error factors in SMEs.

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3. Research Methodology

Academics have generally agreed that the nature of research, the variables involved, and the anticipated type of data, would all influence the choice of a suitable methodology approach. The selection of research method is influenced by a variety of organizational, historical, political, ethical, evidentiary, and personally significant elements of the fields of research in addition to research objectives, norms of practice, and epistemological concerns (Bryman, 2007).

The elements described in this chapter will help me to identify the methods and tools which are applied in the research.

3.1 Research Approach and Method

There are different types of research methods. The two basic types are qualitative and quantitative.

The quantitative method is applied in this study since it is more accurate, impartial, focused, and fast. Using the quantitative method, a significantly broader study that includes more participants can be conducted. Generally, one can extrapolate research findings with more accuracy to a wider population through the quantitative method (Babbie, 2010).

A survey approach is used to answer research questions in this study. To answer the research questions, using questionnaires in the first part of the study which focuses on the impact of applying strategic planning on organization performance, and structured interviews in the second part which concentrate on prioritization of strategic planning models using FBWM, are suggested.

The survey design is thought to be appropriate for gathering the amount of information required to assess the extent of strategic planning among various Iranian manufacturing SMEs. To fully describe a research methodology, I am inspired by the work of Saunders et al. (2009).

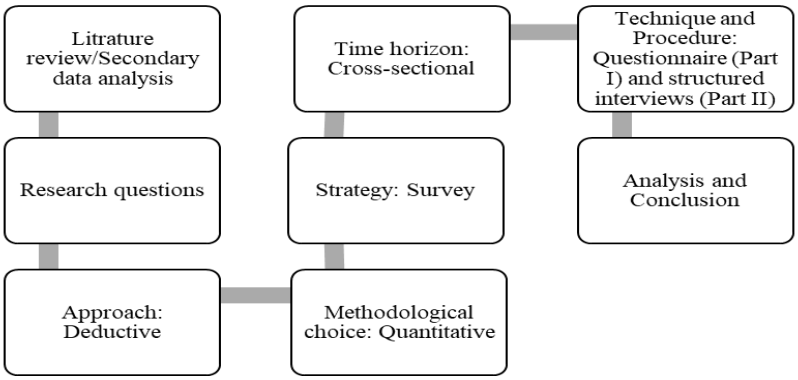

Figure 3. 1 Methodology map. Source: My own ed.

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I have created a methodology map in this research (Figure 3.1). Reviewing the literature not only helped me shape the research questions but also aided in the choice and development of data collection tools.

The selection of philosophy, paradigm, and other techniques components following the study's goal and the main focus is summarizing in this chapter.

The following main research questions were raised after a careful literature review. "What is the impact of applying strategic planning on Iranian SMEs' performance? "and "What is the rank of strategic planning models in Iranian SMEs?"

3.1.1 Research Approach

The overall research aims of my study are: 1. determining the impact of applying strategic planning on Iranian SMEs' performance and 2. determining an appropriate strategic planning model for applying to Iranian manufacturing SMEs.

In the first section of my study, I develop a main model and three subsidiary models and then formulate specific hypotheses that can be tested through experimentation. After that, I delineate the variables and concepts in a manner that allows for their quantification or observation. Finally, data are collected to test the hypotheses and analyze the results to determine whether the hypotheses are supported or not.

In the second section, the strategic planning models are suggested and the data are collected to assess the models.

3.1.2 Research Hypotheses

The hypotheses of the first section were formulated as follows in my study.

Main hypothesis

H_1- There is a considerable relationship between applying strategic planning and Iranian SMEs' performance.

Sub hypotheses

H_2- Dimensions of applying strategic planning[1] have a significant impact on Iranian SMEs' performance.

H_3- Applying strategic planning significantly impacts the dimensions of Iranian SMEs' performance[2].

H_4- Flexibility significantly impacts on Iranian SMEs innovativeness.

[1] Dimensions of applying strategic planning included: Business objectives, Engagement with strategic planning, Flexibility, Innovativeness, Planning sophistication, Strategic planning activities

[2] Financial and Non-Financial performance

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H_5- Iranian SMEs' features (size and age), individuals' cultural inclusion and faith significantly impact engagement with strategic planning.

H_{5a}- Iranian SMEs size significantly impact engagement with strategic planning.

H_{5b}- Iranian SMEs age significantly impact engagement with strategic planning.

H_{5c}- Individuals' cultural inclusion and faith significantly impact engagement with strategic planning in Iranian SMEs.

H_6- Iranian SMEs features (size and age) significantly impact planning sophistication.

H_{6a}- Iranian SMEs size significantly impact planning sophistication.

H_{6b}- Iranian SMEs age significantly impact planning sophistication.

H_7- Iranian SMEs features (size and age) significantly impact innovativeness.

H_{67a}- Iranian SMEs size significantly impact innovativeness.

H_{7b}- Iranian SMEs age significantly impact innovativeness.

3.1.3 Quantitative Methodology

The quantitative research design is determined for the current study since the goal is to quantify the relationships, attain generalizability, uphold objectivity, test hypotheses, facilitate comparisons and predictions, and guarantee the replicability of the research.

3.1.4 Research Design

In line with the research goals and questions, a quantitative research approach was selected. In advance of data collection, the hypotheses and variables were clearly defined. To study causal connections between various variables and focuses on analyzing the situation to shed light on how various variables relate to one another, a questionnaire was designed for the first section. The questionnaire was sent (via emails, short messaging services, and letters) to the different Iranian manufacturing SMEs. In the second part of my study which is using FBWM in prioritizing strategic planning models in Iranian SMEs, some structured questions were prepared to let the respondents compare the models based on the most and the least important criteria. An interview was done with managers and owners of Iranian manufacturing SMEs to collect the required data. Before asking any questions, the interviewer provided two sheets about strategic planning models and the criteria descriptions. Then, the respondents were asked to give their ideal score based on the determined qualitative scale. After collecting the required data (320 responses in the first part and 13 interviews with managers and owners of SMEs in the second part), the analysis of data started. Structural equation modeling, Analysis of Variance (ANOVA), and regression analysis were applied for the analysis of data in the first

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part. In addition, Fuzzy Best Worst Method (FBWM) and Lingo 18.0 software were used to analyze the collected data in the second part of the study.

3.1.5 Cross-sectional Design

In agreement with Bryman (2012) and Saunders et al. (2009), the cross-sectional design is applied in my research because the studied organizations (SMEs) demonstrate greater accessibility and inclination to engage in a cross-sectional research investigation, given that it demands a singular data gathering endeavor as opposed to a long-term commitment. In addition, the enterprises have limited resources and time. Furthermore, the utilization of a cross-sectional design facilitates the acquisition of a sample that is truly representative, thereby enhancing the overall feasibility of the research study.

3.1.6 Data Collection Method

The original questionnaire in the first part of current study consisted of 48 items divided into two sections. The questionnaire was adopted from Brown's (2008) study which confirmed that it was intended to collect information on SMEs' strategic planning features, complexity, performance, and descriptive demographics. For the current study, 35 new items were added to the original questionnaire. The new items address aspects of innovativeness, flexibility, business objectives, culture and faith which were part of the novelty of the study. Like the original research, I used a 5-Likert scale ranging from "strongly disagree to strongly agree" for measuring in current study.

Due to using existing survey questions, it was not required to develop a new survey instrument. The benefit of employing pre-existing survey questions is that they would have undergone comprehensive testing prior to their initial and subsequent use (Hyman et al., 2006). Additionally, the previous survey tools were created by academics with vast knowledge and experience (Danneels, 2016). The way questionnaires in the current study have been administrated was a self-completion questionnaire. It allows respondents to finish the questionnaire at their own pace. In the head of the questionnaire, the research topic is brought "The impact of applying strategic planning on SMEs' performance and evaluating strategic planning models using the fuzzy best worst method". Also, a short explanation of the goal, reassurances regarding the confidentiality and anonymity of the data collected, and the voluntary nature of the participant were provided. The questionnaire has two parts. Bio-data is covered in the first part and in the second part of the questionnaire, I incorporated 65 questions. All questions in the questionnaire are closed questions since the questions' closed structure

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ensures that I receives data that is suitable for quantification and comparison (Denscombe, 2014).

The English questionnaire was translated into Persian once the final draft was prepared, and subsequently sent to two reviewers for verification of the accuracy of the translation. The reviewers were asked to provide feedback on the level of simplicity and complexity of the questions. Additionally, they were asked to provide feedback on the format and amount of time needed to complete the entire questionnaire. They expressed satisfaction with the questionnaire in their feedback.

It took roughly 8 to 10 minutes to complete the questionnaire. The survey tools were pilot examined among Ph.D. students. I collected data within two months of receiving the pertinent approvals.

Using the variables in my study, table 3.1 is provided to show a brief description of each variable.

Table 3.1 Conceptualization and Operationalization of the Variables Used in the Study

	Variable	**Description**	**Measure by question(s) No:**
Performance	Financial Performance	The performance of organization in sales/revenue growth rate, market share, profit growth in comparison to the other competitors	34 - 37 in PART **II**
	Non-Financial Performance	The performance of organization in satisfying and retention of employee	38 - 39 in PART **II**
	Engagement with Strategic Planning	The organization engage in formal strategic planning.	9 -12 in PART **I**
	Strategic Planning Activities	The organization setting up mission statement, business aims, goals and objectives, provision for alternative strategies as well as having control systems.	1-4, 7-10, 16-17, 20-23, 25-27, 28-30 in PART **II**
Organization features	Organization Age	The years the organization has been working	5 in PART **I**
	Organization Size	The number of employees working in the organization	7 and 8 in PART **I**
	Business Objectives	The objectives that an organization determine in the long term or short term for its business like sales income, capital growth, market share, international expansion	62 - 65 in PART **II**
	Planning Sophistication	The level of complexity, depth, and effectiveness of the strategic planning processes and activities employed by an organization.	5-6 , 11-15, 18-19, 24, 31-33 in PART **II**
	Cultural Inclusion	The cultural identities, traditions, and experiences in the organization are acknowledged, comprehended, and valued.	15 in PART **I** and 41-45 in PART **II**
	Faith/Religious Inclusion	The role of individuals' faith/religion in strategic planning.	13-14 in PART **I** and 40 in PART **II**

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	Innovativeness	The ability and willingness of an organization to create, develop, and implement new ideas, products, processes, or business models to gain a competitive advantage and drive growth.	57 to 61 in PART **II**
Flexibility	Operational Flexibility	Organization flexibility in production/services by changing market demand.	46 - 47 in PART **II**
	Financial Flexibility	Organization flexibility in financial resource.	48 - 50 in PART **II**
	Structural Flexibility	Organization flexibility in organization structure.	51 - 53 in PART **II**
	Technical Flexibility	Organization technological flexibility.	54 - 56 in PART **II**

The basic beginning point for the identification of potential participants in this research was the list of manufacturing SMEs that was taken from the Iran Small Industrial Park Organization. A questionnaire (paper and online) was prepared and sent to the SMEs through varied strategies using emails, short messaging services, and letters. The questionnaire was sent to 500 SMEs and announced to them that the questionnaire could be filled out by owners, managers, or experts who know the strategic planning of the SMEs. While a good number of the respondents in the SMEs accepted and answered the questionnaire electronically or on paper, some others received the questionnaire and replied that they will respond at a later time. I sent reminder emails to those respondents who did not fill out the questionnaire within a week. Finally, I received 320 responses which show a good percentage of response rate (60%). I removed 20 questionnaires out of 320 because they were not fully completed or had double responses in some parts. Using Excel and SPSS, the obtained data were organized according to the coded values assigned.

In the second part of my study, the structured interview aimed to question owners and managers of Iranian manufacturing SMEs to collect required data on the topic of prioritizing strategic planning models using the fuzzy best worst-method. Due to time limitations and resource constrain, the structured interview was done only in the province of Esfahan which is one of the biggest industrial centers in Iran. The managers/owners of the manufacturing SMEs who are well-known in the subject of my research are identified. I sent my request via email to the SMEs to have an appointment and interview the managers /owners of the SMEs. Four organizations replied that their managers/owners of the SMEs accepted to do interview. After interviewing the managers/owners of the SMEs, I asked the managers to introduce other owners/managers of the SMEs who are completely familiar with the subject. Finally, I succeeds in interviewing thirteen managers. Questions and topics are prepared to be asked during the interview in a specific order. The structured interview has two parts. The first part includes four questions covering the determination of best and worst evaluation criteria and

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comparing the best criteria to others and others to the worst. In the second part, six questions are asked regarding the coverage of evaluation criteria by a strategic planning model. Before the formal start of each interview, I tried to have an informal discussion and pleasantry with the interviewee to break the ice of the meeting. I started then outlining the study's history in verbal form. This allowed the participant to gradually enter conversations concerning the study area until they reached debates about strategic planning models and evaluation criteria. Then, sheet of the assessment criteria description was given to the participant and asked them to read it carefully. When they read the description completely, they were asked the questions of the first sections.

I gave a broad overview of the survey and an explanation of the ethical procedure used to guarantee the anonymity and confidentiality of the information and interviews both during and after the interview.

3.1.7 Validity and Reliability

Since I borrowed the measures from Brown (2008), with only minor adaptations, the current study acknowledges that the reliability and validity of the measures subsist and can be used in the current research. However, I calculated the reliability and validity. The results are shown in the next chapter.

When I was designing the survey instruments, the validity was also checked. My supervisor, an experienced professor, gave both the questionnaire instruments and structured interview a critical eye to make sure they were appropriate for collecting the desired data.

In line with Brown (2008) I also calculated Cronbach alpha in the current study which shows good reliability (≥ 0.7) of the research.

3.1.8 Study Population

The application of strategic planning is the main topic of this study, along with how it affects the performance of SMEs**.** Iran is a large country with an estimated population of 84.4 million people (SCI, 2022) and 31 provinces. According to Iran Small Industries and Industrial Park Organization (ISIPO), around 33800 SMEs (enterprises less than 150 employees) are operating in Iran. There are also some other SMEs that are under construction or just licensed. Due to the large number of SMEs, it is not possible to survey all small and medium-sized enterprises in the country. Accordingly, this study, in the first place, narrows the research focus on strategic planning and SME performance and then narrows the study focus to Iranian SMEs operating in the manufacturing sector.

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With regard to SCI (2020), 30% of SMEs are operating in the manufacturing sector. In line with the overall policy of the Iranian government, there is a need to advance the manufacturing and industrial segment of SMEs as they have a positive impact on economic expansion, job creation, inflation reduction, per capita income growth, public welfare enhancement, and mitigation of sanctions. Thus, the target sample is selected from the manufacturing-related sector.

Owners, managers, and specialists from SMEs who know strategic planning, make strategic decisions, and perform planning activities for their enterprises are the survey's targeted participants in this study. As a result, it makes sense to focus on this group of individuals as the best candidates to offer solutions to their organizations' planning procedures.

3.1.9 Sampling

I used simple random sampling in the first part of the study. The sample was identified through the ISIPO database. There was a list of SMEs and I used an online random number generation to select the samples. I gathered contact information for the selected companies, including phone numbers, email addresses, and physical addresses. Then I contacted each of the selected enterprises.

Using Partial Least Square (PLS) - structure equation modeling (SEM) for the analysis of data in the current study, Memon et al. (2020) proposed that a sample of 160-300 valid observations is typically well suited for multivariate statistical analysis, Chin and Newsted (1999) and Reinartz et al. (2009) posited that smaller samples can definitely be used with PLS-SEM. However, the situation in which small sample sizes are appropriate depends on the characteristics of the population (Rigdon, 2016). Kock and Hadaya (2018) proposed inverse square root method to calculate sample size. In addition, the 10-times rule method is suggested by Hair et al. (2011); Peng and Lai (2012); Goodhue et al. (2012). They posited that the sample size should be more than 10-times the maximum number of inner or outer model linkage pointing at any latent variable in the model. Similar previous studies (Stewart, 2002; Brown, 2008) show that the sample size is between 100-120 for generalization of results.

The standard equation (Eq. 3.1) utilized to calculate the minimum required sample size in the research using PLS-SEM is:

$$N = \frac{10 \times max\{m_1. \dots .m_i\}}{R^2} \qquad \text{Equation 3.1}$$

where:

N: minimum sample size

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m_1, …, m_i: the number of inner or outer model linkage pointing at any latent variable in the model.

R^2: the maximum amount of variance in the endogenous construct explained by the exogenous constructs (Chin and Newsted, 1999).

In my study, the maximum number of m_i=20 and the maximum R^2=0.930. So, the minimum number of sample size N=215.

Expert sampling and snowball sampling are used in the second part of my study since I targeted to interview managers and owners of manufacturing SMEs who know strategic planning, perceive research questions, and have enough (at least 5 years) experience to answer the related questions properly. Interviewing the first four SMEs' managers/owners, I asked them to introduce other managers/owners to do more interviews.

Although the results obtained through expert sampling may lack statistical generalizability to a wider population, they remain pertinent and applicable to analogous organizational settings or situations involving critical strategic planning and fuzzy decision-making. Carvalho et al. (2019) mentioned that expert sampling does not necessitate large sample sizes, given that the emphasis lies on the quality and pertinence of the experts' knowledge rather than statistical generalization. A typical range of 10-30 experts is often utilized for the sample size.

3.1.10 Analysis of Data

Quantitative data make up the data collected for this particular study. The collected data in the first and second parts of the study were entered into the excel spreadsheet. The collected data were sorted and then analysis started by identifying and analyzing the valid samples. To investigate the research questions in the first part, structural equation modeling, Analysis of Variance (ANOVA), and regression analysis are applied. Smart PLS software and the Partial Least Square (PLS) method, which is variance-based, is used. PLS- SEM have been recently used by some scholars Nitzl (2016), Richter et al. (2016), Boubker et al. (2021), Gimeno-Arias et al. (2021) in management research.

Fuzzy Best Worst Method (FBWM) and Lingo 18.0 software is applied to analyze the collected data in the second part of the study. In this study, the Best Worst Method as an MCDM technique is successfully combined with fuzzy set theory, which conveys uncertainty in human judgments, to produce more sensitive, tangible, and realistic findings. FBWM is a Multi-Criteria Decision-Making technique that could be applied in solving decision-making problems. The technique is based on the decision maker's judgments by using fuzzy linguistic

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terms. According to the literature review, six criteria (formality, clarity, measurability, objectivity, coverage, and consistency) were determined to evaluate six strategic planning models (Bryson, Wright, Wheelen and Hunger, Hill and Jones, Bowman and Asch, and F.R. David) in Iranian manufacturing SMEs. Then, based on the decision maker's judgment, a strategic planning model was recommended for manufacturing SMEs in the province of Esfahan.

3.2 Descriptive Statistics

In this section, the demographic characteristics (gender, age, academic qualification) of the individuals participating in the first part of my research are described. The gender of 34% of respondents in the survey are female and 66% are male. Age and education qualification characteristics are shown in figures 3.2 and 3.3.

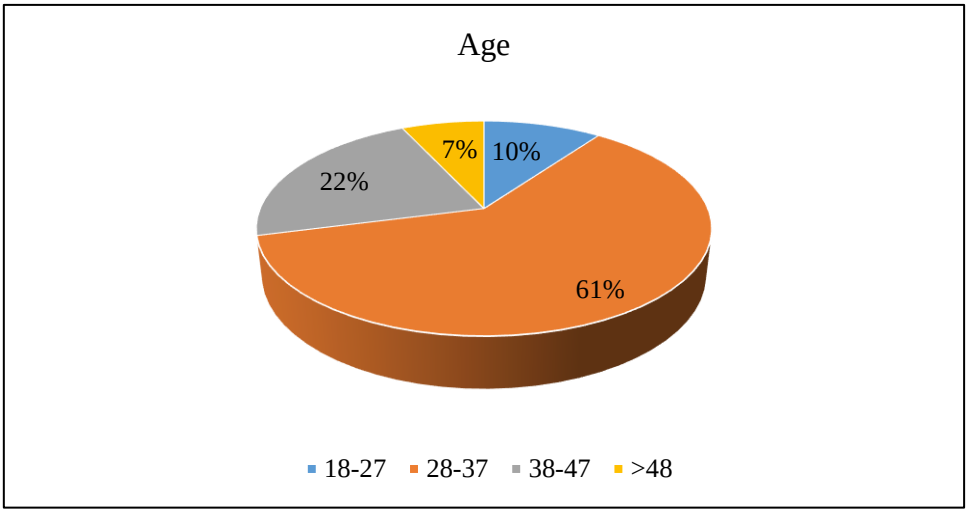

Figure 3.2 Demographic Characteristic (Age)

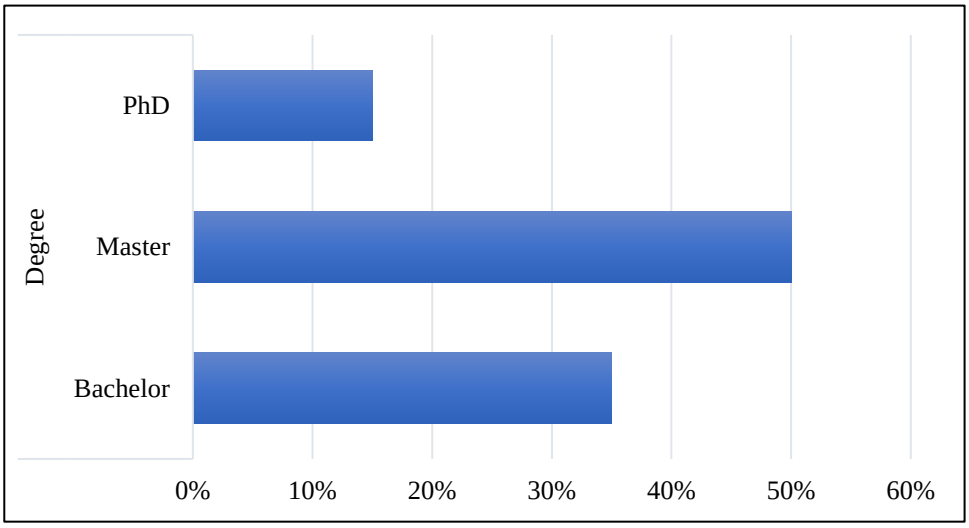

Figure 3.3 Demographic Characteristic (Education Qualification)

The results are shown that 66% of participants in the study are men that 61% of them are 28-37 years old. The education qualification of the majority of respondents (50 %) is master

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degree. Below, the characteristics of the organizations participating in the research are described by the figures (3.4 - 3.8) and table 3.4.

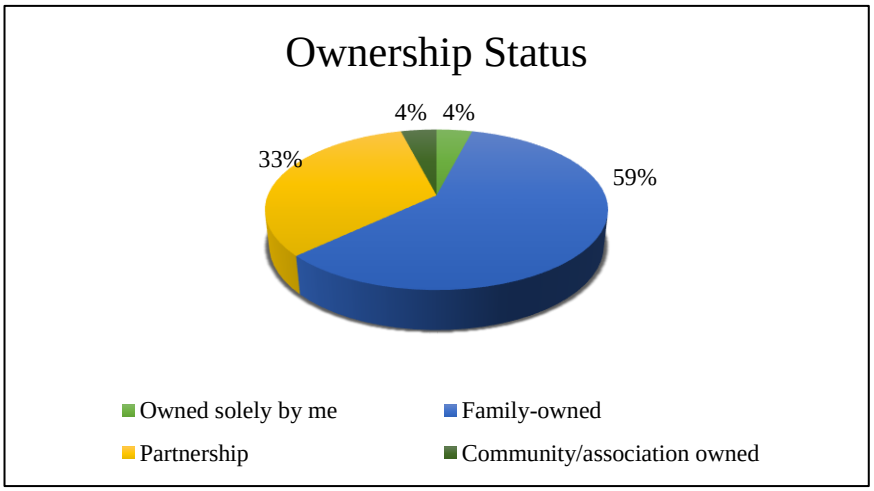

Figure 3.4 Organization Characteristic (Ownership Status)

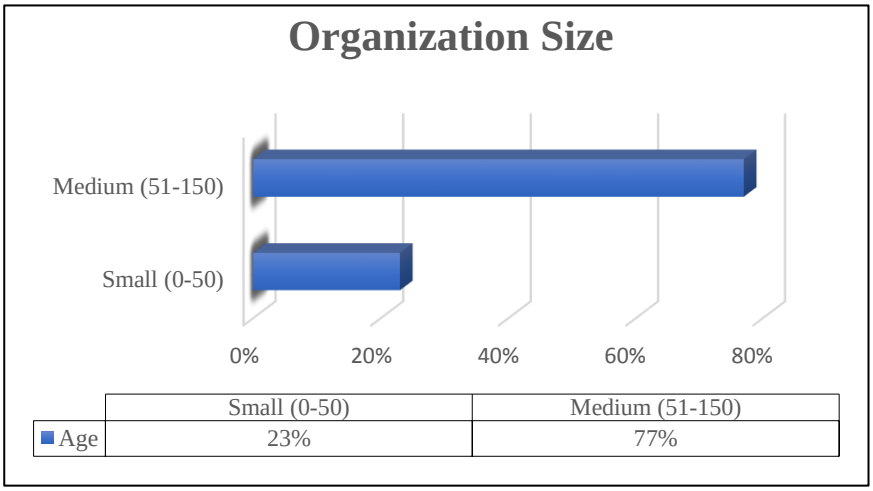

Figure 3.5 Organization Size

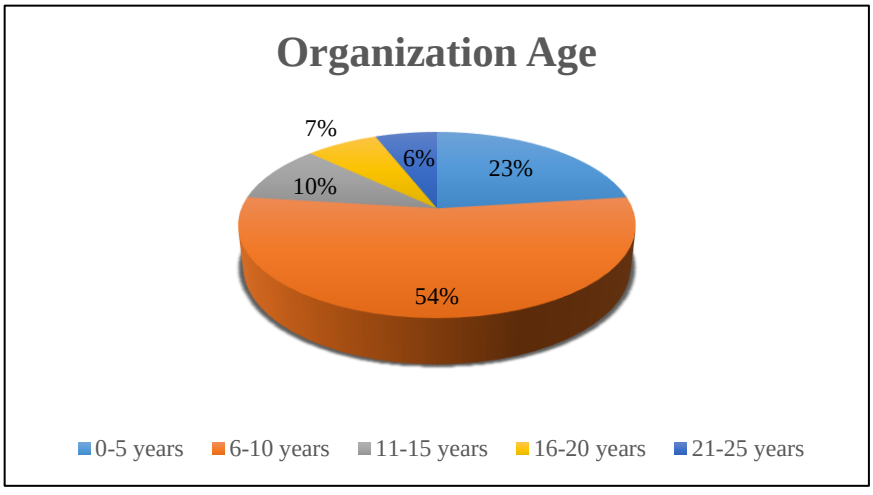

Figure 3.6 Organization Age

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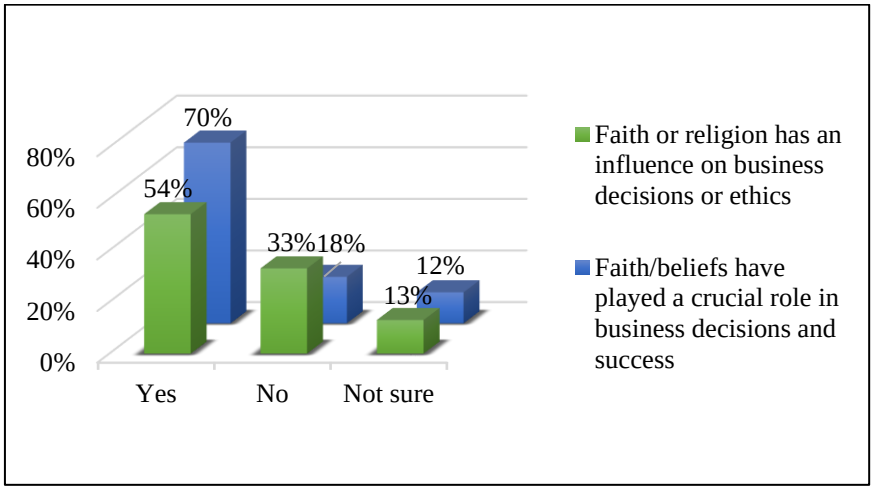

Figure 3.7 The Role of Faith/Religion/Belief in the Business Decision of the Organizations

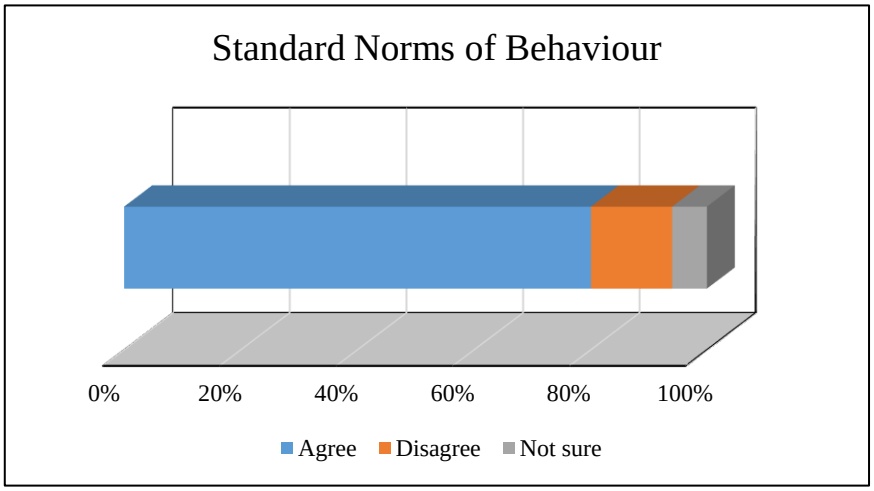

Figure 3.8 The Importance of Standard Norms of Behavior in Organizations

The results in the above figures are shown that 177 out of 300 organizations are owned by families. More than 70% of organizations that participated in my study are medium enterprises. Most of the enterprises (54%) are 6-10 years old.

Faith or religion has an impact on business decisions in most organizations (54%) and plays a crucial role in business decisions and the success of 70% of organizations. Nearly 80% of the organizations participating in my study agreed that the standard patterns of behavior in society are important to their business.

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Table 3.2 Descriptive Statistics of Organization Characteristics Having a Strategic Planning

		Valid Percent %
Type of Plan	Structured strategic plans	57.8%
	Structured operational plans	26.7%
	Intuitive plans (daily)	11.1%
	Unstructured plans	4.4%
The Period Covers Strategic Plans	Less than 1 year	28.9%
	1-2 years	37.8%
	More than 3 years	33.3%
The Main Objective in Mind When Drawing a Business Plan	Capital growth	15%
	Sales earning	34%
	Highest market share	36%
	International expansion	15%
Responsible for Developing Strategic Plans	Owner	27%
	Chief Executive Officer (CEO)	31%
	A strategic planning committee	39%
	A centralized planning department	3%
Using Consultants in Developing Strategic Plans	Yes	41%
	No	59%

It was observed that the majority of the organizations (57.8%) have structured strategic plans. The main objective of 36% of organizations participating in my study is to gain the highest market share. The majority of the organizations (39%) develop their strategic plans through the planning committee and less than 50% use national and international consultants while developing a strategic plan.

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4. Results Analysis

Statistics and data analysis are divided into descriptive and inferential sections. In the descriptive statistics section, with the help of frequency tables and figures, not only the data are summarized and the obtained information could be seen easier, but also the study population is described. Although the description of the conditions prevailing in society can lead to analyses, to provide a definite result, stronger evidence is needed which is done through appropriate tests in inferential statistics. In the previous chapter, section 3.2, the information obtained through the questionnaire is described using tables and figures (descriptive statistics). In this chapter, I described the inferential statistics. The research hypotheses and questions are examined and analyzed using appropriate hypotheses tests and modeling techniques. In the second part, the results obtained through the structured interview are analyzed.

Research questions and hypotheses were formulated, and survey instruments were created to collect data for the study to empirically assess the effect of applying strategic planning on performance, and to evaluate strategic planning models in Iranian manufacturing SMEs.
This chapter includes an analysis and discussion of the numerous variables in accordance with the study's goals, questions, and hypotheses. The results and analysis from all of the collected data are presented in this chapter.

4.1 Correlation Analysis and Regression Analysis

The current study was intended to clarify the impact of applying strategic planning on the performance of Iranian manufacturing SMEs in the first section. The prior studies emphasized the positive correlation between strategic planning and a firm's performance (Campbell, 2010; Wilson and Eilertsen, 2010; Vargo and Seville, 2011; Aldehayyat and Twaissi, 2011; Donkor et al., 2018; Haleem et al., 2019; Maldeniya et al., 2021; Thaher and Jaaron, 2022). For the numerous relationship in this context, hypotheses were established, and they will be examined for any potential connections.

This study expands on earlier research on developing countries in general and Iran in particular.

In the previous chapter, all the variables that should be measured and hypothesized are listed.

With reference to Babbie (2010), the degrees to which the test statistics deviate from the null hypothesis can be described as the significance test. He put forward that the statistical significance is explained by the probability of varying degrees at which the sampling

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distribution deviates from the sample statistics on the curve, also known as the probability values (p-value). The null and alternative hypotheses are accepted or rejected based on a comparison of the p-value and significance level (α). The value of observing an effect in a sample is measured by the p-value. The standard cutoff point for affirming statistical significance is a p-value<0.05.

4.1.1 Effect Confirmation and Hypothesis Testing Using SEM

H1- There is a considerable relationship between applying strategic planning and Iranian SMEs' performance.

To test this hypothesis, firstly, the assumptions in the model should be examined. If the model fit, then, the inference could be done.

Examination of Assumptions (H1)

There are three steps in examining assumptions using Smart PLS software for data analysis and model fit. The steps are included: evaluation of the measurement model (validity and reliability), structural model assessment, and general evaluation. Each stage will be examined separately. If the model is confirmed by the indices in each step, the hypothesis could be investigated.

Investigating The Indices In The Structural Model Of Applying Strategic Planning and Its Impact on Organization Performance.

To examine the impact of applying strategic planning on organization performance, a conceptual model is shown in figure 4.1.

Evaluation of Measurement Model (Validity and Reliability)

To evaluate the measurement model, reliability indices (Cronbach's alpha, Composite Reliability, Loadings), convergent validity, and divergent validity are used. Cronbach's alpha is a classic index to measure internal reliability and consistency. Values greater than 0.7 indicate that there is a high determining variance between one variable and its related questions (Cronbach, 1951). The values in table 4.1 show the acceptable reliability of variables in the model. Composite reliability is a modern index in comparison to Cronbach's alpha. The reliability of variables is calculated according to the loadings of questions. The values greater than 0.7 are desirable for this index (Nunnally, 1978). It is clear that the composite reliability of the latent variables, introduced in the model, indicates the strong reliability of extracted factors. Convergent validity shows the correlation degree of one variable and its questions. The higher

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the correlation, the better fit. Convergent validity is checked by Average Variance Extracted (AVE). If the value of AVE>0.5, convergent validity is acceptable (Fornell and Larcker, 1981). As is shown in table 4.1, the AVE for all the latent variables in the model is greater than 0.5.

Table 4.1 Cronbach's Alpha Coefficient, Composite Reliability, and Convergent Validity of Each variable

Variables	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Applying Strategic Planning	0.977	0.979	0.573
Business Objectives	0.871	0.912	0.722
Engagement With Strategic Planning	0.907	0.933	0.741
Flexibility	0.877	0.900	0.561
Flexibility: Financial	0.860	0.914	0.781
Flexibility: Operational	0.918	0.961	0.924
Flexibility: Structural	0.849	0.909	0.769
Flexibility: Technical	0.887	0.930	0.816
Innovativeness	0.897	0.924	0.710
Planning Sophistication	0.955	0.961	0.732
Strategic Planning Activities	0.974	0.976	0.674
Performance	0.827	0.876	0.818
Performance: Financial	0.756	0.845	0.583
Performance: Non-financial	0.772	0.898	0.814

Another index that confirms reliability, is assessing factor loadings. It could be obtained by calculating the correlation value of questions related to one variable and that variable itself. If the values ≥ 0.4 the reliability of the model is acceptable (Hulland, 1999).

Note: As it is mentioned at the beginning of this section, the measurement models could be evaluated through reliability indices, convergent validity, and divergent validity. The Fornell-Larcker matrix is used to examine divergent validity. Using all of the related questions in the questionnaire, it is observed that the result of divergent validity is not acceptable for planning sophistication. To reach an acceptable divergent validity, the author removed some of the related questions (numbers 5,6,19, and 24 in the part II questionnaire) from the whole analysis of this study. The following analyses were done after removing the questions.

Table 4.2 Questions Lodgings in the Model of Applying Strategic Planning and Its Impact on Organization Performance

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Outer Model	*Direct Effects*	*T Statistics*	*P Values*	*Confidence Interval*	
				2.5%	**97.5%**
q12-part I <- Engagement of strategic planning	0.625	8.240	0.000*	0.455	0.756
q9.1-part I <- Engagement of strategic planning	0.944	63.945	0.000*	0.912	0.969
q9.2-part I <- Engagement of strategic planning	0.843	25.425	0.000*	0.768	0.899
q9.3-part I <- Engagement of strategic planning	0.892	40.191	0.000*	0.846	0.933
q9-part I <- Engagement of strategic planning	0.957	80.214	0.000*	0.930	0.976
q1 <- Strategic planning activities	0.875	31.206	0.000*	0.813	0.922
q10 <- Strategic planning activities	0.728	13.014	0.000*	0.605	0.826
q11 <- Planning sophistication	0.864	26.516	0.000*	0.785	0.915
q12 <- Planning sophistication	0.847	20.371	0.000*	0.749	0.910
q13 <- Planning sophistication	0.883	30.954	0.000*	0.814	0.924
q14 <- Planning sophistication	0.861	23.180	0.000*	0.771	0.915
q15 <- Planning sophistication	0.882	34.387	0.000*	0.820	0.919
q16 <- Strategic planning activities	0.857	32.615	0.000*	0.799	0.900
q17 <- Strategic planning activities	0.803	19.260	0.000*	0.707	0.873
q18 <- Planning sophistication	0.836	27.731	0.000*	0.772	0.889
q2 <- Strategic planning activities	0.754	13.079	0.000*	0.626	0.853
q20 <- Strategic planning activities	0.861	31.548	0.000*	0.802	0.909
q21 <- Strategic planning activities	0.821	23.016	0.000*	0.742	0.882
q22 <- Strategic planning activities	0.800	18.072	0.000*	0.703	0.874
q23 <- Strategic planning activities	0.796	13.262	0.000*	0.664	0.894
q25 <- Strategic planning activities	0.842	27.974	0.000*	0.778	0.895
q26 <- Strategic planning activities	0.854	31.306	0.000*	0.793	0.901
q27 <- Strategic planning activities	0.813	21.542	0.000*	0.730	0.877
q28 <- Strategic planning activities	0.841	24.832	0.000*	0.764	0.897
q29 <- Strategic planning activities	0.899	49.521	0.000*	0.858	0.929
q3 <- Strategic planning activities	0.727	10.126	0.000*	0.567	0.846
q30 <- Strategic planning activities	0.846	27.938	0.000*	0.781	0.898
q31 <- Planning sophistication	0.820	26.006	0.000*	0.751	0.872
q32 <- Planning sophistication	0.861	37.703	0.000*	0.813	0.901
q33 <- Planning sophistication	0.845	38.771	0.000*	0.801	0.887
q34 <- Performance: financial	0.747	11.724	0.000*	0.604	0.850
q35 <- Performance: financial	0.577	4.031	0.000*	0.227	0.783
q36 <- Performance: financial	0.869	30.355	0.000*	0.805	0.917
q37 <- Performance: financial	0.828	20.944	0.000*	0.737	0.891
q38 <- Performance: non-financial	0.898	31.888	0.000*	0.831	0.941
q39 <- Performance: non-financial	0.906	40.434	0.000*	0.856	0.944
q4 <- Strategic planning activities	0.789	15.695	0.000*	0.675	0.870
q46 <- Flexibility: operational	0.956	43.091	0.000*	0.900	0.985
q47 <- Flexibility: operational	0.966	106.797	0.000*	0.950	0.985
q48 <- Flexibility: financial	0.909	38.907	0.000*	0.854	0.945
q49 <- Flexibility: financial	0.881	21.967	0.000*	0.782	0.936
q50 <- Flexibility: financial	0.861	25.451	0.000*	0.783	0.915

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Outer Model	*Direct Effects*	*T Statistics*	*P Values*	*Confidence Interval*	
				2.5%	**97.5%**
q51 <- Flexibility: structural	0.843	17.677	0.000*	0.729	0.910
q52 <- Flexibility: structural	0.862	20.470	0.000*	0.766	0.924
q53 <- Flexibility: structural	0.923	52.816	0.000*	0.884	0.953
q54 <- Flexibility: technical	0.871	24.036	0.000*	0.792	0.931
q55 <- Flexibility: technical	0.937	61.142	0.000*	0.908	0.960
q56 <- Flexibility: technical	0.899	38.347	0.000*	0.849	0.939
q57 <- Innovativeness	0.800	13.117	0.000*	0.657	0.893
q58 <- Innovativeness	0.884	27.763	0.000*	0.810	0.934
q59 <- Innovativeness	0.845	18.515	0.000*	0.742	0.919
q60 <- Innovativeness	0.890	30.290	0.000*	0.822	0.936
q61 <- Innovativeness	0.790	15.665	0.000*	0.675	0.868
q62 <- Business objectives	0.879	25.344	0.000*	0.796	0.933
q63 <- Business objectives	0.800	10.723	0.000*	0.616	0.906
q64 <- Business objectives	0.907	43.244	0.000*	0.859	0.942
q65 <- Business objectives	0.807	12.039	0.000*	0.644	0.904
q7 <- Strategic planning activities	0.863	32.992	0.000*	0.805	0.907
q8 <- Strategic planning activities	0.814	22.193	0.000*	0.732	0.875
q9 <- Strategic planning activities	0.814	19.750	0.000*	0.723	0.885

*P Value <0.05

As it is demonstrated in table 4.2, loadings of most questions (standard estimates) are greater than 0.7 which shows a desirable value. To evaluate the significance of factor loads in all paths, the t-statistic is used. If the value of t >1.96, it shows there is a significant relationship between the question and the relevant variable, and as a result, the model is confirmed. The model in my study is confirmed since all the questions show significant t (t >1.96). Therefore, they are statistically significant and the presence of all questions in the model is required. Generally, all the questions in the model of applying strategic planning and its impact on organization performance, are acceptable.

Divergent validity is the extent to which one variable is correctly distinguished from other variables. It indicates that one variable is unique. One of the methods for examining divergent validity is the Fornell-Larcker matrix. In this method, the degree of correlation between the questions of one variable is compared with other variables. If the values on the principal diameter, which are equal to the square root of AVE, are higher than the correlation between them (sub-diameter values), it indicates a suitable divergent validity and a good fit for the measurement model. According to the below table 4.3, it can be seen that in the studied

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model, the values on the principal diameter are higher than the sub-diameters and the model has good divergent validity.

Table 4.3 Assessing Divergent Validity by the Fornell-Larcker Matrix Method in the Model of Applying Strategic Planning and Its Impact on Organization Performance

	BO	ESP	F(f)	F(o)	F(s)	F(t)	I	Per(f)	Per(n-f)	Soph	Acti
BO*[3]	0.850										
ESP	0.321	0.861									
F(f)	0.560	0.303	0.884								
F(o)	0.398	0.023	0.516	0.961							
F(s)	0.317	0.200	0.542	0.484	0.877						
F(t)	0.302	0.411	0.418	0.253	0.239	0.903					
I	0.679	0.342	0.670	0.519	0.509	0.548	0.843				
Per(f)	0.542	0.314	0.641	0.446	0.543	0.381	0.588	0.763			
Per(n-f)	0.383	0.344	0.466	0.428	0.631	0.243	0.428	0.647	0.902		
soph	0.438	0.673	0.431	0.281	0.489	0.404	0.503	0.469	0.552	0.856	
Acti	0.585	0.662	0.558	0.308	0.555	0.457	0.659	0.574	0.562	0.816	0.821

Another index for evaluating the divergent validity of the measurement model is the Cross-Loadings Matrix. In the cross-loading method, the correlation of one variable with itself and the correlation between the questions of one variable with other variables are compared. If the correlation between a question and another variable is greater than the correlation between that question and its variable, the divergent validity of the model is questioned (Henseler et al., 2009).

The results in table 4.4 represent that the correlation between questions and their variables is greater than the correlation of questions with other variables. It shows the measurement model, the impact of applying strategic planning on organization performance, is valid.

Table 4. 4. Assessment of Divergent Validity By Cross-Loading Matrix Method In The Model of Applying Strategic Planning And Its Impact On Organization Performance

	BO	ESP	F(f)	F(o)	F(s)	F(t)	I	Soph	Acti	Per (f)	Per (n-f)
q12-part I	0.248	0.625	0.160	-0.033	0.139	0.225	0.284	0.461	0.370	0.219	0.198
q9.1-part I	0.279	0.944	0.283	0.012	0.201	0.360	0.311	0.643	0.637	0.280	0.320
q9.2-part I	0.211	0.843	0.310	0.024	0.219	0.324	0.231	0.540	0.551	0.286	0.357
q9.3-part I	0.313	0.892	0.273	0.113	0.195	0.431	0.327	0.616	0.604	0.311	0.360
q9-part I	0.326	0.957	0.262	-0.033	0.112	0.399	0.321	0.617	0.643	0.255	0.237
q1	0.465	0.663	0.424	0.193	0.435	0.388	0.554	0.643	0.875	0.465	0.481

[3] BO: Business objectives, ESP: Engagement with strategic planning, F(f): Flexibility(financial), F(o): Flexibility(operational), F(s): Flexibility(structural), F(t): Flexibility(technical), I: Innovativeness, Per(f): Performance(financial), Per(n-f): Performance(non-financial), Soph: Planning sophistication, Acti: Strategic planning activities

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	BO	ESP	F(f)	F(o)	F(s)	F(t)	I	Soph	Acti	Per (f)	Per (n-f)
q10	0.452	0.517	0.435	0.388	0.485	0.318	0.515	0.615	0.728	0.500	0.465
q11	0.276	0.613	0.262	0.186	0.271	0.359	0.293	0.864	0.559	0.334	0.427
q12	0.257	0.609	0.248	0.169	0.257	0.242	0.270	0.847	0.517	0.285	0.433
q13	0.267	0.643	0.282	0.190	0.291	0.333	0.317	0.883	0.554	0.329	0.443
q14	0.317	0.569	0.309	0.263	0.361	0.297	0.408	0.861	0.559	0.315	0.426
q15	0.287	0.617	0.357	0.211	0.348	0.331	0.375	0.882	0.581	0.358	0.478
q16	0.432	0.671	0.414	0.137	0.388	0.423	0.535	0.748	0.857	0.374	0.437
q17	0.428	0.568	0.407	0.178	0.321	0.393	0.466	0.701	0.803	0.394	0.381
q18	0.442	0.556	0.426	0.311	0.495	0.374	0.517	0.836	0.868	0.397	0.450
q2	0.373	0.471	0.405	0.100	0.482	0.407	0.428	0.591	0.754	0.402	0.399
q20	0.541	0.532	0.486	0.359	0.528	0.405	0.636	0.655	0.861	0.500	0.496
q21	0.557	0.444	0.489	0.382	0.535	0.385	0.652	0.681	0.821	0.525	0.511
q22	0.587	0.460	0.490	0.401	0.468	0.379	0.648	0.656	0.800	0.494	0.493
q23	0.534	0.511	0.404	0.272	0.439	0.276	0.558	0.635	0.796	0.506	0.426
q25	0.439	0.460	0.483	0.329	0.636	0.307	0.549	0.769	0.842	0.538	0.583
q26	0.449	0.631	0.418	0.141	0.453	0.416	0.548	0.735	0.854	0.394	0.429
q27	0.430	0.563	0.471	0.173	0.411	0.412	0.477	0.690	0.813	0.417	0.416
q28	0.573	0.589	0.511	0.178	0.411	0.399	0.539	0.721	0.841	0.502	0.432
q29	0.518	0.599	0.536	0.258	0.427	0.453	0.579	0.756	0.899	0.539	0.456
q3	0.350	0.406	0.404	0.289	0.361	0.407	0.439	0.480	0.727	0.405	0.405
q30	0.467	0.538	0.545	0.295	0.523	0.408	0.519	0.716	0.846	0.535	0.499
q31	0.462	0.528	0.452	0.277	0.531	0.363	0.479	0.820	0.807	0.476	0.526
q32	0.465	0.523	0.446	0.241	0.547	0.391	0.549	0.861	0.818	0.511	0.516
q33	0.484	0.552	0.439	0.265	0.529	0.374	0.542	0.845	0.843	0.513	0.508
q34	0.476	0.256	0.481	0.398	0.493	0.282	0.377	0.417	0.470	0.747	0.488
q35	0.389	0.221	0.569	0.235	0.294	0.282	0.358	0.287	0.337	0.577	0.222
q36	0.491	0.262	0.470	0.383	0.402	0.276	0.509	0.376	0.499	0.869	0.564
q37	0.322	0.231	0.500	0.330	0.456	0.336	0.531	0.353	0.437	0.828	0.619
q38	0.270	0.382	0.379	0.358	0.518	0.250	0.383	0.516	0.479	0.563	0.898
q39	0.418	0.242	0.460	0.413	0.620	0.189	0.389	0.480	0.534	0.604	0.906
q4	0.502	0.396	0.433	0.288	0.418	0.346	0.554	0.572	0.789	0.490	0.410
q46	0.325	-0.004	0.444	0.956	0.454	0.174	0.450	0.222	0.232	0.360	0.394
q47	0.434	0.044	0.542	0.966	0.475	0.303	0.543	0.312	0.352	0.489	0.427
q48	0.572	0.314	0.909	0.550	0.483	0.359	0.619	0.418	0.528	0.551	0.439
q49	0.407	0.259	0.881	0.352	0.380	0.373	0.498	0.350	0.449	0.483	0.270
q50	0.495	0.228	0.861	0.453	0.564	0.377	0.650	0.370	0.498	0.658	0.511
q51	0.305	0.262	0.503	0.364	0.843	0.157	0.423	0.397	0.448	0.463	0.579
q52	0.224	0.097	0.357	0.441	0.862	0.168	0.334	0.402	0.475	0.415	0.535
q53	0.302	0.168	0.551	0.465	0.923	0.288	0.560	0.482	0.531	0.542	0.551
q54	0.200	0.361	0.274	0.184	0.170	0.871	0.428	0.372	0.346	0.274	0.169
q55	0.292	0.372	0.368	0.238	0.238	0.937	0.537	0.408	0.450	0.360	0.218
q56	0.315	0.380	0.471	0.254	0.231	0.899	0.509	0.320	0.432	0.385	0.261
q58	0.439	0.349	0.440	0.308	0.300	0.607	0.800	0.385	0.506	0.402	0.225

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	BO	ESP	F(f)	F(o)	F(s)	F(t)	I	Soph	Acti	Per (f)	Per (n-f)
q57	0.587	0.269	0.561	0.515	0.449	0.490	0.884	0.432	0.582	0.480	0.393
q59	0.582	0.236	0.588	0.479	0.477	0.453	0.845	0.410	0.583	0.477	0.354
q60	0.581	0.298	0.568	0.445	0.513	0.436	0.890	0.423	0.567	0.543	0.441
q61	0.660	0.296	0.656	0.426	0.390	0.335	0.790	0.468	0.534	0.568	0.377
q62	0.879	0.157	0.534	0.401	0.262	0.240	0.589	0.276	0.453	0.434	0.262
q63	0.800	0.344	0.372	0.229	0.249	0.148	0.483	0.373	0.440	0.369	0.312
q64	0.907	0.277	0.540	0.395	0.267	0.323	0.640	0.393	0.563	0.555	0.388
q65	0.807	0.309	0.448	0.319	0.297	0.297	0.581	0.434	0.517	0.464	0.328
q7	0.540	0.622	0.482	0.197	0.412	0.351	0.585	0.660	0.863	0.493	0.496
q8	0.470	0.511	0.503	0.268	0.553	0.243	0.492	0.617	0.814	0.520	0.537
q9	0.476	0.676	0.414	0.236	0.418	0.386	0.520	0.708	0.814	0.432	0.468

Structural Model Evaluation

To evaluate the structural model, the coefficient of determination R^2 and Q^2 are used. R^2 is used to connect the measurement and structural part of structural equation modeling. It shows the effect of an exogenous variable on an endogenous variable. The values 0.19, 0.33, and 0.67 indicate weak, medium, and strong values in the coefficient of determination, respectively (Chin, 1998). Hensler et al. (2009) stated that if one endogenous variable is affected by only one or two exogenous variables, the value of R^2 >0.33 shows a strong relationship between the exogenous variables and the endogenous variable. The Q^2 index is introduced by Stone and Geisser. It determines the predictive power of the model. Hensler et al. (2009) determined the value predictive power of the model as 0.02, 0.15, and 0.35. A value of 0.02 indicates poor predictive power. Table 4.5 indicates the determination coefficient for the endogenous variables defined in the model of applying strategic planning and its impact on the organization's performance, is above the average. Based on the coefficient of determination index, it can be concluded that the model is acceptable. To give an example, the determination of the coefficient in planning sophistication is 0.93. It means, that the variance of applying strategic planning can explain 93% of planning sophistication changes. In other words, 93% of planning sophistication changes are due to applying strategic planning.

The values of Q^2 for all endogenous variables in table 4.5 obtained greater than 0.15, which represents a good predictive power for this model.

Table 4.5 The Values of R^2 and Q^2 Dimensions in the Model of Applying Strategic Planning and Its Impact on Organization Performance

	R^2	Q^2
Business Objectives	0.435	0.288

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Engagement With Strategic Planning	0.474	0.330
Innovativeness	0.753	0.497
Planning Sophistication	0.930	0.580
Strategic Planning Activities	0.577	0.382
Flexibility	0.574	0.229
Flexibility: Financial	0.732	0.536
Flexibility: Operational	0.513	0.448
Flexibility: Structural	0.597	0.433
Flexibility: Technical	0.383	0.284
Performance	0.470	0.236
Performance: Financial	0.884	0.479
Performance: Non-Financial	0.749	0.584

General Evaluation of the Model

To evaluate the fit of the general model, an index named Goodness of Fit (GOF) is used. Wetzel et al. (2009) introduced three values 0.01, 0.25, and 0.36 as weak, medium, and strong values, respectively, for this index. In the studied model, the GOF value is equal to 0.676 which is placed in the strong range. So, the developed model is in the acceptable range and represents the desired fit of the model.

The structural equation model of applying strategic planning and its impact on organization performance is presented in figure 4.1.

The significant effect of all variables of applying strategic planning and organization performance confirms the overall structure of the model. The results are provided in table 4.6.

Table 4.6 Estimations of Coefficients in The Model of Applying Strategic Planning and Its Impact on Organization Performance

Inner Model	Path Coefficients (Direct Effects)	T Statistics	P Values	Confidence Interval	
				2.5%	97.5%
Applying Strategic Planning -> Business Objectives	0.664	10.115	**0.000***	0.518	0.773
Applying Strategic Planning -> Engagement of Strategic Planning	0.692	13.414	**0.000***	0.580	0.784
Applying Strategic Planning -> Flexibility	0.760	12.523	**0.000***	0.621	0.854
Applying Strategic Planning -> Innovativeness	0.763	14.742	**0.000***	0.642	0.847
Applying Strategic Planning -> Planning Sophistication	0.869	35.601	**0.000***	0.817	0.912
Applying Strategic Planning -> Strategic Planning Activities	0.965	136.970	**0.000***	0.949	0.976
Flexibility -> Flexibility: Financial	0.857	20.926	**0.000***	0.761	0.916
Flexibility -> Flexibility: Operational	0.720	11.464	**0.000***	0.582	0.825

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Flexibility -> Flexibility: Structural	0.776	13.388	**0.000***	0.646	0.870
Flexibility -> Flexibility: Technical	0.624	4.851	**0.000***	0.297	0.798
Applying Strategic Planning -> Performance	0.690	10.633	**0.000***	0.546	0.800
Performance -> Performance: Financial	0.941	67.633	**0.000***	0.909	0.964
Performance -> Performance: Non-financial	0.867	31.531	**0.000***	0.807	0.914

*P-Value<0.05

The results in the above table represent that applying strategic planning is affected by all of its dimensions (P<0.05, $|T| > 1.96$), and the determined variance of this variable is significant in each dimension. The results indicate that applying strategic planning is mostly affected by strategic planning activities (coefficient of 0.965). With regards to the results, the variance of applying strategic planning can determine 57.7 % (R^2 = 0.577) of variation in strategic planning activities.

The confidence interval (CI) is used to compare the ability of each variable in determining the variance of the variable. The confidence interval in strategic planning activities (0.949, 0.976) does not overlap the confidence interval in other variables of applying strategic planning. So, it could be concluded that there is a significant difference between the ability to determine the variance of applying strategic planning in the variable of strategic planning activities and other variables.

The results have shown the financial variable has more effect on the performance with a coefficient of 0.941 than the non-financial variable with a coefficient of 0.867. So that the performance variance can determine 88.4% and 74.9% of the variation in financial and non-financial dimensions, respectively. Since the confidence interval in both variables overlaps ((0.909, 0.964), (0.804, 0.915)), the ability to determine the variance of performance for the two variables is not significantly different from each other.

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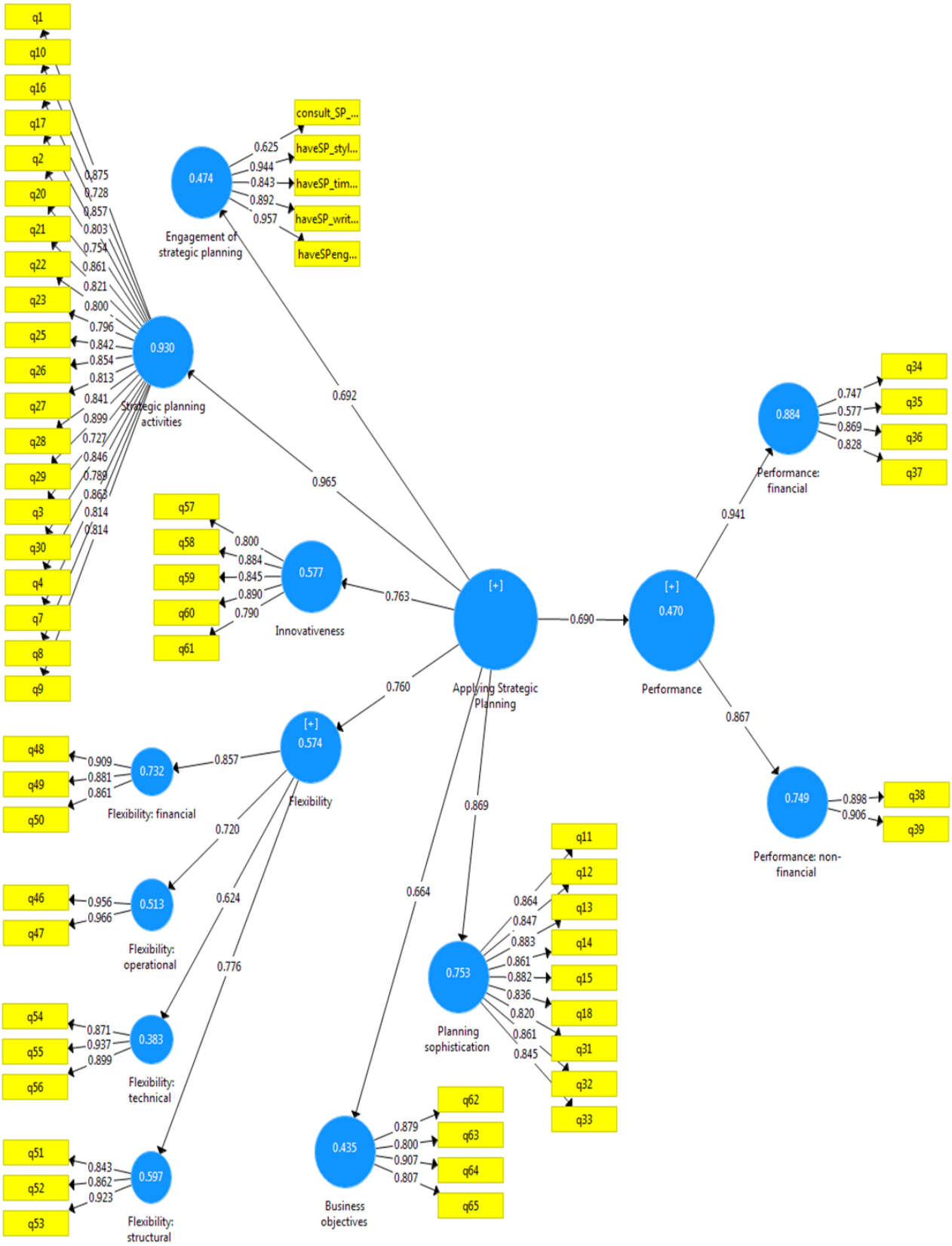

Figure 4.1 Structure Model of Applying Strategic Planning and Its Impact on Organization Performance

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The items in the figure have shown the question's number in the questionnaire. For example, q1 represents question number 1. Some of the items are shown as text (haveSPeng: have strategic engagment, haveSP_writ…: have written strategic plan, haveSP_tim…: timeframe that strategic plan cover, haveSP_styl…: have key goal when doing strategic planning ,consult_SP_...: having counsultan in developing strategic plan.

The next step after examining the assumptions is hypothesis testing.

Investigating the Hypothesis of the Impact of Applying Strategic Planning on Organization Performance

Structural equation modeling (Figure 4.1) is used to investigate the hypothesis of the impact of applying strategic planning on organization performance. The structural model was fully reviewed and analyzed. All loadings and model fit indices are confirmed. Therefore, according to the approval of the studied model, the hypothesis can be tested.

Findings: Hypothesis 1 was aimed to test if applying strategic planning has a direct and significant effect on SMEs' performance. With reference to the results in table 4.6, the significance level of the path (Applying Strategic Planning-> Performance) is less than 0.05 (P<0.05) and this path is meaningful. The null hypothesis is rejected and applying strategic planning has a direct and significant effect on performance. It can be concluded that applying strategic planning has a 69% significant direct effect on SMEs' performance. Also, concerning table 4.5, applying strategic planning is 47% effective in determining performance variance (R^2*=0.470). Therefore, it is proposed that the more SMEs apply strategic planning, the better performance it will have.*

H_2- Dimensions of applying strategic planning4 have a significant impact on Iranian SMEs' performance.

Examination of Assumptions (H_2)

Using Smart PLS software for data analysis and model fit, three steps for assumptions examination should be done. Evaluation of the measurement model (validity and reliability), structural model assessment, and general evaluation. Each stage will be examined separately. If the model is confirmed by the indices in each step, the hypothesis could be investigated.

Investigating the Indices in the Structural Model of Flexibility and Its Impact on Innovativeness

[4] Dimensions of applying strategic planning included: Business objectives, Engagement with strategic planning, Flexibility, Innovativeness, Planning sophistication, Strategic planning activities

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Evaluation of Measurement Model (Validity and Reliability)

The measurement part of the models "the impact applying strategic planning on performance" and "the impact of dimensions of applying strategic planning on organization performance" are the same. So, there is no need to analyze and evaluate the measurement model.

Structural Model Evaluation

The structural model is evaluated by the coefficient of determination (R^2) and Q^2 index. According to table 4.7, the coefficient of determination for endogenous variables in the model of dimensions of applying strategic planning and its impact on organization performance is greater than 0.5 which is above the average level (0.33). So, based on this index, the structure of the model is desirable. For instance, the coefficient of determination (R^2) in the variable of performance was 0.555. It means variables of applying strategic planning are 55.5% effective in the variations of the performance variable. In addition, the results in the Q^2 column have shown that all the values of endogenous variables are greater than 0.15 which shows desirable predictive power in this model.

Table 4. 7 R^2 and Q^2 Values in the Model of Dimensions of Applying Strategic Planning and Its Impact on Performance

	R^2	Q^2
Performance	0.555	0.286
Performance: financial	0.887	0.481
Performance: non-financial	0.745	0.581

General Evaluation of the Model

The Goodness of Fit index is used to evaluate the general fit of the model. The value of GOF in the model of dimensions of applying strategic planning and its impact on performance is 0.687 which shows a good fit for the model. The structural equation model of dimensions of applying strategic planning and its impact on performance is indicated in figure 4.2.
The direct effect and the significance level are displayed in Table 4.8.

Table 4.8 Estimations of Coefficients in the Model of Dimensions of Applying Strategic Planning and Its Impact on Performance

Inner Model	**Path Coefficients (Direct Effects)**	**T Statistics**	**P Values**	**Confidence Interval**	
				2.5%	97.5%
Business objectives -> Performance	0.165	1.521	**0.128**	-0.072	0.361

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Engagement of strategic planning -> Performance	-0.014	0.127	**0.899**	-0.225	0.196
Planning sophistication -> Performance	0.109	0.805	**0.421**	-0.154	0.393
Strategic planning activities -> Performance	0.176	1.030	**0.303**	-0.151	0.514
Flexibility -> Performance	0.543	5.141	**0.000***	0.331	0.744
Innovativeness -> Performance	-0.108	0.911	**0.362**	-0.338	0.132

*P-Value<0.05

Investigating the Hypothesis of the Impact of Dimensions of Applying Strategic Planning on Performance

Structural equation modeling (Figure 4.2) is used to investigate hypothesis 2. The structural model was fully reviewed and analyzed. All loadings and model fit indices are confirmed. Therefore, according to the approval of the studied model, the hypothesis can be tested.

Findings: Hypothesis 2 was put forward to test if dimensions of applying strategic planning (Business objectives, Engagement with strategic planning, Flexibility, Innovativeness, Planning sophistication, and Strategic planning activities) have a direct and significant effect on SMEs' performance. The results of the significant level of the path in table 4.8 indicated that business objectives, engagement with strategic planning, planning sophistication, strategic planning activities, and innovativeness to performance is greater than 0.05. These paths are not significant. So, business objectives, engagement with strategic planning, planning sophistication, strategic planning activities, and innovativeness do not have a significant effect on performance seperately. However, the significant level of the path (Flexibility -> Performance) is less than 0.05. It shows that flexibility has a significant effect on performance. The direct effect of flexibility on performance is 0.543. It can be concluded that flexibility has a 54.3% direct and significant impact on performance. In addition, flexibility is 29% effective in determining the variance of performance (R^2_partial = 0.543^2). Therefore, the hypothesis is accepted with 95% confidence only in the flexibility dimension. It leads to the conclusion that the more an SME is flexible, the better performance it will have.

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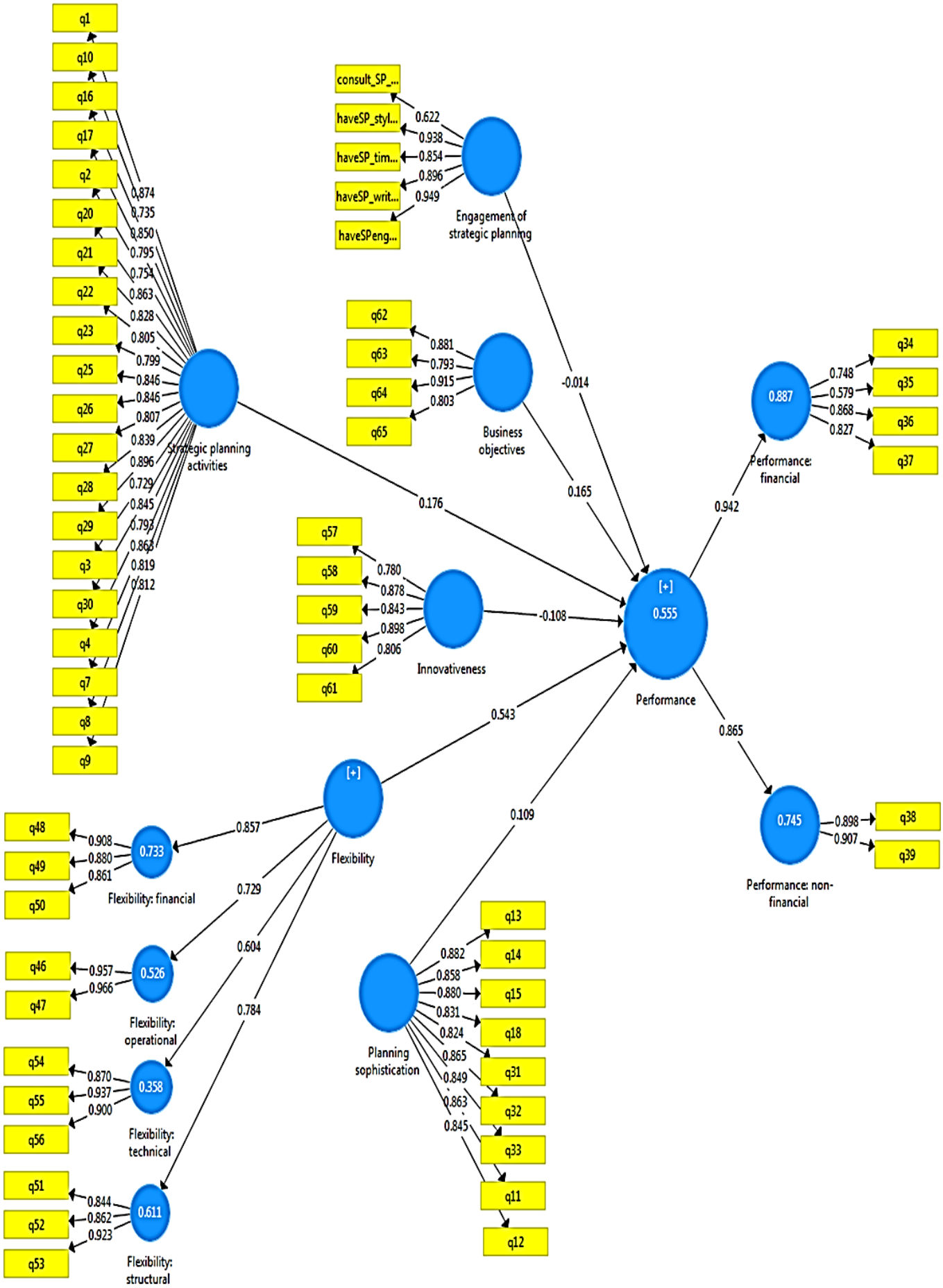

Figure 4.2 Structure Model of Dimensions of Applying Strategic Planning and Its Impact on Performance

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H3- Applying strategic planning has a significant impact on the dimensions of Iranian SMEs' performance.

Examination of Assumptions (H_3)

Using Smart PLS software for data analysis and model fit, three steps for assumptions examination should be done. Evaluation of the measurement model (validity and reliability), structural model assessment, and general evaluation. Each stage will be examined separately. If the model is confirmed by the indices in each step, the hypothesis could be investigated.

Investigating the Indices in the Structural Model of Applying Strategic Planning and Its Impact on Dimensions of Organization Performance.

Evaluation of Measurement Model (Validity and Reliability)

The measurement part of the models "the impact of applying strategic planning on organization performance" and "applying strategic planning and its impact on dimensions of organization performance" are the same. So, there is no need to analyze and evaluate the measurement model.

Structural Model Evaluation

The coefficient of determination (R^2) and Q^2 index is used to evaluate the structural model. According to table 4.9, the coefficient of determination for endogenous variables in the model of applying strategic planning and its impact on dimensions of organization performance is greater than the average level (0.33). So, based on this index, the structure of the model is acceptable. For instance, the coefficient of determination (R^2) in the dimension of performance: financial obtained 0.410. It means, that the variance of applying strategic planning is 41% effective in the variations of financial performance. Moreover, the results in the Q^2 column have represented that all the values of endogenous variables are greater than 0.15 which shows desirable predictive power in this model.

Table 4.9 R^2 and Q^2 values in the Model of Applying Strategic Planning and Its Impact on Dimensions of Organization Performance

	R^2	Q^2
Business Objectives	0.435	0.288
Engagement With Strategic Planning	0.472	0.329
Strategic Planning Activities	0.930	0.580
Planning Sophistication	0.752	0.496
Innovativeness	0.578	0.382
Flexibility	0.577	0.230
Flexibility: Financial	0.732	0.536
Flexibility: Operational	0.514	0.448
Flexibility: Structural	0.598	0.433

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Flexibility: Technical	0.382	0.284
Performance: Financial	0.410	0.215
Performance: Non-Financial	0.366	0.283

General Evaluation of the Model

The Goodness of Fit index is used to evaluate the general fit of the model. The value of GOF in the model of applying strategic planning and its impact on dimensions of performance is 0.639 which shows a good fit for the model.

The structural equation model of applying strategic planning and its impact on dimensions of organization performance is indicated in figure 4.3.

The direct effect and the significance level are displayed in Table 4.10.

Table 4.10 Estimations of Coefficients in the Model of Applying Strategic Planning and Its Impact on Dimensions of Performance

Inner Model	Path Coefficients (Direct Effects)	T Statistics	P Values	Confidence Interval	
				2.5%	97.5%
Applying Strategic Planning -> Business objectives	0.664	10.233	**0.000***	0.524	0.773
Applying Strategic Planning -> Engagement with strategic planning	0.691	13.024	**0.000***	0.574	0.782
Applying Strategic Planning -> Flexibility	0.762	12.332	**0.000***	0.611	0.853
Applying Strategic Planning -> Innovativeness	0.763	14.354	**0.000***	0.639	0.847
Applying Strategic Planning -> Planning sophistication	0.869	36.009	**0.000***	0.817	0.912
Applying Strategic Planning -> Strategic planning activities	0.965	134.473	**0.000***	0.949	0.976
Flexibility -> Flexibility: financial	0.857	21.037	**0.000***	0.758	0.916
Flexibility -> Flexibility: operational	0.720	11.496	**0.000***	0.580	0.826
Flexibility -> Flexibility: structural	0.776	13.481	**0.000***	0.645	0.867
Flexibility -> Flexibility: technical	0.623	4.966	**0.000***	0.311	0.797
Applying Strategic Planning -> Performance: financial	0.645	9.261	**0.000***	0.503	0.771
Applying Strategic Planning -> Performance: non-financial	0.610	9.598	**0.000***	0.478	0.727

*P-Value<0.05

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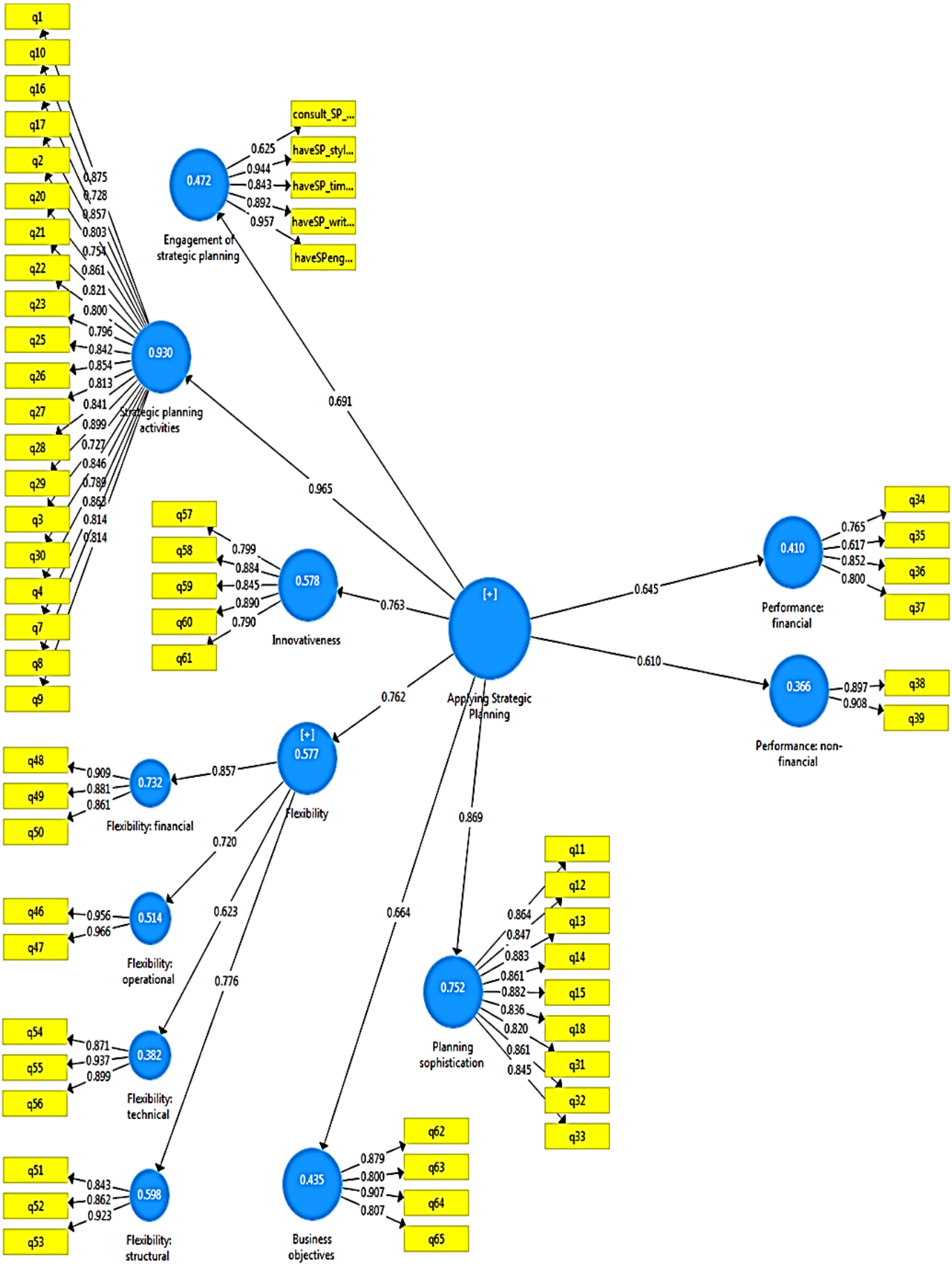

Figure 4.3 Structure Model of Applying Strategic Planning and Its Impact on Dimensions of Organization Performance

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Investigating the Hypothesis of the Impact of Applying Strategic Planning on Dimensions of Organization Performance

To test hypothesis 3, structural equation modeling (figure 4.3) is employed. The structural model has been thoroughly reviewed and analyzed using Smart PLS. All loadings and model fit indices have been validated. Therefore, the hypothesis can be tested in accordance with the study's model's acceptance.

Findings: Hypothesis 3 was put forward to test if applying strategic planning has a direct and significant effect on the financial and non-financial Iranian SMEs' performance separately. According to the results in table 4.10, the p-values indicated that the significance level of the paths (Applying strategic planning-> Performance: financial, Applying strategic planning -> Performance: non-financial) is less than 0.05. These paths are significant. Thus, applying strategic planning has a significant impact on both financial and non-financial performance. So, the null hypothesis is rejected, and applying strategic planning and its impact on dimensions of organization performance is accepted with 95% confidence. With regard to the direct effect values in table 4.10, it can be explained that applying strategic planning has 64.5% direct and significant effects on financial performance and 61% direct and significant effects on non-financial performance. In addition, pointing to the coefficient determination (R^2) values in table 4.9, applying strategic planning is 41% effective in determining the variance of financial performance and 36.6% effective in determining the variance of non-financial performance. It could rise to the conclusion that the SME applied strategic planning, has better financial performance than non-financial performance.

H_4-There is a considerable relationship between flexibility and innovativeness.

To evaluate a hypothesis, it is essential to scrutinize the assumptions embedded within the model thoroughly. Subsequently, upon confirming the suitability of the model, the process of making inferences can be initiated.

Examination of Assumptions (H4)

There are three stages in the examination of assumptions through the utilization of Smart PLS software for data analysis and model adequacy. These stages encompass the assessment of the measurement model (validity and reliability), the evaluation of the structural model, and a general assessment. Each phase will be subject to scrutiny autonomously. Should the model be affirmed by the metrics at each stage, it would be plausible to investigate the hypothesis.

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Investigating the Indices in the Structural Model of Flexibility and Its Impact on Innovativeness

Evaluation of Measurement Model (Validity and Reliability)

The measurement part of the models "the impact of flexibility on innovativeness" and "the impact of applying strategic planning on organization performance" are the same. Therefore, there is no necessity to examine and assess the measurement model.

Structural Model Evaluation

Considering table 4.11 (The values of R^2 and Q^2), the coefficient of determination (R^2) for endogenous variables in the model of flexibility and its impact on innovativeness is above the average point. So, based on this index, the structure of the model is desirable. The coefficient of determination in innovativeness is 0.567. That is to say, flexibility variance can determine 56% of innovation variations. It means, that 56.7% of innovativeness variations are driven by flexibility.

It is represented in table 4.11 that Q^2 in the innovativeness variable and other endogenous variables is greater than 0.35 which shows a desirable predictive power of the model.

Table 4.11 R^2 and Q^2 Values in the Model of Flexibility and Their Impact on Innovativeness

	R^2	Q^2
Flexibility: financial	0.733	0.537
Flexibility: operational	0.522	0.456
Flexibility: structural	0.588	0.426
Flexibility: technical	0.384	0.285
Innovativeness	0.567	0.372

General Evaluation of the Model

The Goodness of Fit index is used to assess the general fit of the model. The value of GOF in the estimated model is 0.651 which represents a good fit for the model.

The structural equation model of flexibility and its impact on innovativeness is shown below in figure 4.4.

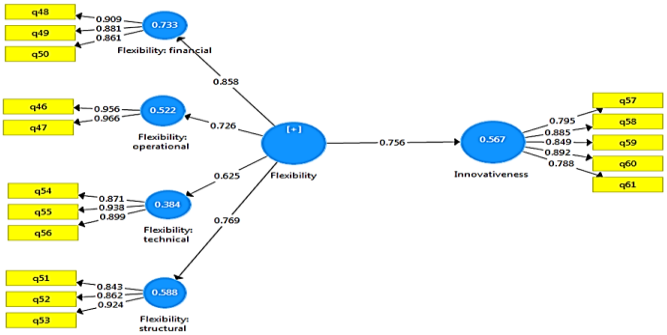

Figure 4.4 Structure Model of Flexibility and Its Impact on Innovativeness

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The Direct Effect and the Significance Level Are Displayed in Table 4.10.

Table 4.12 Estimations of Coefficients in the Model of Flexibility and Its Impact on Innovativeness

Inner Model	Path Coefficients (Direct Effects)	T Statistics	P Values	Confidence Interval	
				2.5%	97.5%
Flexibility -> Innovativeness	0.756	15.162	**0.000***	0.651	0.843

*P-Value<0.05

In the next step, the hypothesis can be tested.

Investigating the Hypothesis of the Impact of Flexibility on Innovativeness

Structural equation modeling (Figure 4.4) is used to investigate the impact of flexibility on innovativeness in small and medium-sized enterprises. The structural model was fully reviewed and analyzed. All loadings and model fit indices are confirmed. Therefore, according to the approval of the studied model, the hypothesis can be tested.

Findings: Hypothesis 4 was posited to test if flexibility in SMEs has a direct and significant impact on innovativeness. Referring to the results in table 4.12, the significance level of the path (flexibility -> innovativeness) is less than 0.05 (P<0.05) and this path is meaningful. Thus, the alternative hypothesis is accepted and flexibility has a direct and significant impact on the innovativeness of SMEs. Given the value of direct effect (0.756) in table 4.12, it can be concluded that flexibility has a 75% direct and significant impact on innovativeness. With reference to table 4.10, flexibility is 56% effective in determining the variance of innovativeness (R^2*=0.567). Therefore, it could be assumed that the more an SME is flexible, the more innovative it will be.*

4.1.2. Effect Confirmation and Hypothesis Testing Using Regression Analysis and Analysis of Variance (ANOVA)

To investigate the rest of the hypothesis (H_{5a}-H_{7b}), regression analysis and analysis of variance (ANOVA) are used.

Regression analysis is used to investigate the effect of the continuous predictor (independent) variable on the continuous response (dependent) variable, provided that the distribution of the quantitative response variable is normal. If the significance level is less than 0.05 (P<0.05) the hypothesis of the effect of the predictor variable on the response variable is accepted. In regression and Anova analysis, one needs to have a unique score for each of the latent variables (engagement with strategic planning, planning sophistication, innovativeness). Each of the latent variables in my study is constructed based on several questions. To define a unique score for each of the latent variables, a factor analysis with only one factor is applied and a factor score for each latent variable is calculated. As an index of all related questions,

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one can use the factor score in the analysis. Factor scores are standard scores with a Mean=0, Variance = squared multiple correlation (SMC) between questions and factors.

The hypotheses H_{5b}-H_{7b} are investigated by using regression analysis. At first, the normality assumption must be examined. Then, the hypotheses could be tested if the normality assumption was established.

Examining Regression Model Assumptions (H_{5b}, H_{5c}, H_{6b}, H_{7b})

The normality assumption of standardized residuals in regression models is examined. One sample Kolmogorov-Smirnov test is used to assess the normality of standardized residues in regression models. To test whether a sample comes from a specific distribution, a one-sample Kolmogorov-Smirnov test is used. This method can be used to determine if a sample comes from a population that is normally distributed. In the Kolmogorov-Smirnov test, the null hypothesis is following the normal distribution. If the P-Value>0.05, it can be accepted that the distribution of residuals is normal.

Table 4.13 Assessing Normality of Standardized Residues in Regression Models Using Kolmogorov-Smirnov Test

Standardized Residuals	**Test of Normality**	
Organization's age -> Engagement With the Strategic Planning	Kolmogorov-Smirnov Z	1.47
	p-value	0.025*
Organization's age -> Planning Sophistication	Kolmogorov-Smirnov Z	0.58
	p-value	0.89
Organization's age -> Innovativeness	Kolmogorov-Smirnov Z	0.79
	p-value	0.55
Individual's Culture Inclusion -> Engagement With the Strategic Planning	Kolmogorov-Smirnov Z	0.85
	p-value	0.45
Individual's Religion/Faith -> Engagement With the Strategic Planning	Kolmogorov-Smirnov Z	1.35
	p-value	0.05

*P-Value<0.05

The results in the above table (4.13) indicate that the distribution of standardized residuals in all regression models is normal (the significance level is greater than 0.05 (P-Value>0.05)) except for the effect of the organization's age on engagement with the strategic planning model. The P-Value for the normality test of standardized residuals of the model "organization's age on engagement with strategic planning" is less than 0.05. So, the normality assumption is rejected. However, the sample size is 300, according to the central limit theorem, the average sample distribution is normal.

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In addition, the homogeneity of variance assumption in regression analysis is investigated by a scatter plot of the standardized predicted values versus the standardized residuals (Figures 4.5 to 4.9). This assumption is confirmed due to the random scattering point around zero.

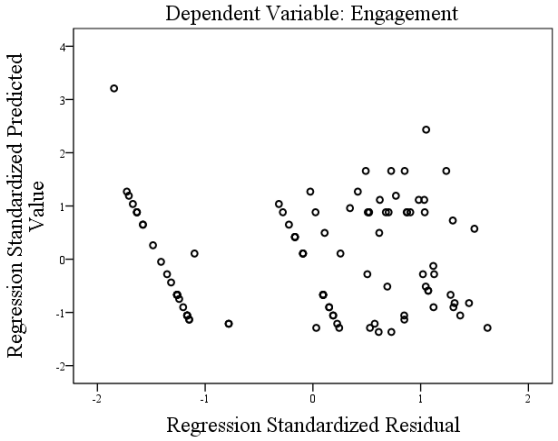

Figure 4.5 The standardized predicted values versus the standardized residuals for assessing the effect of organization age on engagement with the strategic planning model

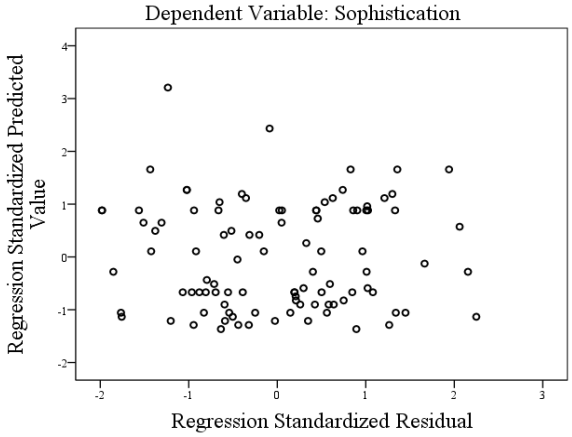

Figure 4.6 The standardized predicted values versus the standardized residuals for assessing the effect of organization age on the planning sophistication model

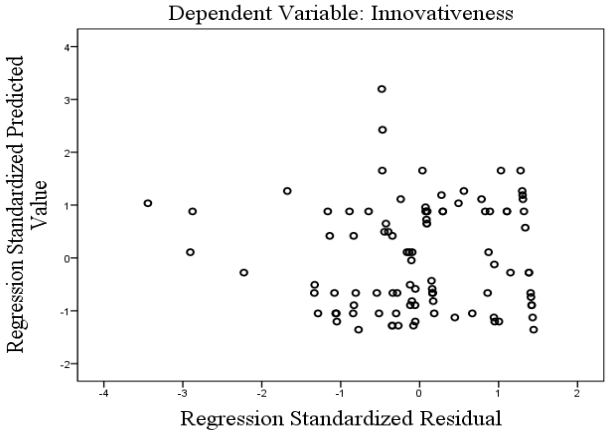

Figure 4.7 The standardized predicted values versus the standardized residuals for assessing the effect of organization age on the innovativeness model

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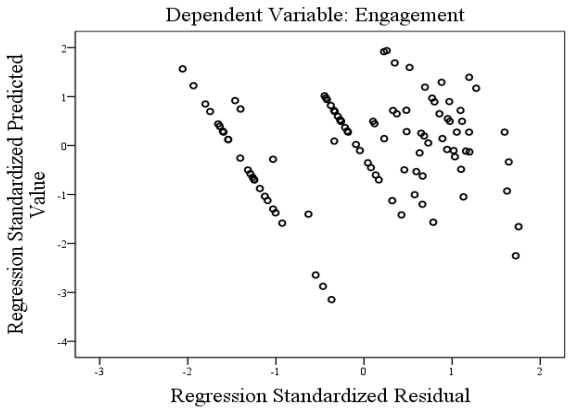

Figure 4.8 The standardized predicted values versus the standardized residuals for assessing the effect of individual's culture inclusion on engagement with the strategic planning model

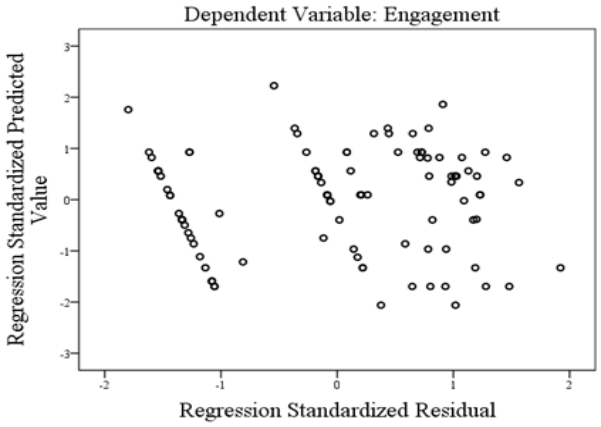

Figure 4.9 The standardized predicted values versus the standardized residuals for assessing the effect of individual's faith on engagement with the strategic planning model

Testing the Hypotheses H_{5b}, H_{5c}, H_{6b}, H_{7b}

The impact of organization's age on engagement with strategic planning, planning sophistication, and innovativeness, besides, the impact of cultural inclusion and religion/faith on engagement with strategic planning by using regression analysis are shown in the table 4.14.

Table 4.14 Regression Analysis of Hypotheses H_{5b} , H_{5c} , H_{6b} , H_{7b}

Response / Predictor		Engagement	Planning Sophistication	Innovativeness
Organization's Age	**B**	0.018	0.009	0.004
	Std. Error	0.008	0.008	0.008
	t	2.383	1.094	0.542
	P-value	**0.019***	**0.277**	**0.589**
	R^2	0.055	0.012	0.003
Individual's Culture Inclusion	**B**	0.337		
	Std. Error	0.095		
	t	3.549		
	P-value	**0.001***		
	R^2	0.115		

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Individual's Religion/Faith	**B**	0.211
	Std. Error	0.099
	t	2.136
	P-value	**0.035***
	R^2	0.044

*P-Value<0.05

H_{5b}- There is a considerable relationship between Iranian SMEs' age and engagement with strategic planning.

Findings: Hypothesis 5b was purposed to test if organization age effect engagement with strategic planning. Before testing this hypothesis, the normality assumption in the regression model was examined. The Kolmogorov-Smirnov test was used to find the normality of the distribution of standardized residuals. If the significance level (p-value) >0.05, the null hypothesis is accepted i.e. that the distribution of standardized residuals is normal. Although the p-value<0.05 for the row (Organization's age -> Engagement with the strategic planning) in table 4.13 indicates that the distribution of standardized residual is not normal, according to the central limit theorem and homogeneity of variance assumption (figure 4.11) the normality of the distribution is approved. Then, hypothesis 5b was tested. According to the results in table 4.14, the significance level of the regression coefficient is less than 0.05 (P<0.05) i.e. that SMEs' age has a significant effect on engagement with strategic planning. With regards to the regression coefficient, by one unit (year) increase in the SME's age, engagement with strategic planning will increase 0.02 on average. Furthermore, the SME's age is 5.5% effective in variance determination of engagement with strategic planning (R^2=0.055). In conclusion, the more SMEs age, the more engagement with the strategic plan.

H_{5c}- There is a considerable relationship between individual's cultural inclusion, faith and engagement with strategic planning.

Findings: Hypothesis 5c was raised to test whether individual's cultural inclusion and faith affects engagement with strategic planning. The results in table 4.13 indicat that the distribution of standardized residuals is normal for Individual's culture inclusion and Individual's faith -> Engagement with the strategic planning since the p-value>0.05. So, it is possible to test the hypothesis. The results of regression analysis in table 4.14 display that an individual's cultural inclusion and faith has a significant impact on engagement with strategic planning since the significance level of the regression coefficient is less than 0.05). Considering the regression coefficient, with a one-unit increase in cultural inclusion, engagement with strategic planning will increase by 0.33 on average, and, with a one-unit increase in individual's faith, engagement with strategic planning will increase by 0.21 on average. In addition, culture inclusion is 11% effective in variance determination of engagement with strategic planning (R^2=0.11) and individual's faith is 4.4% effective in variance determination of engagement with strategic planning (R^2=0.044). It can be offered that the more the cultural inclusion and faith of an individual in an organization, the more engagement with the strategic planning.

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H_{6b}- There is a considerable relationship between Iranian SMEs' age and planning sophistication.

Findings: Hypothesis 6b was determined to test if SMEs' age affects planning sophistication. The normality of the distribution of standardized residuals was calculated. The p-value >0.05 in table 4.13 represents that the distribution of standardized residuals is normal. Therefore, hypothesis 6b is allowed to be tested. Testing the hypothesis by using regression analysis, the null hypothesis is accepted because the p-value > 0.05 (see table 4.14). It means that the organization's age does not have a significant effect on planning sophistication.

H_{7b}- There is a considerable relationship between Iranian SMEs' age and innovativeness.

Findings: Hypothesis 7b was put on the table to test if SMEs' age impacts innovativeness. The normality assumption was examined through the test of Kolmogorov-Smirnov and the gained p-value was greater than 0.05. The null hypothesis was accepted and the distribution of standardized residuals was normal. So, the hypothesis could be tested. Using regression analysis to test this hypothesis, the gained p-value is greater than 0.05 (see table 4.14). It represents that the alternative hypothesis is rejected. That is to say, organization age does not have a significant impact on innovativeness.

Following, the hypotheses (H_{5a}, H_{6a}, H_{7a}) are investigated by using parametric analysis of variance. To investigate the impact of a qualitative variable on a quantitative variable, parametric analysis of variance is used provided that the distribution of the quantitative variable is normal at different levels of the qualitative variable. If the significance level is less than 5% ($P<0.05$), the hypothesis effect of the qualitative variable on the quantitative variable is accepted. Firstly, the normality assumption must be examined. If the normality was established, then the hypotheses could be tested.

Examining the Assumptions of the Analysis of the Variance Model

At first, the normality of response (dependent) variables at different levels of predictor (independent) variables is checked. Table 4.15 represents the normality assessment of response variables at different levels of predictor variables.

Table 4.15 Assessing Normality of Response Variables at Different Levels of Predictor Variables

			Engagement With the Strategic Planning	Planning Sophistication	Innovativeness
Organization Size	Small	Kolmogorov-Smirnov Z	0.914	0.515	0.886
		p-value	0.374	0.953	0.413
	Medium	Kolmogorov-Smirnov Z	1.556	0.769	1.173
		p-value	0.016*	0.595	0.128

*P-Value<0.05

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The results in Table 4.15 have represented that the normality assumption is rejected in engagement with strategic planning in the category of medium for organization size (P-Value<0.05). Since the sample size in these categories is 216, according to the central limit theorem, the average sample distribution of this variable is normal, however. Therefore, to test all the hypotheses in this section, the parametric analysis of variance is used.

Testing the Hypotheses H_{5a}, H_{6a}, H_{7a}

The results of variance analysis to investigate the effect of categorical predictor variables are shown in Table 4.16.

Table 4.16 Results of Variance Analysis for Investigating the Effect of Categorical Predictor Variables on Response Variables

Response variable: Engagement With the Strategic Planning		N	Mean	Std. Deviation	95% Confidence Interval for Mean		F	p-value
					Lower Bound	Upper Bound		
Organization's Size	**Small**	84	-0.05	0.187	-0.43	0.33	0.096	0.757
	Medium	216	0.19	0.118	-0.21	0.25		
Response Variable: Planning Sophistication								
Organization's Size	**Small**	84	0.099	0.182	-0.27	0.47	0.386	0.536
	Medium	216	-0.038	0.119	-0.27	.20		
Response Variable: Innovativeness								
Organization's Size	**Small**	84	0.103	0.196	-0.29	0.50	0.418	0.520
	Medium	216	-0.040	0.117	-0.27	0.19		

H_{5a}- There is a considerable relationship between Iranian SMEs' size and engagement with strategic planning.

Findings: Hypothesis 5a was designed to test if SMEs size impacts engagement with strategic planning. Before testing the hypothesis, the normality assumption of response variables at different levels of predictor variables was checked by using the Kolmogorov-Smirnov test. Although the normality assumption is rejected (see table 4.15) in engagement with strategic planning in the category of medium for organization size (p-value>0.05), according to the central limit theorem it was accepted. So, the hypothesis could be tested. With reference to the results of the analysis of variance (Table 4.16), no significant effect was observed between organization size and engagement with strategic planning since the significance level of the variance analysis is more than 0.05. Therefore, organization size has no effect on engagement with strategic planning. However, according to the mean value in table 4.16, engagement with strategic planning in medium organizations is more than in small organizations

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H_{6a}- There is a considerable relationship between Iranian SMEs' size and planning sophistication.

Findings: Hypothesis 6a was put forward to test if SME size impacts the complexity of planning. The normality assumption was checked. According to the results in table 4.15 (planning sophistication column and category of organization size), the p-value>0.05 i.e. the normality assumption is kept. Then, the hypothesis was tested by analysis of variance. The result of a significant level in analysis of variance for organization size and planning sophistication indicated that organization size does not have any significant effect on planning sophistication. However, the mean value in table 4.16, shows that planning in small enterprises is more sophisticated than planning in medium ones.

H_{7a}- There is a considerable relationship between Iranian SMEs' size and innovativeness.

Findings: Hypothesis 7a was posited to test if organization size affects innovativeness. Normality assumption was done by using the Kolmogorov-Smirnov test. Pointing to the results in table 4.15, the significance level of the response variable (innovativeness) at a different level of the predictor (organization size) variable indicates that they are significant since the p-value>0.05. As a result, the normality assumption is satisfied. Testing the hypothesis by using analysis of variance, brought about the result that organization size does not impact innovativeness (p-value>0.05, see table 4.16). Nevertheless, considering the mean value in table 4.16, it can be concluded that small organizations are more innovative than medium ones.

Figures 4.10 to 4.12 are presented to help for better comprehension of the above interpretation.

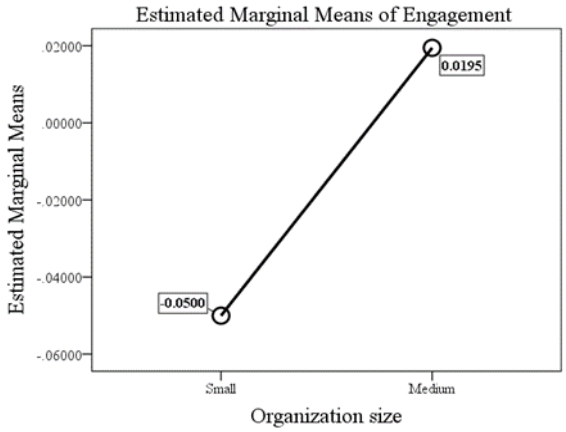

Figure 4.10 Estimated marginal means of engagement with strategic planning in the categories of organization size.

The larger the size of an organization, the more engagement to the strategic planning it has. According to the figures 4.10, medium enterprises have more engagement with the strategic planning than small ones.

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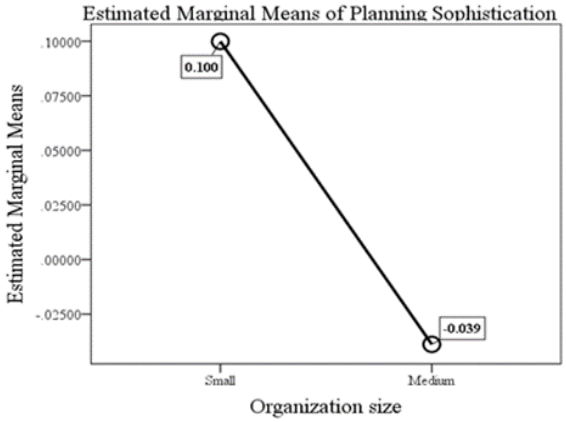

Figure 4.11 Estimated marginal means of planning sophistication in the categories of organization size

By increasing the size of an organization, the sophistication of planning in the organization decrease. The planning sophistication in medium enterprises is lower than in small enterprises.

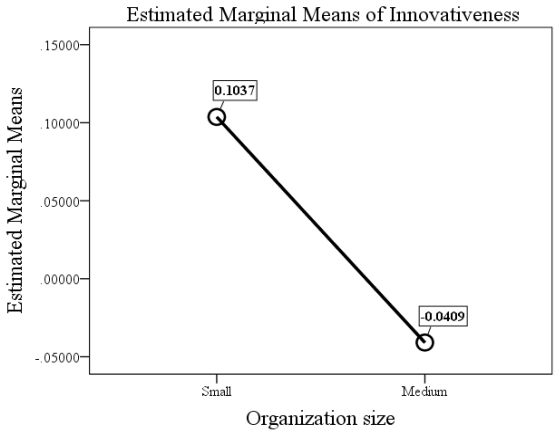

Figure 4.12 Estimated marginal means of innovativeness in the categories of organization size

The larger the size of an organization, the lower the innovativeness. Innovativeness in medium-sized enterprises observed less than in small enterprises.

4.2 Analysis of Evaluating and Prioritizing Strategic Planning Models Using Fuzzy Best Worst Method

To answer the main question in the second part of the current study which is evaluating and prioritizing strategic planning models in Iranian manufacturing SMES, I am motivated to apply one of the new methods of Multi Criteria Decision Making techniques “FBWM” for analyzing the problem. Generally, in the MCDM techniques, at first evaluation criteria should be determined. Calculation of criteria weights is the next step. Then, each alternative should be evaluated based on each criterion. Finally, multiplying the weights of criteria and alternatives provides the final rank of alternatives.

Referring to Rumelt (1980), Mellalieu (1992), Whelan and Sisson (1993), and Cox (1997) six criteria (formality, clarity, measurability, objectivity, coverage, and consistency) are selected to evaluate strategic planning models. These criteria collectively improve the

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efficiency and dependability of strategic planning, allowing organizations to maneuver through intricate surroundings and reach their ultimate goals. Six strategic planning models (Bryson (1988), Wright (Sobhanallahi et al., 2016), Wheelen and Hunger (2012), Hill and Jones (Hill, et al., 2014), Bowman and Asch (1989), and David (David, 2011)) are considered to be evaluated based on the six criteria. Thirteen managers were interviewed in small and medium-sized enterprises to collect the required data.

According to the FBWM, firstly, managers were asked to select the best (C_B) and the worst (C_W) criterion. In the next step, managers compared the best criterion to the others and others to the worst based on 5-scale linguistic terms such as Equally Important (EI), Weakly Important (WI), Fairly Important (FI), Very Important (VI), and Absolutely Important (AI). Then, manager's verbal evaluation should be translated into a fuzzy rating (Triangular Fuzzy Numbers) (Van Laarhoven and Pedrycz, 1983). Table 4.17 indicates the transformation of linguistic terms.

Table 4.17 Linguistic terms transformation rules

Linguistic terms	Equally importance (EI)	Weakly important (WI)	Fairly important (FI)	Very important (VI)	Absolutely important (AI)
Membership Function (l, m, u)	(1,1,1)	$(^2/_3, 1, ^3/_2)$	$(^3/_2, 2, ^5/_2)$	$(^5/_2, 3, ^7/_2)$	$(^7/_2, 4, ^9/_2)$

In my study, due to the extent of strategic planning models and criterion description, sending a questionnaire to managers, who are always busy, did not have any reasonable feedback. It was decided to interview the managers by using a prepared questionnaire. The calculation procedure is described as follows:

Step 1. Comparison of Best Criterion to the Others and Others to the Worst

During the meetings with managers, they were initially given a sheet detailing the criteria and were tasked with identifying the best and worst criteria. They were required to read the descriptions and respond to the question: "In your opinion, which criteria is the most suitable for evaluating strategic planning models, and which is the least appropriate?" Following this, managers were asked to assess the importance of the best criterion compared to others, as well as the importance of the worst criterion using linguistic terms. Equally Important (EI), Weakly Important (WI), Fairly Important (FI), Very Important (VI), or Absolutely Important (AI).

Table 4.18, 4.19 shows the judgment comparison of the best criterion to the others and others to the worst by the 13 managers in Iranian manufacturing SMEs.

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Table 4.18 Comparison of Best Criterion to the Others

Criteria / Best Criterion (C_B)	Formality C1	Clarity C2	Measurability C3	Objectivity C4	Coverage C5	Consistency C6
Manager 1	C2	VI	EI	EI	FI	VI	VI
Manager 2	C3	FI	VI	EI	VI	FI	AI
Manager 3	C1	EI	FI	FI	FI	VI	EI
Manager 4	C1	EI	AI	FI	FI	VI	FI
Manager 5	C1	EI	FI	FI	VI	VI	AI
Manager 6	C6	FI	FI	AI	EI	FI	EI
Manager 7	C5	EI	WI	FI	VI	EI	VI
Manager 8	C1	EI	VI	FI	FI	AI	FI
Manager 9	C3	FI	FI	EI	FI	VI	FI
Manager 10	C1	EI	FI	FI	FI	VI	FI
Manager 11	C3	VI	VI	EI	AI	VI	FI
Manager 12	C3	EI	FI	EI	FI	AI	EI
Manager 13	C6	VI	VI	FI	AI	VI	EI

Table 4.19 Comparison of the Other Criteria to the Worst

Worst Criterion (C_W) / Criteria	*Manager 1*	*Manager 2*	*Manager 3*	*Manager 4*	*Manager 5*	*Manager 6*	*Manager 7*	*Manager 8*	*Manager 9*	*Manager 10*	*Manager 11*	*Manager 12*	*Manager 13*
	C5	**C6**	**C4**	**C2**	**C6**	**C3**	**C6**	**C5**	**C4**	**C5**	**C4**	**C6**	**C4**
Formality (C1)	FI	VI	VI	AI	AI	VI	FI	AI	FI	VI	FI	VI	FI
Clarity (C2)	AI	FI	EI	EI	FI	VI	FI	VI	FI	FI	FI	FI	FI
Measurability (C3)	AI	AI	EI	VI	FI	EI	EI	FI	VI	FI	AI	EI	FI
Objectivity (C4)	FI	FI	EI	VI	FI	FI	EI	FI	EI	FI	EI	EI	EI
Coverage (C5)	EI	FI	WI	FI	FI	FI	VI	EI	WI	EI	FI	VI	FI
Consistency (C6)	FI	EI	FI	VI	EI	AI	EI	VI	FI	FI	VI	EI	AI

Transferring the linguistic terms by using table 4.17, the fuzzy values of best criterion to the others and other to the worst are shown in table 4.20 and 4.21.

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Table 4.20 The fuzzy value of best criterion to the others

Criteria / Best Criterion (C_B)	Formality C1	Clarity C2	Measurability C3	Objectivity C4	Coverage C5	Consistency C6
Manager 1	C2	(5/2,3,7/2)	(1,1,1)	(1,1,1)	(3/2,2,5/2)	(7/2,4,9/2)	(5/2,3,7/2)
Manager 2	C3	(3/2,2,5/2)	(5/2,3,7/2)	(1,1,1)	(5/2,3,7/2)	(3/2,2,5/2)	(7/2,4,9/2)
Manager 3	C1	(1,1,1)	(3/2,2,5/2)	(3/2,2,5/2)	(5/2,3,7/2)	(5/2,3,7/2)	(1,1,1)
Manager 4	C1	(1,1,1)	(7/2,4,9/2)	(3/2,2,5/2)	(3/2,2,5/2)	(5/2,3,7/2)	(3/2,2,5/2)
Manager 5	C1	(1,1,1)	(3/2,2,5/2)	(3/2,2,5/2)	(5/2,3,7/2)	(5/2,3,7/2)	(7/2,4,9/2)
Manager 6	C6	(3/2,2,5/2)	(3/2,2,5/2)	(7/2,4,9/2)	(1,1,1)	(3/2,2,5/2)	(1,1,1)
Manager 7	C5	(1,1,1)	(2/3,1,3/2)	(3/2,2,5/2)	(5/2,3,7/2)	(1,1,1)	(5/2,3,7/2)
Manager 8	C1	(1,1,1)	(5/2,3,7/2)	(3/2,2,5/2)	(3/2,2,5/2)	(7/2,4,9/2)	(3/2,2,5/2)
Manager 9	C3	(3/2,2,5/2)	(3/2,2,5/2)	(1,1,1)	(5/2,3,7/2)	(5/2,3,7/2)	(3/2,2,5/2)
Manager 10	C1	(1,1,1)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(5/2,3,7/2)	(3/2,2,5/2)
Manager 11	C3	(5/2,3,7/2)	(5/2,3,7/2)	(1,1,1)	(7/2,4,9/2)	(5/2,3,7/2)	(3/2,2,5/2)
Manager 12	C3	(1,1,1)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)	(7/2,4,9/2)	(1,1,1)
Manager 13	C6	(5/2,3,7/2)	(5/2,3,7/2)	(3/2,2,5/2)	(7/2,4,9/2)	(5/2,3,7/2)	(1,1,1)

Table 4.21 Fuzzy value of the other criteria to the worst

Worst Criterion (C_W) / *Criteria*	***Manager 1***	***Manager 2***	***Manager 3***	***Manager 4***	***Manager 5***	***Manager 6***	***Manager 7***	***Manager 8***	***Manager 9***	***Manager 10***	***Manager 11***	***Manager 12***	***Manager 13***
	C5	**C6**	**C4**	**C2**	**C6**	**C3**	**C6**	**C5**	**C4**	**C5**	**C4**	**C6**	**C4**
Formality (C1)	(3/2,2,5/2)	(5/2,3,7/2)	(5/2,3,7/2)	(7/2,4,9/2)	(7/2,4,9/2)	(5/2,3,7/2)	(3/2,2,5/2)	(7/2,4,9/2)	(3/2,2,5/2)	(5/2,3,7/2)	(3/2,2,5/2)	(5/2,3,7/2)	(3/2,2,5/2)
Clarity (C2)	(7/2,4,9/2)	(3/2,2,5/2)	(1,1,1)	(1,1,1)	(3/2,2,5/2)	(5/2,3,7/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)
Measurability (C3)	(7/2,4,9/2)	(7/2,4,9/2)	(1,1,1)	(5/2,3,7/2)	(3/2,2,5/2)	(1,1,1)	(1,1,1)	(5/2,3,7/2)	(5/2,3,7/2)	(3/2,2,5/2)	(7/2,4,9/2)	(1,1,1)	(3/2,2,5/2)
Objectivity (C4)	(3/2,2,5/2)	(3/2,2,5/2)	(1,1,1)	(5/2,3,7/2)	(3/2,2,5/2)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)	(1,1,1)	(1,1,1)	(1,1,1)
Coverage (C5)	(1,1,1)	(3/2,2,5/2)	(2/3,1,3/2)	(3/2,2,5/2)	(3/2,2,5/2)	(3/2,2,5/2)	(5/2,3,7/2)	(1,1,1)	(2/3,1,3/2)	(1,1,1)	(3/2,2,5/2)	(5/2,3,7/2)	(3/2,2,5/2)
Consistency (C6)	(3/2,2,5/2)	(1,1,1)	(3/2,2,5/2)	(5/2,3,7/2)	(1,1,1)	(7/2,4,9/2)	(1,1,1)	(5/2,3,7/2)	(3/2,2,5/2)	(3/2,2,5/2)	(5/2,3,7/2)	(1,1,1)	(7/2,4,9/2)

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Step 2. Calculating the Consistency Ratio of Pairwise Comparison

Before proceeding to the next stage, it is possible to evaluate the consistency ratio of pairwise comparisons. The consistency ratio for fuzzy best-worst group decision-making can be computed using Guo and Qi's (2021) extended version of Liang et al.'s (2020) method in a fuzzy environment. The suggested approach employs input-based consistency measurement, which is straightforward and offers prompt feedback. The formula for the input-based consistency ratio is provided below (Guo and Qi's, 2021).)

$$\mathrm{CR}^{\mathrm{I}} = \max_{\mathrm{j}} \mathrm{CR}_{\mathrm{j}}^{\mathrm{I}} \qquad \text{Eq(1)}$$

where

$$\mathrm{CR}_{\mathrm{j}}^{\mathrm{I}} = \begin{cases} \left| \dfrac{\mathrm{R}(\tilde{a}_{\mathrm{Bj}} * \tilde{a}_{\mathrm{jW}} - \tilde{a}_{\mathrm{BW}})}{\mathrm{R}(\tilde{a}_{\mathrm{BW}} * \tilde{a}_{\mathrm{BW}} - \tilde{a}_{\mathrm{BW}})} \right| & \tilde{a}_{\mathrm{BW}} \neq (1,1,1) \\ 0 & \tilde{a}_{\mathrm{BW}} = (1,1,1) \end{cases} \qquad \text{Eq(2)}$$

CR^{I}: global input-based consistency ratio for all criterion

$\mathrm{CR}_{\mathrm{j}}^{\mathrm{I}}$: level of local consistency related to the criterion

$\tilde{a}_{\mathrm{Bj}}$: the fuzzy value of best criterion over j[th] criterion

$\tilde{a}_{\mathrm{jW}}$: the fuzzy value of j[th] criterion over the worst

Some basic operational rules of triangular fuzzy numbers are provided (see Eq.3-Eq.8 in Appendix C).

The triangular fuzzy numbers may be transformed into precise values (Equation 9) by employing the representation of graded mean integration (GMIR). (Zhao and Guo, 2014; Chen and Li, 2000).

$$\text{If} \quad \tilde{a}_{\mathrm{j}} = l_{\mathrm{j}} + m_{\mathrm{j}} + u_{\mathrm{j}} \quad \rightarrow \quad \mathrm{R}(\tilde{a}_{\mathrm{j}}) = \frac{l_{\mathrm{j}} + 4 * m_{\mathrm{j}} + u_{\mathrm{j}}}{6} \qquad \text{Eq(9)}$$

$\tilde{a}_{\mathrm{j}}$: real fuzzy number

l_{j}: lower bound

m_{j}: median

u_{j}: upper bound

Consistency evaluation of outcomes is given in table 4.22 of the consistency ratio threshold in Liang et al. (2020).

Table 4.22 Input-Based Consistency Measurement Threshold for Various Combinations

	Criteria						
	3	4	5	6	7	8	9
scales							
3	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667
4	0.1121	0.1529	0.1898	0.2206	0.2527	0.2577	0.2683

5	0.1354	0.1994	0.2306	0.2546	0.2716	0.2844	0.2960
6	0.1330	0.1990	0.2643	0.3044	0.3144	0.3221	0.3262
7	0.1294	0.2457	0.2819	0.3029	0.3144	0.3251	0.3403
8	0.1309	0.2521	0.2958	0.3154	0.3408	0.3620	0.3657
9	0.1359	0.2681	0.3062	0.3337	0.3517	0.3620	0.3662

Source: Retrieved from Guo and Qi (2021)

Let the scales of the row dimension in table 4.22 represent the estimated size $R(\tilde{a}_{BW})$. Because $R(\tilde{a}_{BW})$ may not be an integer and the row dimension data in the database is all integer, it can approximate the integer value to produce $R(\tilde{a}_{BW})$.

With reference to tables 4.20 and 4.21, and applying Eq.1,2, the consistency ratio of pairwise comparison for manager 1 is calculated.

$$\tilde{a}_{BW} = \tilde{a}_{25} = (\frac{7}{2}, 4, \frac{9}{2})$$

$$CR_1^I = \left\{\left|\frac{R(\tilde{a}_{21}*\tilde{a}_{15}-\tilde{a}_{25})}{R(\tilde{a}_{25}*\tilde{a}_{25}-\tilde{a}_{25})}\right| = \left|\frac{(\frac{5}{2},3,\frac{7}{2})*(\frac{3}{2},2,\frac{5}{2})-(\frac{7}{2},4,\frac{9}{2})}{(\frac{7}{2},4,\frac{9}{2})*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}\right| = 0.172 \quad CR_4^I = \left\{\left|\frac{R(\tilde{a}_{24}*\tilde{a}_{45}-\tilde{a}_{25})}{R(\tilde{a}_{25}*\tilde{a}_{25}-\tilde{a}_{25})}\right| = \left|\frac{(\frac{3}{2},2,\frac{5}{2})*(\frac{3}{2},2,\frac{5}{2})-(\frac{7}{2},4,\frac{9}{2})}{(\frac{7}{2},4,\frac{9}{2})*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}\right| = 0.0069$$

$$CR_2^I = \left\{\left|\frac{R(\tilde{a}_{22}*\tilde{a}_{25}-\tilde{a}_{25})}{R(\tilde{a}_{25}*\tilde{a}_{25}-\tilde{a}_{25})}\right| = \left|\frac{(1,1,1)*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}{(\frac{7}{2},4,\frac{9}{2})*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}\right| = 0 \quad CR_5^I = \left\{\left|\frac{R(\tilde{a}_{25}*\tilde{a}_{55}-\tilde{a}_{25})}{R(\tilde{a}_{25}*\tilde{a}_{25}-\tilde{a}_{25})}\right| = \left|\frac{(\frac{7}{2},4,\frac{9}{2})*(1,1,1)-(\frac{7}{2},4,\frac{9}{2})}{(\frac{7}{2},4,\frac{9}{2})*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}\right| = 0$$

$$CR_3^I = \left\{\left|\frac{R(\tilde{a}_{23}*\tilde{a}_{35}-\tilde{a}_{25})}{R(\tilde{a}_{25}*\tilde{a}_{25}-\tilde{a}_{25})}\right| = \left|\frac{(1,1,1)*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}{(\frac{7}{2},4,\frac{9}{2})*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}\right| = 0 \quad CR_6^I = \left\{\left|\frac{R(\tilde{a}_{26}*\tilde{a}_{65}-\tilde{a}_{25})}{R(\tilde{a}_{25}*\tilde{a}_{25}-\tilde{a}_{25})}\right| = \left|\frac{(\frac{5}{2},3,\frac{7}{2})*(\frac{3}{2},2,\frac{5}{2})-(\frac{7}{2},4,\frac{9}{2})}{(\frac{7}{2},4,\frac{9}{2})*(\frac{7}{2},4,\frac{9}{2})-(\frac{7}{2},4,\frac{9}{2})}\right| = 0.172$$

Upon comparing the results presented with the values outlined in table 4.22, a consistent pattern is observed in the assessments made by manager 1.

The outcomes of the overall input-based consistency ratio for each criterion and the extent of internal consistency across all managers can be observed in table 4.23.

Table 4.23 Global Input-Based Consistency Ratio and The Local Consistency Level of Each Manager

MANAGER	$\mathbf{CR^I}$	$\mathbf{CR_1^I}$	$\mathbf{CR_2^I}$	$\mathbf{CR_3^I}$	$\mathbf{CR_4^I}$	$\mathbf{CR_5^I}$	$\mathbf{CR_6^I}$
M1	0.172	0.172	0	0	0.0069	0	0.172
M2	0.172	0.172	0.172	0	0.172	0.041	0
M3	0.164	0	0.164	0.164	0	0.02	0.164
M4	0.172	0	0	0.172	0.172	0.172	0.172
M5	0.172	0	0.041	0.041	0.172	0.172	0
M6	0.172	0.172	0.172	0	0.165	0.0069	0
M7	0.164	0.164	0.048	0.164	0	0	0
M8	0.172	0	0.172	0.172	0.0069	0	0.172
M9	0.089	0.089	0.089	0	0	0.025	0.089
M10	0.089	0	0.089	0.089	0.089	0	0.089
M11	0.172	0.172	0.172	0	0	0.172	0.172
M12	0	0	0	0	0	0	0
M13	0.172	0.172	0.172	0.041	0	0.172	0

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Upon comparing the values derived from table 4.23 with those presented in table 4.22, it can be inferred that a uniformity exists in the judgments made by all managers.

Subsequent to establishing the consistency in managers' judgments, the next step involves computing the weights for the criteria.

Step 3. Calculating Criteria Weights

To determine the weights of the criteria, the following linear programming model is suggested (Amiri et al., 2020):

Min $\sum_i k_i^*$

s.t.

$$\begin{cases} \left| \frac{(l_B^i, m_B^i, u_B^i)}{(l_j^i, m_j^i, u_j^i)} - l_{Bj}^i, m_{Bj}^i, u_{Bj}^i \right| \le k_i^* \\ \left| \frac{(l_j^i, m_j^i, u_j^i)}{(l_W^i, m_W^i, u_W^i)} - l_{jW}^i, m_{jW}^i, u_{jW}^i \right| \le k_i^* \\ \sum_{j=1}^{6} R(\widetilde{W}_j^i) = 1 \\ l_j^i \le m_j^i \le u_j^i \\ l_j^i > 0 \\ k_i^* \ge 0 \\ j = 1,2,3,4,5,6 \\ i = 1,2,\dots,13 \\ \mu_j = \frac{\sum R(\widetilde{W}_j^i)}{d}, \quad \forall j \end{cases}$$

where $\widetilde{W}_B^i = (l_B^i, m_B^i, u_B^i)$,$\widetilde{W}_W^i = (l_W^i, m_W^i, u_W^i)$,$\widetilde{W}_j^i = (l_j^i, m_j^i, u_j^i)$, $\widetilde{\square}_{Bj}^i = (l_{Bj}^i, m_{Bj}^i, u_{Bj}^i)$, $\tilde{a}_{jW}^i = (l_{jW}^i, m_{jW}^i, u_{jW}^i)$, $\tilde{\xi}_i = (k_i^*, k_i^*, k_i^*)$

$i \in D = \{1,2,\dots,13\}$: indices of decision makers (managers);

$j \in C = \{1,2,\dots,6\}$: indices of criteria

$l \in A = \{1,2,\dots,6\}$: indices of alternative

B: indices of the best criterion

W: indices of the worst criterion

$\widetilde{W}_B^i$: the fuzzy weight of the best criterion for the i[th] decision maker

$\widetilde{W}_W^i$: the fuzzy weight of the worst criterion for the i[th] decision maker

$\tilde{\xi}_i$: the fuzzy dependent variable of consistency ratio for the i[th] decision maker

$\widetilde{W}_j^i$: the fuzzy weight of criterion j for the i[th] decision maker

μ_j: aggregated weight of criterion j

$\tilde{a}_{Bj}^i$: the fuzzy value of best criterion over j[th] criterion for i[th] decision maker

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$\tilde{a}_{jW}^{i}$: the fuzzy value of j[th] criterion over the worst for i[th] decision maker

Suppose $\tilde{\xi}_i=(k_i^*, k_i^*, k_i^*)$, the model could be transformed as follow:

In my study, there are a total of 6 criteria and 13 managers (decision makers) involved. The extended model, which takes into account both the number of criteria and decision makers, is presented in Appendix C-Extended model for criteria weights. Upon extracting the necessary data from tables 4.20 and 4.21 and incorporating them into the model, the criteria weights are derived. Solving the model by applying Lingo 18.0 software and using the provided data in table 4.24 (see Appendix C), the final weights of each criterion are indicated in table 4.25.

Table 4.25 Aggregated weights of criteria

μ_1 (Formality)	**0.202**
μ_2 (Clarity)	0.201
μ_3 (Mesurability)	0.186
μ_4 (Objectivity)	0.114
μ_5 (Coverage)	0.135
μ_6 (Consistency)	0.165

Analysis of criteria: criterion C1 (formality) was assigned the highest weight (0.202), while criterion C4 (objectivity) was allocated the lowest weight (0.114). This indicates that formality holds the utmost significance as a criterion, whereas objectivity is deemed the least significant in the assessment of strategic planning models by managers in the manufacturing SMEs $\mu_1 > \mu_2 > \mu_3 > \mu_6 > \mu_5 > \mu_4$.

Step 4. Determining Fuzzy Values of Strategic Planning Models

To determine the ultimate fuzzy values of strategic planning models, equations 10-12 can be utilized. The normalized value of alternative l for criterion j, as designated by the i[th] decision maker, may be utilized for positive and negative criteria in equations 11 and 12, respectively. (Amiri et al., 2020):

$$\tilde{V}_l^i = \sum_{j=1}^{n} \mu_j \tilde{p}_{lj}^i \quad \text{for all l} \qquad \text{Eq(10)}$$

$$\tilde{p}_{lj}^i = \frac{\tilde{x}_{lj}^i}{\sum_j \tilde{x}_{lj}^i} \quad , \quad \text{for positive criteria} \qquad \text{Eq(11)}$$

$$\tilde{p}_{lj}^i = \frac{\frac{1}{\tilde{x}_{lj}^i}}{\sum_j \frac{1}{\tilde{x}_{lj}^i}} \quad , \quad \text{for negative criteria} \qquad \text{Eq(12)}$$

$$\tilde{x}_{lj}^i = (a_{lj}^i, b_{lj}^i, c_{lj}^i)$$

Where

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μ_j : aggregated weight of criterion j ,

$\tilde{p}_{lj}^{i}$: the normalized value of the alternative l for criterion j assigned by i^{th} decision maker

$\tilde{x}_{lj}^{i}$: the value of alternative l for criterion j for the i^{th} decision maker

In order to obtain pertinent data to determine the ultimate ranking of strategic planning models, an initial step involved providing managers with a sheet that detailed the description and summary of each strategic planning model. Following a review of the strategic planning descriptions by the managers, they were inquired about the degree to which strategic planning models addressed criteria such as formality, clarity, measurability, objectivity, coverage, and consistency from their perspective. Managers were required to articulate their responses to the question using linguistic expressions. (Very Low(LV), Low(L), Moderate(M), High(H), Very High(VH)).

Six strategic planning models (Bryson, Wright, Wheelen, Hill and Jones, Bowman and Asch, David) are regarded as the potential options to be evaluated according to the six criteria. Table 4.26 to 4.31 illustrates the responses provided by the managers in relation to the evaluation of each strategic planning model according to the established criteria.

Table 4.26 Assessment of Bryson Model Based on the Criteria

Criteria	*Formality*	*Clarity*	*Measurability*	*Objectivity*	*Coverage*	*Consistency*
Manager 1	M	H	M	M	H	L
Manager 2	VH	VH	M	M	H	L
Manager 3	H	M	M	H	M	L
Manager 4	H	H	L	M	H	M
Manager 5	H	VH	M	H	M	VH
Manager 6	M	H	L	L	M	H
Manager 7	VH	H	H	M	H	H
Manager 8	M	H	M	L	M	M
Manager 9	VH	H	M	M	M	H
Manager 10	H	M	H	H	M	H
Manager 11	H	H	VH	H	H	H
Manager 12	H	M	M	H	H	M
Manager 13	H	L	M	M	H	M

Table 4.27 Assessment of Wright model based on the criteria

Criteria	*Formality*	*Clarity*	*Measurability*	*Objectivity*	*Coverage*	*Consistency*
Manager 1	H	L	M	M	H	M
Manager 2	M	H	L	H	VH	H
Manager 3	M	L	H	VL	M	H
Manager 4	M	M	L	M	M	L
Manager 5	H	M	L	M	H	M
Manager 6	H	H	L	L	M	M
Manager 7	M	L	VL	M	M	M
Manager 8	H	H	M	VL	M	M

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Manager 9	L	L	L	M	M	M
Manager 10	L	L	L	L	L	L
Manager 11	M	H	M	H	H	M
Manager 12	M	H	H	M	H	H
Manager 13	M	L	H	H	H	H

Table 4.28 Assessment of Wheelen model based on the criteria

Criteria	*Formality*	*Clarity*	*Measurability*	*Objectivity*	*Coverage*	*Consistency*
Manager 1	H	M	M	M	H	M
Manager 2	M	L	L	M	VH	H
Manager 3	H	M	M	H	M	H
Manager 4	M	L	L	M	H	H
Manager 5	VH	M	L	M	H	H
Manager 6	M	H	H	H	VH	VH
Manager 7	M	VH	VH	VH	H	M
Manager 8	M	M	H	M	H	L
Manager 9	L	L	L	H	H	H
Manager 10	H	H	H	H	H	H
Manager 11	H	H	H	H	H	M
Manager 12	M	H	H	M	H	H
Manager 13	H	M	M	H	H	VH

Table 4.29 Assessment of Hill and Jones Model Based on the Criteria

Criteria	*Formality*	*Clarity*	*Measurability*	*Objectivity*	*Coverage*	*Consistency*
Manager 1	H	H	M	H	H	H
Manager 2	M	M	H	L	L	H
Manager 3	H	M	M	M	H	H
Manager 4	H	M	L	H	M	M
Manager 5	VH	VH	M	H	H	H
Manager 6	H	VH	H	H	H	M
Manager 7	VH	VH	H	VH	VH	H
Manager 8	VH	H	H	M	H	H
Manager 9	H	M	M	H	H	H
Manager 10	L	H	L	L	H	H
Manager 11	H	M	H	M	H	H
Manager 12	VH	M	H	H	M	H
Manager 13	H	M	M	M	H	H

Table 4.30 Assessment of Bowman and Asch Model Based on the Criteria

Criteria	*Formality*	*Clarity*	*Measurability*	*Objectivity*	*Coverage*	*Consistency*
Manager 1	H	M	H	M	H	H
Manager 2	M	VH	VH	H	H	H
Manager 3	H	M	M	M	M	H
Manager 4	M	L	M	L	M	H
Manager 5	VH	H	M	H	VL	L
Manager 6	H	VH	VH	H	VH	VH
Manager 7	H	M	M	H	H	VH
Manager 8	H	H	VH	M	M	L
Manager 9	L	L	L	M	M	H

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Manager 10	L	L	L	L	H	H
Manager 11	M	H	H	H	H	VH
Manager 12	H	H	M	H	M	H
Manager 13	M	H	H	M	H	H

Table 4.31 Assessment of David Model Based on the Criteria

Criteria	*Formality*	*Clarity*	*Measurability*	*Objectivity*	*Coverage*	*Consistency*
Manager 1	H	H	H	H	H	H
Manager 2	H	VH	VH	H	H	H
Manager 3	H	H	H	H	H	H
Manager 4	M	L	M	M	H	H
Manager 5	H	M	M	H	L	M
Manager 6	H	H	M	H	VH	VH
Manager 7	H	H	M	M	H	VH
Manager 8	VH	H	VH	M	L	M
Manager 9	H	H	H	H	H	H
Manager 10	H	H	L	L	H	H
Manager 11	VH	H	H	M	H	H
Manager 12	H	H	H	M	H	L
Manager 13	H	H	H	M	H	H

Converting the Linguistic Terminology into Fuzzy Triangular Numbers through the utilization of Table 4.32.

Table 4.32 Linguistic Variables Transformation Rules

Linguistic terms	**Very Low (VL)**	**Low (L)**	**Medium (M)**	**High (H)**	**Very High (VH)**
TFN	(0,0.1,0.3)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.7,0.9,1)

Retrieved from Tavana et al. (2021)

By utilizing table 4.32, the linguistic terms are transferred to ascertain the fuzzy values of every strategic planning model according to each criterion as presented in tables 4.33 to 4.38 (refer to Appendix C) for individual managers. The subsequent phase involves the normalization of alternative values for each criterion. Given that all criteria exhibit positivity, the normalization process involves the utilization of equation 11. The normalized fuzzy values of strategic planning models based on individual criteria are illustrated in Tables 4.40 to 4.45 (refer to Appendix C). Upon completion of the normalization process, the ultimate ranking of strategic planning models can be derived by employing equation 10.

The final fuzzy value of each strategic planning model ($\tilde{V}_1^i$) for each manager is shown in figures 4.13 to 4.19.

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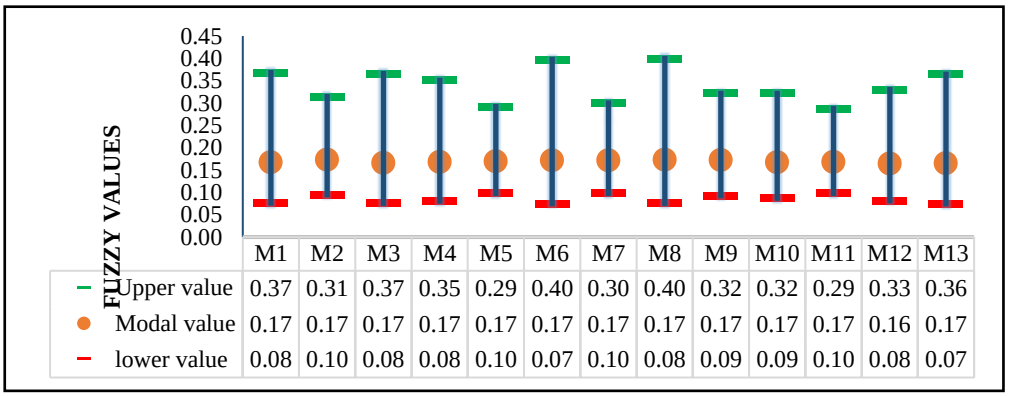
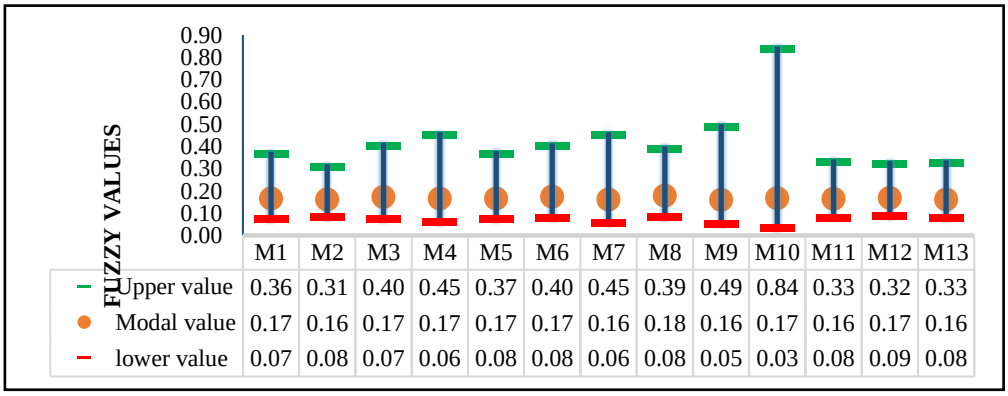


	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Upper value	0.37	0.31	0.37	0.35	0.29	0.40	0.30	0.40	0.32	0.32	0.29	0.33	0.36
Modal value	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.17
lower value	0.08	0.10	0.08	0.08	0.10	0.07	0.10	0.08	0.09	0.09	0.10	0.08	0.07

Figure 4.13 Fuzzy Values of Bryson Model

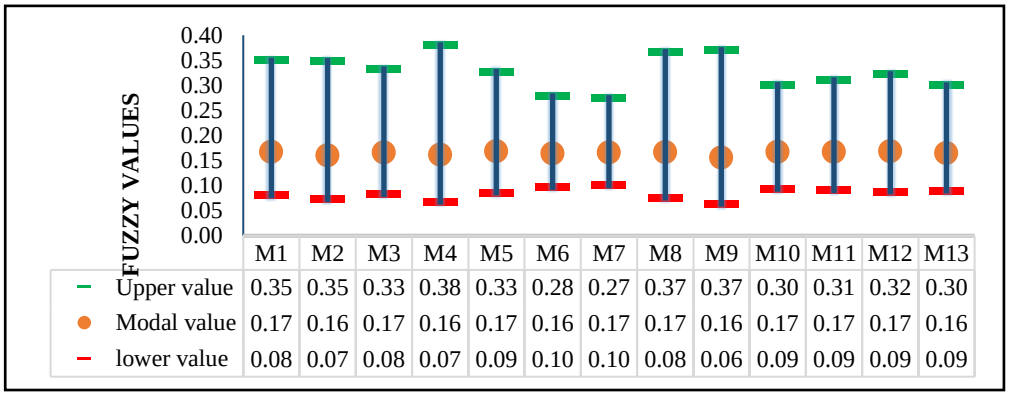
Based on the analysis of the upper threshold in the data presented in figures 4.13, Bryson's framework for strategic planning was rated most favorably by the individuals representing the perspectives of managers 6 and 8 (referred to as M6 and M8).



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Upper value	0.36	0.31	0.40	0.45	0.37	0.40	0.45	0.39	0.49	0.84	0.33	0.32	0.33
Modal value	0.17	0.16	0.17	0.17	0.17	0.17	0.16	0.18	0.16	0.17	0.16	0.17	0.16
lower value	0.07	0.08	0.07	0.06	0.08	0.08	0.06	0.08	0.05	0.03	0.08	0.09	0.08

Figure 4.14 Fuzzy Values of Wright Model

From the perspective of manager 10 (M10), Wright's strategic planning model has achieved the top score in the upper echelon. When considering these upper echelons, a notable disparity emerges in the assessment of Wright's strategic planning model between manager 10 (M10) and other managerial perspectives.



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Upper value	0.35	0.35	0.33	0.38	0.33	0.28	0.27	0.37	0.37	0.30	0.31	0.32	0.30
Modal value	0.17	0.16	0.17	0.16	0.17	0.16	0.17	0.17	0.16	0.17	0.17	0.17	0.16
lower value	0.08	0.07	0.08	0.07	0.09	0.10	0.10	0.08	0.06	0.09	0.09	0.09	0.09

Figure 4.15 Fuzzy Values of Wheelen Model

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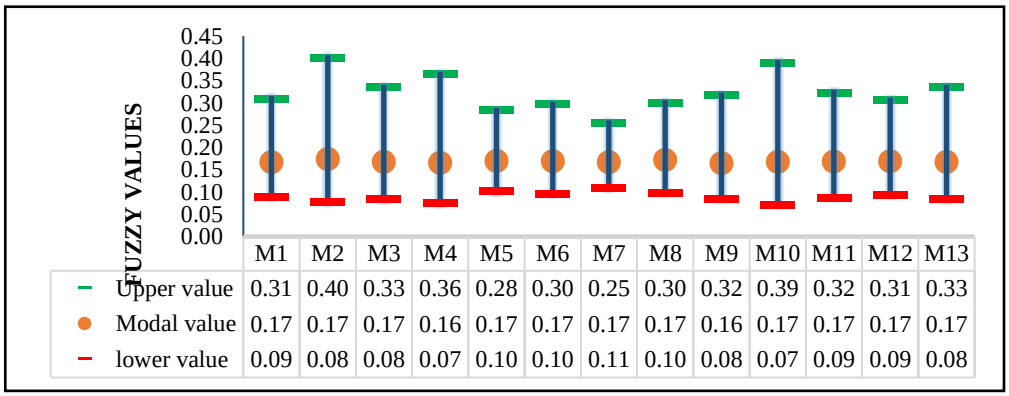
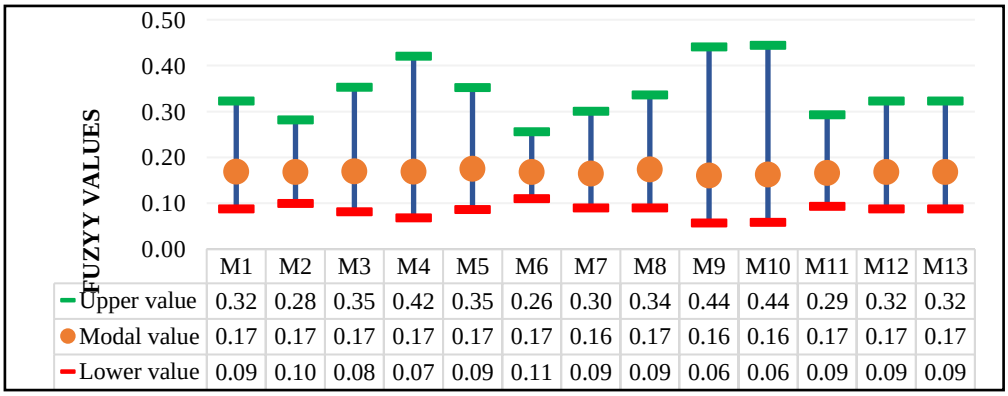
The upper values depicted in figures 4.15 indicate that M4, M8, and M9 are proponents of the Wheelen strategic planning model.



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Upper value	0.31	0.40	0.33	0.36	0.28	0.30	0.25	0.30	0.32	0.39	0.32	0.31	0.33
Modal value	0.17	0.17	0.17	0.16	0.17	0.17	0.17	0.17	0.16	0.17	0.17	0.17	0.17
lower value	0.09	0.08	0.08	0.07	0.10	0.10	0.11	0.10	0.08	0.07	0.09	0.09	0.08

Figure 4.16 Fuzzy Values of Hill and Jones model

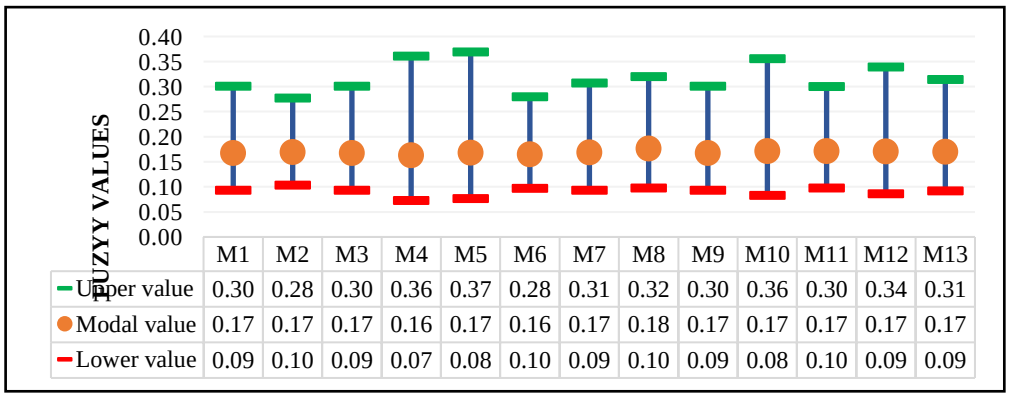
Hill and Jones' strategic planning model received the most significant approval from managers 2 and managers 10, respectively, in terms of their standpoint.



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Upper value	0.32	0.28	0.35	0.42	0.35	0.26	0.30	0.34	0.44	0.44	0.29	0.32	0.32
Modal value	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.17	0.16	0.16	0.17	0.17	0.17
Lower value	0.09	0.10	0.08	0.07	0.09	0.11	0.09	0.09	0.06	0.06	0.09	0.09	0.09

Figure 4.17 Fuzzy Values of Bowman and Asch Model

Based on the upper values presented in graph 4.17, it can be observed that managers 9, 10, and 4 exhibit a higher inclination towards the Bowman and Asch strategic planning model in comparison to the perspectives of other managers.



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
Upper value	0.30	0.28	0.30	0.36	0.37	0.28	0.31	0.32	0.30	0.36	0.30	0.34	0.31
Modal value	0.17	0.17	0.17	0.16	0.17	0.16	0.17	0.18	0.17	0.17	0.17	0.17	0.17
Lower value	0.09	0.10	0.09	0.07	0.08	0.10	0.09	0.10	0.09	0.08	0.10	0.09	0.09

Figure 4.18 Fuzzy Values of David Model

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With regard to the higher value depicted in figures 4.18, there exist no substantial discrepancies among the perspectives of managers concerning the David strategic planning framework. It can be inferred that David's strategic planning model received identical appraisal from the viewpoints of all managers.

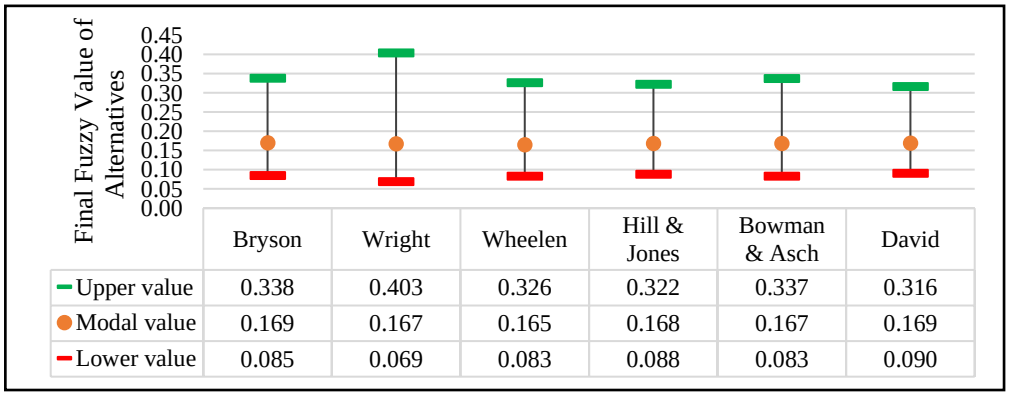
Step 5. Evaluating and Prioritizing Strategic Planning Models

The ultimate fuzzy rank of strategic planning models must be determined through the integration of all fuzzy values. Consistent with Norouzi and Namin (2019); Guo and Qi (2021); Haseli et al. (2021), the current investigation employs the geometric mean to amalgamate the fuzzy values of strategic planning models. This approach circumvents the utilization of outlier values that could impact the overall scenario.

The geometric average is defined as the result of computing the n^{th} root of the products of various values, with n representing the total number of values under consideration. A data collection of values $\{v_1, v_2, \dots, v_n\}$ is given by its geometric average, GA. The calculation of the geometric mean for a data set $\{v_1, v_2, \dots, v_n\}$ is as follows (Yousefi and Carranza, 2015):

$$G_A(v_1, v_2, \dots, v_n) = \left(\prod_{i=1}^{n} v_i\right)^{1/n} = \sqrt[n]{v_1 . v_2 . \dots . v_n} \quad \text{Eq(13)}$$

Utilizing the concept of the geometric mean, the ultimate fuzzy value of the alternatives is depicted in figures 4.19.



	Bryson	Wright	Wheelen	Hill & Jones	Bowman & Asch	David
Upper value	0.338	0.403	0.326	0.322	0.337	0.316
Modal value	0.169	0.167	0.165	0.168	0.167	0.169
Lower value	0.085	0.069	0.083	0.088	0.083	0.090

Figure 4.19 Final Fuzzy Value of Alternatives

Taking into account the higher values attributed to various models, the strategic planning models can be ranked in the following order: Wright ≻ Bryson ≻ Bowman and Asch ≻ Wheelen ≻ Hill and Jones ≻ David. When considering the modal values, the ranking of the models changes to Bryson ≈ David ≻ Hill and Jones ≻ Wright ≈ Bowman and Asch ≻ Wheelen. On the other hand, a different prioritization is obtained when lower values are applied, with David ≻ Hill and Jones ≻ Bryson ≻ Wheelen ≈ Bowman and Asch ≻ Wright.

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Step 6. Defuzzification of Fuzzy Values

To achieve a precise set of options, the process of defuzzification of fuzzy outcomes becomes essential. By employing equation 9, the ultimate set of options is derived, as illustrated in Table 4.45.

Table 4.45 Final Alternative Values

	Crisp Value
Bryson	0.183
Wright	0.190
Wheelen	0.178
Hill & Jones	0.180
Bowman & Asch	0.182
David	0.180

In light of the clear significance, the ultimate ranking of strategic planning models can be delineated as follows:

Wright surpasses Bryson, which in turn surpasses Bowman and Asch, with David being equivalent to Hill and Jones, and followed by Wheelen (Wright≻ Bryson≻ Bowman and Asch≻ David≈ Hill and Jones≻ Wheelen).

Thus, the response to the principal inquiry regarding the precedence of strategic planning models in Iranian manufacturing SMEs has been answered.

Findings: The outcomes illustrate that Wright's strategic planning model, as an applied model, is given the highest priority according to the perspective of managers within manufacturing SMEs. Following this, Bryson, Bowman and Asch, David, Hill and Jones, and Wheelen are placed in subsequent priorities. When compared to other models examined in the research, Wright's strategic planning model is characterized as relatively uncomplicated and comprehensible for both managers and employees in SMEs. Consequently, it can be inferred that managers within Iranian manufacturing SMEs in the province of Esfahan prefer to use a model that is not only practical but also easy to use.

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5. Conclusion and Recommendation

This chapter provides a summary of the whole thesis. It covers a discussion, conclusion, recommendation, and limitation of the current study. This study's primary goal was not only to examine the hypotheses and concepts from earlier studies that proposed a significant effect between strategic planning and the performance of SMEs but also to evaluate strategic planning models using fuzzy best-worst decision-making in Iranian manufacturing SMEs. Research questions and hypotheses were formulated, and survey instruments were created to collect data for the study to empirically assess the relationship between strategic planning and performance, besides, to evaluate strategic planning models in Iranian SMEs.

Discussion

Discussion Part I

Results from data analysis on the features of SMEs concerning the impact of variables as related to the engagement of strategic planning, planning sophistication did not demonstrate a significant convergence, except for the impact of organization age on engagement with strategic planning. SMEs' size does not have any significant effect on the engagement of organizations with strategic planning, the planning sophistication and innovativeness, this is in agreement with Wijewardena et al. (2004), Yusuf and Saffu (2005), Brown (2008). The results are in contrast to the study of Bracker and Pearson (1986) that confirmed the organization's features affect engagement with strategic planning, planning sophistication. Additionally, in line with Hoffman (2007) and Kim et al., (2009), Parboteeah et al. (2005), the quantitative data also demonstrated good validation in the comprehended impact of individuals' cultural inclusion and faith/religion on the attitude and involvement of Iranian SMEs in strategic planning. Considering flexibility as one of the dimensions of strategic planning, the quantitative data analysis, in line with White (1988) and Salavou and Avlonitis (2008), confirmed that flexibility could affect SME performance. Moreover, flexibility can affect the innovativeness of SMEs. Finally, in agreement with Thaher and Jaaron (2022), Haleem et al. (2019), Donkor et al. (2018), Skokan et al. (2013), Owolabi and Makinde (2012), Aldehayyat and Twaissi (2011), Gaál and Fekete (2011), Aldehayyat and Twaissi (2011), Wilson and Eilertsen (2010), Elbanna (2009), Glaister et al. (2008), Dibrell et al. (2007), Al-shammari and Hussein (2007), Kraus et al. (2006), self-reported data analysis on the supposed effect of

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strategic planning on SMEs' performance, validates the main hypothesis that "applying strategic planning has a significant impact on SME's performance". However, the dimensions of applying strategic planning, separately, do not significantly impact SMEs' performance except in the flexibility dimension.

Discussion Part II

The second part of the current study was intended to investigate an appropriate strategic planning model for Iranian manufacturing SMEs in the provenience of Esfahan using a multi-criteria decision-making technique (the fuzzy best worst method). Although many authors and creators of strategic planning models expressed that all kinds of models can be used depending on the situation, the fact that the nature of the application of strategic planning models is not clear and there is no guidance in this field, many organizations in the way of planning are faced strategic problems and suffered significant losses. Therefore, some of the small and medium-sized enterprises searching for suitable strategic planning to apply in their organizations. So, this issue motivated me to do the second part of the current research and recommend a strategic planning model for the SMEs. To the best of my knowledge, no research has been done to assess different strategic planning models for Iranian manufacturing SMEs by applying multi-criteria decision-making techniques. There are only two studies that have been done in Iran regarding assessing strategic planning models. Khatami and Mehdidzade (2008) focused on eighteen strategic planning models (David, Hill, Wright, Bryson, …) in manufacturing, industrial, commercial and service organization and compare the models, presenting the advantages and disadvantages of each model. Finally, they presented a comprehensive strategic planning model for applying in the organizations. Another study classified strategic planning models by focusing on the type of organization ("Classification of ...", 2016). In addition, Aghazadeh (2003) did a comparative study and evaluate different strategic planning models (Tylor, Wright, Hill, Bryson, Glueck, …) for small organizations. He proposed a conceptual model based on the comparative analysis of different models. None of the previous studies assessed strategic planning models by applying a multi-criteria decision-making technique, particularly in Iranian small and medium-sized enterprises. Prioritizing strategic planning models using the fuzzy best-worst method, Wright's strategic planning model based on the 13 managers' judgments got the highest score among all the models which shows managers in SMEs tend to apply a practical and easy-to-understand model. Also, the formality criterion was the most important criterion from the SME managers' standpoint in evaluating the strategic planning models.

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Conclusion

It was necessary to employ quantitative methodologies in this study to determine whether strategic planning actually impacts the performance of Iranian manufacturing SMEs, and which strategic planning model is preferred for applying to the SMEs.

The developed economies of the West were the main focus of a number of earlier studies on related subjects. In contrast to other studies that concentrated on Western economies and only took into consideration particular attributes related to SMEs, the current study not only focuses on an Eastern economy but also evaluated other aspects like innovations, flexibility, engagement, cultural inclusion, and faith in SMEs. Moreover, prioritizing strategic planning models by applying the MCDM technique has never been focused at least in developing countries.

To conclude, a researcher can use data analysis. The quantitative approach made it possible to summarize features across groups or relationships and to generalize the findings to other study geographical areas. The following was obtained by the analysis of the study results:

- The majority of Iranian SMEs adopt strategic planning and have written, structured strategic plans for 1-2 years.
- By showing the impact of applying strategic planning and performance, this study generally confirmed recognized trends from other studies on strategic planning and SMEs' performance.
- All the alternative hypotheses of this study were accepted except the hypotheses that test the impact of organizations' size on planning sophistication, innovativeness, and engagement with strategic planning. Also, the alternative hypotheses were rejected in examining the effect of organization age on innovativeness, and dimensions of applying strategic planning (except flexibility) on performance.
- The manufacturing SMEs prefer a strategic planning model which is not only practical but also easy to use and easy to perceive like Wright's strategic planning model.

In conclusion, it is noteworthy that the majority of Iranian manufacturing SMEs are engaged in strategic planning. The results of hypothesis testing acknowledge that applying strategic planning affects Iranian manufacturing SMEs' performance. Moreover, Wright's strategic planning model is the most favorable one among Iranian manufacturing SMEs.

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Limitations of the Study

Although this study achieved a lot of progress in terms of theory and practice, there are still certain limitations that should be mentioned. As a result of time and resource limits, there are restrictions on the sample's size and distribution. Compared to most other studies with a similar focus, this study used a number of participants for the quantitative investigation, however, the sample was only drawn from a few Iranian states.

Also, there was a restriction on the availability of an up-to-date database of small enterprises that were registered in the study area. Identifying the needed number of SMEs took much longer than it would have if there were an up-to-date database.

Furthermore, due to time and resource limitations, it was not possible to condense the study population into one homogeneous industry.

Recommendation

Despite the limitation of this study, it is strongly advised that future studies investigate a range of concerns from different perspectives for the subject matter due to the dearth of empirical data on the topic mentioned for the study's location. The following ideas for further research are thus suggested:

- Extending the geographic scope of data collection to include all areas and organizations in the research location.
- Focusing on homogeneous industries instead of different unrelated industries in the manufacturing section
- Instead of a cross-sectional study, apply longitudinal research
- Applying other fuzzy MCDM techniques (e.g., Fuzzy AHP, Fuzzy TOPSIS, Fuzzy ELECTRE) and comparing the results in evaluations of strategic planning models.
- Using hybrid fuzzy MCDM techniques.

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List of Scientific Publications

1	***Ajripour, I.,*** *Appluing a Hybrid MCDM Technique in Warehouse Management. Vezetéstudomány/Budapest Management Review, 2022, https://journals.lib.uni-corvinus.hu/ (It will be published in November 2022 forthcoming issue).*
2	***Ajripour, I.***, Molnar, V., A Case Study in Strategic Decision Making Using Multi-Criteria Decision Making and Balanced Scorecard. International Journal of Applied Decision Sciences, 2022, ISSN 1755-8085 (Electronic). DOI: 10.1504/IJADS.2022.10045461
3	***Ajripour, I.***, "Supplier Selection during Covid-19 Pandemic Situation by Applying Fuzzy TOPSIS Method: A Case Study", Acta Universitatis Sapientiae, Economics and Business journal, 2022, ISSN 2260-0047 (Electronic). DOI: https://doi.org/10.2478/auseb-2022-0006
4	***Ajripour, I.***, "AN APPLICATION OF ANALYTIC HIERARCHY PROCESS FOR SELECTING THE BEST SUPPLIER", The PhD forum organized by the University of Miskolc Faculty of Economics, November 2020. (In proceedings)
5	***Ajripour, I***., Ranjbar, S., "MULTI-CRITERIA CLASSIFICATION OF SPARE PARTS - CASE STUDY", International conference on Decision making for Small and Medium-Sized Enterprises (DEMSME 2021), School of Business Administration in Karvina at Silesian university in Opava, May 13- 14th 2021. *https://demsme.opf.slu.cz/conference-proceedings*
6	***Ajripour, I.,*** "Applying Linear Assignment Method in assessing suppliers during COVID-19 pandemic situation- Case study", 4th Smart Communities Academy: Building Smart Communities for the Future-International Conference at Technical University of Kosice-Slovakia, October 7-8th 2021. http://smartcommunities.eu/en/activities/smart-communities-2-0/smart-academy/4-th-smart-communities-academy
7	***Ajripour, I***., Alamian, R., Comparing Green Economy in Iran with OECD Asian Countries by Applying TOPSIS and GI Method. THEORY METHODOLOGY PRACTICE: CLUB OF ECONOMICS IN MISKOLC, 2021, 17 (1). pp. 15-26. ISSN 1589-3413 (print); 2415-9883. http://real.mtak.hu/127425/
8	***Ajripour, I.***, "Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors: A case study", The European Union's contention in the reshaping global economy organized by the University of Szeged Faculty of Economics and Business Administration, 2020. *http://acta.bibl.u-szeged.hu/71538/*
9	***Ajripour, I***., Asadpour, M., Tabatabaie, L. A model for organization performance management applying MCDM and BSC: a case study. Journal of Applied Research on Industrial Engineering, 2019; 6(1): 52-70. doi: 10.22105/jarie.2019.171886.1080

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Appendix A

Questionnaire of Quantitative Survey

Ph.D. Thesis Questionnaire

Tile of thesis: The impact of applying strategic planning on enterprises' performance and evaluating strategic planning models by applying FBWM in Iranian SMEs.

Instruction

This questionnaire aims to collect data to confirm the impact of applying strategic planning on Iranian SMEs' performance in the manufacturing-related industry.

Due to your role as an owner, manager, or expert and a member of the strategic planning team, you have been sent this questionnaire.

I request all respondents to help me in completing my research by sending their real and valuable answers.

The maximum time to complete this questionnaire is 8 minutes.

The data collected in this questionnaire will be used anonymously to answer the study questions while maintaining the confidentiality of all information.

Thank you in advance for your help and consideration.

Please insert your email address: …….

Please insert the name of your business: ……..

Part I

---

1. Which of the following describes your job title? If other, please specify.

Owner ….	Manager ….
Partner ….	Boss ….
President ….	Administrator ….
CEO ….	Expert ….
Managing Director ….	Other ….

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2. What is your age group?

   18-27 …. 48-57 ….

   28-37 …. 58-67 ….

   38-47 …. Above 68 ….

3. What is your gender?

   Man …. Woman …. Prefer not to say ….

4. What is your academic qualification? If other, please specify.

   High school diploma …. Associate diploma ….

   Bachelor …. Master ….

   Ph.D. …. Other ….

5. How many years have your company been operating? ….. Years …. Months

6. What is the ownership status of your company? If other, please specify.

   I am the only owner …. Family owned ….

   Partnership …. Community/association owned….

   Other ….

7. What is the estimated number of employee in your organization? ….

8. What is the estimated value of your company's assets (except land and buildings)?

   Less than 30000 €…. Between 30000-300000 €….

   Between 300000-1500000 € …. More than 1500000 €….

9. Does your company have a formal strategic plan?

   Yes …. No …. Not sure ….

   9.1. If yes, which of the following is similar to strategic planning in your company?

   Structured strategic planning …

   Structured operational planning (Monthly-Weekly planning) ….

   Intuitive planning (Daily planning) ….

   Unstructured planning (making decision without prior planning) ….

   9.2. If yes, choose the timeframe that the strategic plan covered.

   Less than one year …. 1-2 years ….

   3-4 years …. 5-6 years….

   7 or more years ….

   9.3. How long has your company been using written strategic planning?

   Never use …. Less than one year ….

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1-2 years …. 3-4 years….

5-6 years …. 7 or more years ….

10. What key goal do you have in mind when you are planning for your company?

Make much profit to support business growth (capital growth) ….

Make much profit to continue business operating (sales earning) ….

Expanding the business and adding more branches for customers (Highest market share) …

Keep expanding until the company becomes a big corporation or conglomerate (International expansion) ….

11. Please indicate the person or unit that is primarily responsible for development of strategic planning in your company. If other, please specify.

Owner ….

CEO ….

Strategic planning committee consisting of selected members of senior management ….

A centralized strategic planning department ….

Other ….

12. Does your company use national and international consultants in developing strategic planning?

Yes …. No ….

13. Does your faith/religion affect your business decisions or ethics?

Yes …. No ….

Not sure … Don't know ….

14. My faith and beliefs have played an important role in my business decision and success?

Yes …. No …. Not sure ….

14.1. If yes, which of the following is true? (possible to select more than one option)

…. My faith/belief impact on the type of job I do and how I go about it.

…. My faith/belief can prevent me from doing some businesses

…. My faith/belief can determine who I employ (male or female with different faith and beliefs)

…. My business identity, including symbols, rituals, and the language of communication, is a reflection of my beliefs.

15. The standard behavior patterns of society (respecting others, being on time, etc.) are considered important in my organization.

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True …. False …. Not sure ….

15.1. If true, select one or more of the following options.

…. In return for business favor, my company provides gifts.

…. I adopt more time than the agreed time for business meetings.

…. I am adaptable and patient with lateness when I have business appointment.

…. I am in favor of closing the organization for events such as weddings, mourning and religious meetings.

Part II

Please indicate your level of agreement with each of the following questions. Strongly agree (SA), Agree (A), Neutral (N), Disagree (D), Strongly Disagree (SD)		SA (5)	A (4)	N (3)	D (2)	SD (1)
1	My organization has a strategic plan.	5	4	3	2	1
2	There is extensive participation by management team in the selection of strategy.	5	4	3	2	1
3	There is extensive participation by management in strategic plans evaluation.	5	4	3	2	1
4	There is extensive management participation in strategic alternatives development.	5	4	3	2	1
5	There is a formal statement of business goals and objectives in my organization.	5	4	3	2	1
6	There is a formal statement of mission in my organization.	5	4	3	2	1
7	My organization has established both long-range and short range strategies.	5	4	3	2	1
8	My company considers the long range implication of external environmental (political, social, technology and environmental) threats and opportunities.	5	4	3	2	1
9	My organization has formal procedures for assessing external environmental (political, social, etc.) threats and opportunities.	5	4	3	2	1
10	There is a extensive management participation in identifying external environmental (political, economic, social, etc.) threats and opportunities.	5	4	3	2	1
11	My organization uses mathematical models or computer simulations in the determination of strengths and weaknesses.	5	4	3	2	1
12	My organization uses mathematical models or computer simulations in developing strategic selection.	5	4	3	2	1
13	My organization uses mathematical models or computer simulation in developing strategic alternatives.	5	4	3	2	1
14	My organization uses mathematical models or computer simulations in the analysis of external environmental (political, economic, social, etc.) threats and opportunities.	5	4	3	2	1
15	My organization uses mathematical models or computer simulations in the review and assessment of strategic plans.	5	4	3	2	1
16	My organization follows a formal process for selecting strategies.	5	4	3	2	1
17	Budgets for strategic plan are developed in my organization.	5	4	3	2	1
18	The outcomes of my company strategic planning clearly outline what will be done, when and by whom.	5	4	3	2	1
19	After reviewing all feasible alternative strategies, the final organization strategies are selected.	5	4	3	2	1
20	Once a strategy had been selected, it is implemented.	5	4	3	2	1
21	There is a extensive management participation in determining organizational strength and weaknesses.	5	4	3	2	1
22	There is extensive management participation in establishing goals and objectives.	5	4	3	2	1

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23	There is extensive managerial participation in selecting company's strategies.	5	4	3	2	1
24	My company has selected specific strategies.	5	4	3	2	1
25	When selecting a strategy, my organization is concerned with long term effects.	5	4	3	2	1
26	There is a formal procedure for choosing strategy in my organization.	5	4	3	2	1
27	My organization develop budget for all strategic alternatives.	5	4	3	2	1
28	My company develops goals and objectives.	5	4	3	2	1
29	There is continuous review and assessment of strategic plan.	5	4	3	2	1
30	For implementing strategic plans, my organization provides adequate resources.	5	4	3	2	1
31	The long term effects of organizational strengths and weaknesses are assessed.	5	4	3	2	1
32	Long-range considerations are important in my company while developing alternative strategies.	5	4	3	2	1
33	Long-range factors in my compny are important when implementing strategy.	5	4	3	2	1
34	My company's sales/revenue growth rate is higher than that of its key competitors.	5	4	3	2	1
35	My company is establishing new sites/locations at a faster rate than that of key competitors.	5	4	3	2	1
36	My company's customer base is growing at a faster rate than that of key competitors.	5	4	3	2	1
37	My company is hiring more staff at faster rate than that of key competitors.	5	4	3	2	1
38	The staff in my company are more satisfied in comparison to the staff in key competitors.	5	4	3	2	1
39	The retention of staff in my company is at higher rate than the key competitors.	5	4	3	2	1
40	My faith has played a big role in my business success.	5	4	3	2	1
41	Time is considered as a resource in my company. Employees and I are very watchful of the time and show a positive attitude toward time.	5	4	3	2	1
42	Management and employees converse in a casual, informal manner that occasionally includes local dialect.	5	4	3	2	1
43	Management and employees are very dedicated to their jobs.	5	4	3	2	1
44	The norms, culture, and customs of the place of business are important in my organization.	5	4	3	2	1
45	There is a clear cut between my family life and my work life.	5	4	3	2	1
46	My organization changes its production with market demand.	5	4	3	2	1
47	My organization changes its product mix with market demand.	5	4	3	2	1
48	My organization changes fund resources when it is required.	5	4	3	2	1
49	My organization affords external fund resources when it is required.	5	4	3	2	1
50	My organization is financially flexible.	5	4	3	2	1
51	Communication between departments in our organizations is easy.	5	4	3	2	1
52	Bureaucracy has been reduced in our organization.	5	4	3	2	1
53	My organization is structurally flexible.	5	4	3	2	1
54	My organization is equipped with updated computer systems.	5	4	3	2	1
55	My company provides adaptable computer systems to different software and applications when it is required.	5	4	3	2	1
56	It is possible to add or reduce computing capacity of systems in our organization.	5	4	3	2	1
57	My company produce specialty product(s).	5	4	3	2	1
58	My company develop new products.	5	4	3	2	1
59	My company upgrade existing products appearance and performance.	5	4	3	2	1
60	My company innovate in the production processes.	5	4	3	2	1
61	My company invests in new research and development facilities to gain a competitive advantage.	5	4	3	2	1
62	My organization determined growth in sale as a business objective.	5	4	3	2	1
63	My organization determined capital growth as a business objectives.	5	4	3	2	1

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64	My organization determined market share as a business objectives.	5	4	3	2	1
65	My organization determined international expansion as a business objectives.	5	4	3	2	1

Structured Interview

Structured interviews of evaluating strategic planning models based on the fuzzy best worst method.

The data collected through this questionnaire will be treated in the strictest confidence, and it will only be presented in summary form, anonymously, without revealing the respondent's name or organization affiliation.

Part I

Six main criteria for evaluating strategic planning models are identified. A brief description of all the criteria is provided in below. Please read the short description and answer my questions.

Formality	strategic planning model includes all essential elements (vision, mission, values, strategic issues, strategic objectives, and strategies, performance measures).
Clarity	strategic objectives and strategies in the model could be clearly stated.
Measurability	Strategic objectives could be measured, monitored, and evaluated.
Objectivity	describe reliability and serviceability of strategic planning.
Coverage	the subjects such as operating environment, the strategic issues, and a set of strategies and action plans cover by SP model.
Consistency	the strategic planning model seems consistence in response to the environmental change.

1. From your points of view which of the criteria is the "**most important**" criterion in evaluating strategic planning models? (Select only one of the criteria) ……

2. How much more important is the criterion "**most important**" compared **to the others**? (Equally Important (EI), Weakly Important (WI), Fairly Important (FI), Very Important (VI), Absolutely Important(AI))

Criteria	Formality	Clarity	Measurability	Objectivity	Coverage	Consistency
……. (Most important criterion)	……..	……..	……..	……..	……..	……..

3. From your points of view which of the criteria is the "**least important**" criterion in evaluating strategic planning models? (Select only one of the criteria) ……..

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4. How much more important are other criteria compared to the “least important” criterion? (Equally Important (EI), Weakly Important (WI), Fairly Important (FI), Very Important (VI), Absolutely Important(AI))

Criteria	……. (Least important criterion)
Formality	
Clarity	
Measurability	
Objectivity	
Coverage	
Consistency	

Part II

Six different strategic planning models was selected for prioritization in manufacturing SMEs. A brief description of stages in each strategic planning model is provided.

Please read the first model description and let me know when you are ready to answer the question.

First Model (A1): A brief description of Bryson’s strategic planning model.

Step	**Description**
1	Develop initial agreement about strategic planning (purpose of effort, steps in the process, the role, functions and membership of a strategic planning coordinating committee/ strategic planning team).
2	Clarification and identification of formal and informal mandates (legislation, articles of incorporation or charters, regulations, and so on) placed on the organization.
3	Stakeholder analysis should be done.
4	Developing and clarifying mission and values in the organization
5	External environmental assessment (identify the political, economic, social and technological opportunities and threats and internal environmental assessment (to identify organization’s strengths and weaknesses).
6	Identification of strategic issues that affects survival, prosperity, and effectiveness of the organization.
7	Strategy development (practical alternatives, dreams, or visions) for resolving strategic issues.
8	Determination of the actions needed over the next one to two years to implement the strategic plan.
9	To implement the actions, a detailed work program should be prepared.
10	Description of organization in future should be presented (Vision of success)
11	Determine actions and decisions to implement strategies.
12	Evaluating the results of implementing strategies.

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1. To what extent Bryson strategic planning model covers the below criteria? (Very Low Extent (VLE), Low Extent (LE), Moderate Extent(ME), High Extent (HE), Very High Extent (VHE))

	C1: Formality	*C2: Clarity*	*C3: Measurability*	*C4: Objectivity*	*C5: Coverage*	*C6: Consistency*
Bryson						

Please read the second model description and let me know when you are ready to answer the question.

Second Model (A2): A brief description of Wright's strategic planning model.

Step	**Description**
1	Identification of strengths and weaknesses from industry analysis, threats and opportunities from external factors.
2	Determination of the organization's goals, objectives, and mission based on internal strength and opportunities.
3	Strategy formulation, in three levels of management, activity, and function.
4	Implementation of strategy by considering the elements of structure, leadership, and culture.
5	Evaluation and control.

2. To what extent Wright strategic planning model covers the below criteria? (Very Low Extent (VLE), Low Extent (LE), Moderate Extent(ME), High Extent (HE), Very High Extent (VHE))

	C1: Formality	*C2: Clarity*	*C3: Measurability*	*C4: Objectivity*	*C5: Coverage*	*C6: Consistency*
Wright						

Please read the third model description and let me know when you are ready to answer the question.

Third Model (A3): A brief description of Wheelen and Hunger strategic planning model.

Step	**Description**
1	Environmental scanning to identify external (opportunities and threats) and internal (strengths and weaknesses)
2	Doing PESTEL Analysis (Political, Economic, Sociocultural, Technological, Ecological, and Legal forces) and industry analysis (using Porter's competition forces).
3	Identification of elements or groups like governments, local communities, suppliers, competitors, customers, creditors, employees'/labor unions that directly affect the organization or are affected by them.

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4	Formulating strategy which includes defining competitive advantages, identifying weaknesses that impact on the organization growth, crafting the organization mission, specifying achievable objectives, and setting policy guidelines.
5	Objectives, strategies, and policies are put into action through the development of programs and tactics, budgets, and procedures (Strategy implementation).
6	Organization's activities and performance results are monitored so that actual performance can be compared with desired performance (Evaluation and control).

3. To what extent Wheelen and Hunger strategic planning model covers the below criteria? (Very Low Extent (VLE), Low Extent (LE), Moderate Extent(ME), High Extent (HE), Very High Extent (VHE))

	C1: Formality	*C2: Clarity*	*C3: Measurability*	*C4: Objectivity*	*C5: Coverage*	*C6: Consistency*
Wheelen and Hunger						

Please read the fourth model description and let me know when you are ready to answer the question.

Fourth Model (A4): A brief description of Hill and Jones strategic planning model.

Step	**Description**
1	Determining the existing business model.
2	Determination of mission statement which contains mission, vision, values and goals.
3	External analysis to identify strategic opportunities and threats in the organization's operating environment (industry, national, and macro environment).
4	Internal analysis to identify strengths and weaknesses (review the resources, capabilities, and competencies of organization which results in competitive advantage).
5	Doing SWOT analysis to exploit external opportunities, counter threats, build on and protect organization strengths, and eradicate weaknesses.
6	Strategy identification in four main level (corporate-level, business-level, functional-level, and global strategies).
7	A governance system is determined by stockholders to make sure managers are acting in stockholder interests and pursuing the strategies. Ethic also (accepted right or wrong principles that govern the conduct of a person, the members of a profession, or the actions of an organization) is determined.
8	Determining organizational structure to integrate the efforts of employees at all levels-corporate, business, and functional-and across the organization's functions and business units in order to build distinctive competencies and competitive advantage.
9	Designing a control system to specify feedback.
10	Designing organization culture (specific collection of values, norms, beliefs, and attitudes that are shared by people and groups in an organization and that control the way they interact with each other and with stakeholders outside the organization)

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4. To what extent Hill and Jones strategic planning model covers the below criteria? (Very Low Extent (VLE), Low Extent (LE), Moderate Extent(ME), High Extent (HE), Very High Extent (VHE))

	C1: Formality	*C2: Clarity*	*C3: Measurability*	*C4: Objectivity*	*C5: Coverage*	*C6: Consistency*
Hill and Jones						

Please read the fifth model description and let me know when you are ready to answer the question.

Fifth Model (A5): A brief description of Bowman and Asch strategic planning model.

Step	**Description**
1	Analysis of the current situation, strategy, plans, or commitments of the organization.
2	Objectives determination.
3	External environment evaluation (socio-psychological and cultural, technological, legal and governmental, economic forces) to identify opportunities and threats.
4	Internal evaluation of organization to identify strengths and weaknesses.
5	Examining the effect of contingency factors (age and size; growth; the technical system and the environment) on the organization's structure.
6	Identification of social and psychological influences.
7	Understanding of power relationships between the organization and external groups (owners, customers, suppliers, and so on) and within organization.
8	Exploration of strategic options to meet organization objectives.
9	Evaluation and selection of strategic options.
10	Operating the strategies by having plan, budget, and control systems.
11	Adjustment to the existing strategies (strategic change).
12	Managing the changes (strategy, technology, and/or structure) in the organization.

5. To what extent Bowman and Asch strategic planning model covers the below criteria? (Very Low Extent (VLE), Low Extent (LE), Moderate Extent(ME), High Extent (HE), Very High Extent (VHE))

	C1: Formality	*C2: Clarity*	*C3: Measurability*	*C4: Objectivity*	*C5: Coverage*	*C6: Consistency*
Bowman and Asch						

Please read the sixth model description and let me know when you are ready to answer the question.

Sixth Model (A6): A brief description of Fred R. David strategic planning model.

Step	**Description**

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1	Developing mission (what is our business?) and vision (What do we want to become?) statements.
2	External evaluation (economic, social, cultural, demographic, natural environment, political, governmental, legal, technological, and competitive forces) to identify opportunities and threats.
3	Internal evaluation to identify strengths and weaknesses in the functional areas (management, marketing, finance/accounting, production/operations, research and development, and management information systems operations of business).
4	Establishing long-term objectives at the corporate, divisional, and functional levels.
5	Selecting the most appropriate strategies (forward integration, backward integration, horizontal integration, market penetration, market development, product development, related diversification, unrelated diversification, retrenchment, divestiture, and liquidation).
6	Analyzing the strategies and selecting the most appropriate one(s) by using EFE, IFE Matrix, CPM, SWOT, SPACE, BCG, IE, QSPM method.
7	Implementing the selected strategies in separate division of management issues-marketing, finance/accounting, R&D, and MIS issues.
8	Evaluating the strategies to find the organization's performance.
9	Considering global issues, business ethics, social responsibilities, and environmental sustainability.

6. To what extent David strategic planning model covers the below criteria? (Very Low Extent (VLE), Low Extent (LE), Moderate Extent(ME), High Extent (HE), Very High Extent (VHE))

	C1: Formality	*C2: Clarity*	*C3: Measurability*	*C4: Objectivity*	*C5: Coverage*	*C6: Consistency*
David						

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Questionnaire of Quantitative Survey (Persian version)

پرسشنامه پایان نامه دکتری

موضوع: تاثیر کاربرد برنامه ریزی استراتژیک بر عملکرد شرکت ها و ارزیابی مدل‌های برنامه ریزی استراتژیک با استفاده از روش بهترین-بدترین فازی در شرکت های کوچک و متوسط ایران.

شرح:

هدف این پرسشنامه جمع آوری اطلاعات برای تایید تاثیرکاربرد برنامه ریزی استراتژیک بر عملکرد شرکت‌های تولیدی کوچک و متوسط ایران است.

با توجه به نقش شما به عنوان مالک، مدیر یا کارشناس و عضوی از تیم برنامه ریزی استراتژیک، این پرسشنامه برای شما ارسال گردیده است.

از تمامی پاسخ دهندگان تقاضا دارم با ارسال پاسخ‌های واقعی و ارزشمند خود، اینجانب را در تکمیل تحقیقاتم یاری رسانید.

حداکثر زمان تکمیل پرسشنامه ۸ الی ۱۰ دقیقه می باشد.

داده‌های جمع آوری شده در این پرسشنامه با حفظ محرمانگی بودن تمامی اطلاعات به صورت ناشناس برای پاسخگویی به سوالات مطالعه استفاده می شود.

پیشاپیش از کمک و توجه شما سپاسگزارم.

بخش اول

۱.کدامیک از موارد زیر عنوان شغلی شما را مشخص می کند؟ در صورت انتخاب موارد دیگر، لطفا عنوان شغل را مشخص نمایید.

☐	مالک شرکت	☐	مدیر
☐	شریک	☐	رئیس
☐	رئیس هیات مدیره	☐	سرپرست
☐	مدیرعامل	☐	کارشناس
☐	مدیر اجرایی	☐	موارد دیگر.....

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۲. در کدام گروه سنی قرار دارید؟

۱۸-۲۷	۴۸-۵۷
۲۸-۳۷	۵۸-۶۷
۳۸-۴۷	بالاتر از ۶۸

۳. جنسیت شما کدام است؟

مرد	زن
ترجیح می دهم پاسخ ندهم	

۴. آخرین مدرک تحصیلی اخذ شده؟ (در صورت انتخاب موارد دیگر، لطفا مشخص نمایید)

دیپلم	فوق دیپلم
لیسانس	فوق لیسانس
دکتری	موارد دیگر.....

۵. شرکت شما چند سال در حال انجام فعالیت می باشد؟ (مثال : ۳سال) .....

۶. وضعیت مالکیت شرکت چگونه است؟ (در صورت انتخاب موارد دیگر ، لطفا مشخص نمایید)

مالکیت آن فقط در اختیارمن است	مالکیت آن متعلق به یک خانواده است
مالکیت آن متعلق به چند شریک است	مالکیت آن متعلق به یک انجمن یا اتحادیه است.
موارد دیگر.....	

۷. بطورتقریبی تعداد کارکنان شاغل در سازمان شما چند نفرمی باشند؟ .....

۸. بطور تقریبی سطح دارایی های شرکت شما (به استثنای زمین و ساختمان) چقدر می باشد؟

کمتر از ۱ میلیارد تومان	بین ۱ میلیارد تا ۱۰ میلیارد تومان
بین ۱۰ تا ۵۰ میلیارد تومان	بیشتر از ۵۰ میلیارد تومان

۹. آیا سازمان شما دارای یک برنامه ریزی استراتژیک رسمی می باشد؟

بله	خیر
مطمئن نیستم	

۹-۱. اگر بله، کدامیک از موارد زیر مشابه برنامه ریزی استراتژیک در سازمان شما می باشد؟

برنامه ریزی استراتژیک ساختار یافته	برنامه های عملیاتی ساختار یافته (بصورت هفتگی-ماهانه)
برنامه ریزی روزانه براساس شرایط کسب و کار	برنامه ریزی بدون ساختار(اتخاذ هر تصمیمی بدون برنامه قبلی)

۹-۲. اگر بله، طول دوره زمانی که برنامه استراتژیک پوشش می دهد را انتخاب نمایید.

کمتراز یکسال	یک تا دو سال
سه تا چهار سال	پنج تا شش سال
هفت سال و بیشتر	

۹-۳. سازمان شما چه مدت است که از برنامه ریزی استراتژیک مدون و مکتوب استفاده می کند؟

سازمان ما هرگز از برنامه ریزی استراتژیک مدون استفاده نمی کند	کمتر از یکسال
یک تا دو سال	سه تا چهار سال
پنج تا شش سال	بیشترازهفت سال

۱۰. هدف اصلی شما(یا مدیران سازمان) درهنگام برنامه ریزی برای سازمان چیست؟

رشد سرمایه	رشد درآمد حاصل از فروش
کسب بالاترین سهم بازار	توسعه بازارهای بین المللی

۱۱. شخص و یا واحدی که مسئول اصلی توسعه برنامه های استراتژیک در سازمان است را مشخص نمایید. (در صورت انتخاب موارد دیگر، لطفا مشخص نمایید)

مالک شرکت	مدیرعامل

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☐ کمیته یا تیم برنامه ریزی استراتژیک متشکل از اعضای منتخب مدیریت ارشد ☐ دپارتمان برنامه ریزی مرکزی

☐ موارد دیگر.....

۱۲. آیا سازمان در تدوین برنامه ریزی استراتژیک از مشاوران ملی و بین المللی استفاده می کند؟

☐ بله ☐ خیر

۱۳. آیا ایمان یا مذهب شما تاثیری روی تصمیمات کاری یا اخلاقیات شما دارد؟

☐ بله ☐ خیر

☐ مطمئن نیستم ☐ نمی دانم

۱۴. ایمان و باورهای من نقش مهمی در تصمیم گیری و موفقیت کاری من داشته است.

☐ بله ☐ خیر

☐ مطمئن نیستم

۱-۱۴. اگر بله کدامیک از موارد زیر صحیح است؟ (امکان انتخاب بیش از یک گزینه امکان پذیر است)

☐ ایمان و باورهایم تاثیر بسزایی روی نوع شغلم و چگونگی انجام آن دارد

☐ ایمان و باورهایم می تواند من را از انجام برخی کار ها باز دارد

☐ ایمان و باورهایم تاثیر بسزایی روی استخدام افراد بر اساس نوع جنسیت و مذهب دارد

☐ ایمانم در هویت کاریم مانند نمادها، تشریفات مذهبی و زبان ارتباط نمایان می شود

۱۵. الگوهای استاندارد رفتاری جامعه (احترام به دیگران، مقید به زمان بودن و....) در سازمان من در نظرگرفته می شود و مهم است.

☐ درست ☐ نادرست

☐ مطمئن نیستم

۱-۱۵. اگر "درست" است، یک یا بیش از یک مورد از گزینه های زیر را انتخاب نمایید.

☐ سازمان من در ازای دریافت امتیازات کاری، هدایایی ارائه می کند

☐ برای جلسات کاری بیشتر از زمان توافق شده وقت می گذارم

☐ من انعطاف پذیر هستم و با تأخیرات زمانی جلسات کاری مشکلی ندارم

☐ موافق تعطیلی سازمان برای انجام مراسم‌هایی مانند عروسی، عزاداری یا جلسات مذهبی هستم

بخش دوم

	خواهشمند است میزان موافقت خود را با هریک از سوالات زیر مشخص نمایید. **کاملا موافق (۵)، موافق(۴)، نظری ندارم(۳)، مخالف(۲)، کاملا مخالف(۱)**	**کاملا موافق**	**موافق**	**نظری ندارم**	**مخالف**	**کاملا مخالف**
۱	سازمان ما دارای برنامه استراتژیک می باشد.	۵	۴	۳	۲	۱
۲	تیم مدیریت شرکت، در انتخاب استراتژی مشارکت زیادی دارند.	۵	۴	۳	۲	۱
۳	مدیریت در ارزیابی برنامه های استراتژیک مشارکت گسترده دارد.	۵	۴	۳	۲	۱
۴	مدیریت در توسعه گزینه های استراتژیک مشارکت زیادی دارد.	۵	۴	۳	۲	۱
۵	بیانیه ای رسمی از اهداف کسب و کار شرکت در سازمان ما وجود دارد.	۵	۴	۳	۲	۱
۶	بیانیه رسمی ماموریت در سازمان ما وجود دارد.	۵	۴	۳	۲	۱
۷	استراتژی های بلند مدت و کوتاه مدت در سازمان ما تعیین گردیده است.	۵	۴	۳	۲	۱
۸	پیامدهای بلند مدت تهدید ها و فرصت های خارجی (سیاسی، اجتماعی، تکنولوژی، و محیطی) در سازمان ما در نظرگرفته شده است.	۵	۴	۳	۲	۱

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۹	در سازمان ما رویه‌هایی رسمی برای ارزیابی تهدیدها و فرصت‌های محیطی خارجی (سیاسی، اجتماعی و غیره) وجود دارد.	۵	۴	۳	۲	۱
۱۰	مشارکت گسترده مدیریتی در شناسایی تهدیدها و فرصت های محیط خارجی (سیاسی، اقتصادی، اجتماعی و غیره) در سازمان ما وجود دارد.	۵	۴	۳	۲	۱
۱۱	از مدل های ریاضی یا شبیه سازی های کامپیوتری در تعیین نقاط قوت و ضعف سازمان ما استفاده می گردد.	۵	۴	۳	۲	۱
۱۲	سازمان ما از مدل های ریاضی یا شبیه سازی های کامپیوتری برای توسعه انتخاب های استراتژیک استفاده می کند.	۵	۴	۳	۲	۱
۱۳	سازمان ما از مدل های ریاضی یا شبیه سازی های کامپیوتری در توسعه گزینه های استراتژیک استفاده می کند.	۵	۴	۳	۲	۱
۱۴	سازمان ما از مدل های ریاضی یا شبیه سازی های کامپیوتری در تحلیل تهدیدها و فرصت های محیطی خارجی (سیاسی، اقتصادی، اجتماعی و غیره) استفاده می نماید.	۵	۴	۳	۲	۱
۱۵	در سازمان ما از مدل های ریاضی یا شبیه سازی های کامپیوتری برای بررسی و ارزیابی برنامه های استراتژیک استفاده می شود.	۵	۴	۳	۲	۱
۱۶	سازمان ما یک فرآیند رسمی را برای انتخاب استراتژی ها دنبال می کند.	۵	۴	۳	۲	۱
۱۷	در سازمان ما برای برنامه های استراتژیک بودجه تدوین و تعیین میگردد.	۵	۴	۳	۲	۱
۱۸	نتایج فرآیند برنامه ریزی استراتژیک در سازمان ما نشان می دهد که چه کاری، چه زمانی و توسط چه کسی انجام خواهد شد.	۵	۴	۳	۲	۱
۱۹	پس از بررسی همه گزینه های استراتژی امکان پذیر، استراتژی های نهایی سازمان تعیین می گردد.	۵	۴	۳	۲	۱
۲۰	پس از انتخاب استراتژی در سازمان، اجرای آن صورت می گیرد.	۵	۴	۳	۲	۱
۲۱	مشارکت گسترده مدیریتی در تعیین نقاط قوت و ضعف سازمانی ما وجود دارد.	۵	۴	۳	۲	۱
۲۲	مشارکت گسترده مدیریت در تعیین اهداف اصلی و فرعی سازمان وجود دارد.	۵	۴	۳	۲	۱
۲۳	در انتخاب استراتژی های سازمانی، مشارکت گسترده مدیریتی وجود دارد.	۵	۴	۳	۲	۱
۲۴	سازمان ما استراتژی های مشخصی را انتخاب و تعیین کرده است.	۵	۴	۳	۲	۱
۲۵	هنگام انتخاب یک استراتژی، سازمان ما پیامدهای بلندمدت آن را در نظرمی گیرد.	۵	۴	۳	۲	۱
۲۶	برای انتخاب استراتژی در سازمان ما روشهای رسمی وجود دارد.	۵	۴	۳	۲	۱
۲۷	سازمان ما برای همه گزینه های استراتژیک برنامه بودجه تهیه می کند.	۵	۴	۳	۲	۱
۲۸	درسازمان ما اهداف اصلی(goals) و فرعی (objectives) تعیین می شود.	۵	۴	۳	۲	۱
۲۹	بررسی و ارزیابی مستمر برنامه استراتژیک در سازمان ما انجام می گردد.	۵	۴	۳	۲	۱
۳۰	سازمان ما منابع کافی برای اجرای برنامه های استراتژیک تخصیص می دهد.	۵	۴	۳	۲	۱
۳۱	اثرات بلند مدت نقاط قوت و ضعف سازمانی در شرکت ما ارزیابی می شود.	۵	۴	۳	۲	۱
۳۲	در توسعه استراتژی های جایگزین، دیدگاههای بلندمدت در سازمان ما ازاهمیت ویژه ای برخوردار است.	۵	۴	۳	۲	۱
۳۳	در سازمان ما فاکتورهای بلندمدت هنگام اجرای استراتژی، دارای اهمیت ویژه ای هستند.	۵	۴	۳	۲	۱
۳۴	نرخ رشد فروش/درآمد سازمان از رقبای کلیدی آن بالاتر است.	۵	۴	۳	۲	۱
۳۵	شرکت ما در حال تاسیس سایت‌ها/مکان‌های جدید با سرعت بیشتری نسبت به رقبای اصلی است.	۵	۴	۳	۲	۱
۳۶	نرخ رشد مشتریان سازمان ما نسبت به سایر رقبای اصلی بیشتر است.	۵	۴	۳	۲	۱
۳۷	نرخ رشد اشتغال در سازمان ما نسبت به سایر رقبای اصلی بیشتر است.	۵	۴	۳	۲	۱
۳۸	رضایت کارکنان در سازمان ما در مقایسه با کارکنان شرکت های رقیب بیشتر است.	۵	۴	۳	۲	۱
۳۹	میزان حفظ کارکنان در شرکت ما نسبت به سایر رقبای کلیدی بالاتر است.	۵	۴	۳	۲	۱
۴۰	ایمان(اعتقاد /مذهب) نقش مهمی در موفقیت کاری من داشته است.	۵	۴	۳	۲	۱
۴۱	در سازمان ما، زمان به عنوان یک منبع مهم تلقی می گردد، من و سایرکارمندان توجه و نگرش خوبی نسبت به استفاده از زمان داریم.	۵	۴	۳	۲	۱
۴۲	ارتباط بین مدیریت و کارکنان، معمولی، غیر رسمی و دوستانه است.	۵	۴	۳	۲	۱

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۴۳	مدیریت و کارکنان در سازمان ما مسئولیت پذیرهستند و تعهد زیادی به سازمان نشان می دهند.	۵	۴	۳	۲	۱
۴۴	هنجارها، فرهنگ و رسوم محل کسب و کار در سازمان ما مهم است.	۵	۴	۳	۲	۱
۴۵	بین زندگی خانوادگی و زندگی کاری من یک حریم جداگانه ای وجود دارد.	۵	۴	۳	۲	۱
۴۶	سازمان ما تولید/خدمات خود را با تقاضای بازار تغییر می دهد.	۵	۴	۳	۲	۱
۴۷	سازمان ما سبد محصولات/ خدمات خود را با تقاضای بازار تغییر می دهد.	۵	۴	۳	۲	۱
۴۸	سازمان ما منابع سرمایه را در صورت نیاز تغییر می دهد.	۵	۴	۳	۲	۱
۴۹	سازمان ما منابع مالی بیرونی را در صورت لزوم تامین می کند.	۵	۴	۳	۲	۱
۵۰	سازمان ما از نظر مالی انعطاف پذیر است.	۵	۴	۳	۲	۱
۵۱	ارتباط بین بخش ها در سازمان ما آسوده است.	۵	۴	۳	۲	۱
۵۲	بوروکراسی (رعایت تشریفات اداری) در سازمان ما آسان شده است.	۵	۴	۳	۲	۱
۵۳	سازمان ما از نظر ساختاری انعطاف پذیر است.	۵	۴	۳	۲	۱
۵۴	سازمان ما مجهز به سیستم های کامپیوتری به روز است.	۵	۴	۳	۲	۱
۵۵	شرکت ما سیستم های کامپیوتری سازگار با نرم افزارها و برنامه های کاربردی مختلف رادر صورت نیاز فراهم می نماید.	۵	۴	۳	۲	۱
۵۶	امکان کم یا زیاد نمودن ظرفیت سیستم های کامپیوتری در سازمان ما وجود دارد.	۵	۴	۳	۲	۱
۵۷	شرکت ما محصول(محصولات) تخصصی تولید/ خدمات تخصصی ارائه می دهد.	۵	۴	۳	۲	۱
۵۸	شرکت ما محصولات جدیدی تولید/ خدمات جدیدی ارائه می دهد.	۵	۴	۳	۲	۱
۵۹	شرکت ما ظاهر و عملکرد محصولات/خدمات موجود را ارتقا می دهد.	۵	۴	۳	۲	۱
۶۰	شرکت ما در فرآیندهای تولید/خدمات نوآوری دارد.	۵	۴	۳	۲	۱
۶۱	شرکت ما برای به دست آوردن مزیت رقابتی روی امکانات و تجهیزات جدید تحقیق و توسعه سرمایه گذاری می کند.	۵	۴	۳	۲	۱
۶۲	رشد فروش، به عنوان یکی از اهداف سازمان تعیین گردیده است.	۵	۴	۳	۲	۱
۶۳	رشد سرمایه به عنوان یکی از اهدف سازمان تعیین گردیده است.	۵	۴	۳	۲	۱
۶۴	دستیابی به سهم بیشتر بازار به عنوان یکی از اهداف سازمان انتخاب گردیده است.	۵	۴	۳	۲	۱
۶۵	توسعه بازارهای بین المللی به عنوان یکی از اهداف اصلی سازمان انتخاب گردیده است.	۵	۴	۳	۲	۱

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Structured Interview (Persian version)

مصاحبه ساختار یافته ارزیابی مدل‌های مختلف برنامه‌ریزی استراتژیک بر اساس روش بهترین–بدترین فازی.

داده‌های جمع آوری شده از طریق این پرسش نامه در نهایت محرمانه بودن مورد بررسی قرار می‌گیرند و تنها به صورت خلاصه و ناشناس و بدون افشای نام پاسخ دهندگان یا وابستگی سازمانی ارائه می‌شوند.

بخش اول

شش معیار اصلی برای ارزیابی مدل‌های برنامه‌ریزی استراتژیک شناسایی شده است. شرح مختصری از هریک از معیارها در زیر ارائه گردیده است. لطفا توضیحات مربوط به هریک از معیارها را بخوانید و به سوالات پاسخ دهید.

شاخص	شرح
رسمیت	مدل برنامه ریزی استراتژیک شامل تمام عناصر ضروری (چشم انداز، ماموریت، ارزش ها، مسائل استراتژیک، و اهداف استراتژیک، استراتژی ها، و معیارهای عملکرد) است.
شفافیت	اهداف استراتژیک و استراتژی ها می تواند به وضوح بیان شود.
قابلیت اندازه گیری	اهداف استراتژیک را می توان اندازه گیری، پایش و ارزیابی کرد.
عینیت	قابلیت اطمینان و قابلیت استفاده از برنامه ریزی استراتژیک را توصیف می کند.
پوشش	موضوعاتی مانند محیط عملیاتی، مسائل استراتژیک و مجموعه ای از استراتژی ها و برنامه های عملیاتی را پوشش می دهد.
سازگاری	مدل برنامه ریزی استراتژیک در پاسخ به تغییرات محیطی سازگار به نظر می رسد.

۱. بنظر شما کدام یک از معیارها «مهم ترین» معیار در ارزیابی مدل های برنامه ریزی استراتژیک است. (فقط یکی از معیارها را انتخاب کنید) .....

۲. معیار «مهمترین» در مقایسه با بقیه معیارها چقدر مهمتر است؟ (اهمیت یکسان(EI) ، کم اهمیت(WI) ، نسبتاً مهم(FI) ، بسیار مهم(VI) ، کاملاً مهم(AI))

معیار	رسمیت	شفافیت	قابلیت اندازه گیری	عینیت	پوشش	سازگاری
..... مهمترین معیار	……..	……..	……..	……..	……..	……..

۳. از دیدگاه شما کدام یک از معیارها «کم اهمیت ترین» معیار در ارزیابی مدل های برنامه ریزی استراتژیک است. (فقط یکی از معیارها را انتخاب کنید) .....

۴. معیارهای دیگر در مقایسه با معیار "کم اهمیت" چقدر مهمتر هستند؟ (اهمیت یکسان (EI)، کم اهمیت (WI)، نسبتاً مهم (FI)، بسیار مهم (VI)، کاملاً مهم(AI))

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معیار	..... کم اهمیت ترین معیار
رسمیت	
شفافیت	
قابلیت اندازه گیری	
عینیت	
پوشش	
سازگاری	

بخش دوم

شش مدل مختلف برنامه ریزی استراتژیک برای اولویت بندی در شرکتهای تولیدی کوچک و متوسط انتخاب شده است. شرح مختصری از مراحل هر مدل برنامه ریزی استراتژیک ارائه گردیده است.

لطفا" توضیحات مربوط به اولین مدل را بخوانید و وقتی آماده پاسخ به سوال هستید به من اطلاع دهید.

مدل اول (A1): مدل برنامه ریزی استراتژیک Bryson

مرحله	شرح
۱	ایجاد توافق اولیه در مورد برنامه ریزی استراتژیک (هدف از تلاش، مراحل و فرآیندها، نقش، وظایف و عضویت در کمیته هماهنگ کننده برنامه ریزی استراتژیک / تیم برنامه ریزی استراتژیک).
۲	شفاف سازی و شناسایی وظایف رسمی و غیر رسمی (قانون، اساسنامه، مقررات و غیره) که بر عهده سازمان گذاشته شده است.
۳	تجزیه و تحلیل ذینفعان باید انجام شود.
۴	توسعه و شفاف سازی ماموریت ها و ارزش ها در سازمان
۵	ارزیابی محیطی خارجی (شناسایی فرصت ها و تهدیدهای سیاسی، اقتصادی، اجتماعی و فناوری و ارزیابی محیطی داخلی (برای شناسایی نقاط قوت و ضعف سازمان)).
۶	شناسایی موضوعات راهبردی که بر بقا، شکوفایی و اثربخشی سازمان تأثیر می گذارد.
۷	توسعه استراتژی (جایگزین های عملی، رویاها یا چشم اندازها) برای حل مسائل استراتژیک.
۸	تعیین اقدامات مورد نیاز طی یک تا دو سال آینده برای اجرای برنامه راهبردی.
۹	تهیه برنامه دقیق کاری برای اجرای اقدامات
۱۰	ارائه چشم انداز موفقیت سازمان
۱۱	تعیین اقدامات و تصمیمات برای اجرای استراتژی ها.
۱۲	ارزیابی نتایج اجرای استراتژی ها.

۱. مدل برنامه ریزی استراتژیک Bryson تا چه اندازه معیارهای زیر را پوشش می دهد؟ (بسیار کم (VLE)، کم (LE)، متوسط(ME)، زیاد (HE)، خیلی زیاد(VHE))

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	C1: رسمیت	C2: شفافیت	C3: قابلیت اندازه گیری	C4: عینیت	C5: پوشش	C6: سازگاری
Bryson						

لطفا" توضیحات مربوط به دومین مدل را بخوانید و وقتی آماده پاسخ به سوال هستید به من اطلاع دهید.

مدل دوم (A2): مدل برنامه ریزی استراتژیک Wright

مرحله	شرح
۱	شناسایی نقاط قوت و ضعف از تحلیل صنعت، تهدیدها و فرصت ها از عوامل خارجی.
۲	تعیین اهداف، مقاصد و مأموریت سازمان بر اساس توان و فرصت های داخلی.
۳	تدوین استراتژی در سه سطح مدیریت، فعالیت و وظیفه.
۴	اجرای استراتژی با در نظر گرفتن عناصر ساختار، رهبری و فرهنگ.
۵	ارزیابی و کنترل.

۲. مدل برنامه ریزی استراتژیک Wright تا چه اندازه معیارهای زیر را پوشش می دهد؟ (بسیار کم (VLE)، کم (LE)، متوسط(ME)، زیاد (HE)، خیلی زیاد(VHE))

	C1: رسمیت	C2: شفافیت	C3: قابلیت اندازه گیری	C4: عینیت	C5: پوشش	C6: سازگاری
Wright						

لطفا" توضیحات مربوط به سومین مدل را بخوانید و وقتی آماده پاسخ به سوال هستید به من اطلاع دهید.

مدل سوم (A3): مدل برنامه ریزی استراتژیک Wheelen and Hunger

مرحله	شرح
۱	اسکن محیطی برای شناسایی عوامل خارجی (فرصت ها و تهدیدها) و داخلی (قوت ها و ضعف ها)
۲	انجام تجزیه و تحلیلی نیروهای سیاسی، اقتصادی، اجتماعی، فرهنگی، فنی، زیست محیطی و قانونی و تجزیه و تحلیل صنعت با استفاده از نیروهای رقابت پورتر(میزان تهدید تازه‌واردها، قدرت چانه زنی تأمین کنندگان، قدرت چانه زنی مشتریان، قابت میان فعالان فعلی صنعت، تهدید کالاها و خدمات جایگزین)
۳	شناسایی عناصر یا گروه‌هایی مانند دولت‌ها، جوامع محلی، تامین‌کنندگان، رقبا، مشتریان، طلبکاران، اتحادیه‌های کارگری/کارگر که مستقیماً بر سازمان تأثیر می‌گذارند یا تحت تأثیر آنها قرار می‌گیرند.
۴	تدوین استراتژی که شامل تعریف مزیت‌های رقابتی، شناسایی نقاط ضعفی که بر رشد سازمان تأثیر می‌گذارد، تدوین مأموریت سازمان، تعیین اهداف قابل دستیابی، و تعیین خط‌مشی‌های خط مشی است.
۵	اهداف، استراتژی ها و خط مشی ها از طریق توسعه برنامه ها، تاکتیک ها، بودجه ها و رویه ها عملی می شوند(اجرای استراتژی).
٦	فعالیت ها و نتایج عملکرد سازمان نظارت می شود تا بتوان عملکرد واقعی را با عملکرد مطلوب مقایسه کرد (ارزیابی و کنترل).

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۳. مدل برنامه ریزی استراتژیک Wheelen and Hunger تا چه اندازه معیارهای زیر را پوشش می دهد؟ (بسیار کم (VLE)، کم (LE)، متوسط(ME)، زیاد (HE)، خیلی زیاد(VHE))

	C1: رسمیت	C2: شفافیت	C3: قابلیت اندازه گیری	C4: عینیت	C5: پوشش	C6: سازگاری
Wheelen and Hunger						

لطفا" توضیحات مربوط به چهارمین مدل را بخوانید و وقتی آماده پاسخ به سوال هستید به من اطلاع دهید.

مدل چهارم (A4): مدل برنامه ریزی استراتژیک Hill and Jones

مرحله	شرح
۱	تعیین مدل کسب و کار موجود.
۲	تعیین بیانیه ماموریت که حاوی ماموریت، چشم انداز، ارزش ها و اهداف است.
۳	تحلیل خارجی برای شناسایی فرصت ها و تهدیدهای استراتژیک در محیط عملیاتی سازمان (محیط صنعتی، ملی و کلان).
۴	تجزیه و تحلیل داخلی برای شناسایی نقاط قوت و ضعف (بررسی منابع، قابلیت ها و شایستگی های سازمان که منجر به مزیت رقابتی می شود).
۵	انجام تجزیه و تحلیل SWOT برای بهره برداری از فرصت های خارجی، مقابله با تهدیدات، ایجاد و محافظت از نقاط قوت سازمان و ریشه کن کردن نقاط ضعف.
۶	شناسایی استراتژی در چهار سطح اصلی (سطح شرکت، سطح کسب و کار، سطح عملکردی و استراتژی های جهانی)
۷	یک سیستم حاکمیتی توسط سهامداران تعیین می شود تا اطمینان حاصل شود که مدیران در راستای منافع سهامداران عمل می کنند و استراتژی ها را دنبال می کنند. همچنین اخلاق (اصول پذیرفته شده درست یا غلط حاکم بر رفتار یک فرد، اعضای یک حرفه یا اقدامات یک سازمان) تعیین می شود.
۸	تعیین ساختار سازمانی برای ادغام تلاش های کارکنان در تمام سطوح - شرکت، کسب وکار و سطوح وظیفه ای - و در سراسر عملکرد سازمان و واحدهای کسب و کار به منظور ایجاد شایستگی های متمایز و مزیت رقابتی.
۹	ایجاد سیستم کنترل برای تعیین بازخورد.
۱۰	ایجاد فرهنگ سازمانی (مجموعه خاصی از ارزش ها، هنجارها، باورها و نگرش هایی که بین افراد و گروه های یک سازمان مشترک است و نحوه تعامل آنها با یکدیگر و با ذینفعان خارج از سازمان را کنترل می نماید).

٤. مدل برنامه ریزی استراتژیک Hill and Jones تا چه اندازه معیارهای زیر را پوشش می دهد؟ (بسیار کم (VLE)، کم (LE)، متوسط(ME)، زیاد (HE)، خیلی زیاد(VHE))

	C1: رسمیت	C2: شفافیت	C3: قابلیت اندازه گیری	C4: عینیت	C5: پوشش	C6: سازگاری
Hill and Jones						

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لطفا" توضیحات مربوط به پنجمین مدل را بخوانید و وقتی آماده پاسخ به سوال هستید به من اطلاع دهید.

مدل پنجم (A5): مدل برنامه ریزی استراتژیک Bowman and Asch

مرحله	شرح
۱	تجزیه و تحلیل وضعیت فعلی، استراتژی، برنامه ها یا تعهدات سازمان.
۲	تعیین اهداف
۳	ارزیابی محیط بیرونی (نیروهای اجتماعی-روانی، فرهنگی، فناوری، حقوقی و دولتی، اقتصادی) برای شناسایی فرصت ها و تهدیدها.
۴	ارزیابی داخلی سازمان برای شناسایی نقاط قوت و ضعف.
۵	بررسی تأثیر عوامل اقتضایی (سن و اندازه، رشد، سیستم فنی و محیط) بر ساختار سازمان.
۶	شناسایی تأثیرات اجتماعی و روانی.
۷	درک روابط قدرت بین سازمان و گروه های خارجی (مالکان، مشتریان، تامین کنندگان و غیره) و درون سازمان.
۸	بررسی گزینه های استراتژیک برای دستیابی به اهداف سازمان.
۹	ارزیابی و انتخاب گزینه های استراتژیک.
۱۰	اجرای استراتژی ها با داشتن سیستم های برنامه ریزی، بودجه و کنترل.
۱۱	تطبیق با استراتژی های موجود (تغییر استراتژیک)
۱۲	مدیریت تغییرات (استراتژی، فناوری و/یا ساختار) در سازمان.

۵. مدل برنامه ریزی استراتژیک Bowman and Asch تا چه اندازه معیارهای زیر را پوشش می دهد؟ (بسیار کم (VLE)، کم (LE)، متوسط(ME)، زیاد (HE)، خیلی زیاد(VHE))

	C1: رسمیت	*C2: شفافیت*	*C3: قابلیت اندازه گیری*	*C4: عینیت*	*C5: پوشش*	*C6: سازگاری*
Bowman and Asch						

لطفا" توضیحات مربوط به ششمین مدل را بخوانید و وقتی آماده پاسخ به سوال هستید به من اطلاع دهید.

مدل ششم (A6): مدل برنامه ریزی استراتژیک Fred R. David

مرحله	شرح
۱	ایجاد بیانیه ی مأموریت (کسب و کار ما چیست؟) و چشم انداز (به کجا میخواهیم برسیم؟).
۲	ارزیابی بیرونی (اقتصادی، اجتماعی، فرهنگی، جمعیتی، محیط طبیعی، نیروهای سیاسی، دولتی، حقوقی، فنی و رقابتی) برای شناسایی فرصت ها و تهدیدها.
۳	ارزیابی داخلی برای شناسایی نقاط قوت و ضعف در حوزه های عملکردی (مدیریت، بازاریابی، مالی/حسابداری، تولید/عملیات، تحقیق و توسعه، و عملیات سیستم های اطلاعات مدیریت کسب و کار)
۴	تعیین اهداف بلندمدت در سطوح شرکتی، بخشی و وظیفه ای.

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۵	انتخاب مناسب ترین استراتژی ها (ادغام روبه جلو، ادغام رو به عقب، ادغام افقی، نفوذ در بازار، توسعه بازار، توسعه محصول، تنوع مرتبط، تنوع نامرتبط، کاهش، واگذاری، و انحلال)
۶	تجزیه و تحلیل استراتژی ها و انتخاب مناسب ترین راهبردها با استفاده از روش های EFE ، IFE Matrix، CPM، SWOT، SPACE، BCG، IE، .QSPM
۷	اجرای استراتژیهای انتخاب شده در بخش های مجزای مدیریتی – مسائل بازاریابی، مالی/حسابداری، تحقیق و توسعه و سیستم های اطلاعات مدیریت
۸	ارزیابی استراتژی ها برای یافتن عملکرد سازمان.
۹	در نظر گرفتن مسائل جهانی، اخلاق تجاری، مسئولیت های اجتماعی و پایداری زیست محیطی.

۶. مدل برنامه ریزی استراتژیک Fred R. David تا چه اندازه معیارهای زیر را پوشش می دهد؟ (بسیار کم (VLE)، کم (LE)، متوسط(ME)، زیاد (HE)، خیلی زیاد(VHE))

	C1: رسمیت	*C2: شفافیت*	*C3: قابلیت اندازه گیری*	*C4: عینیت*	*C5: پوشش*	*C6: سازگاری*
Fred R. David						

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Appendix B

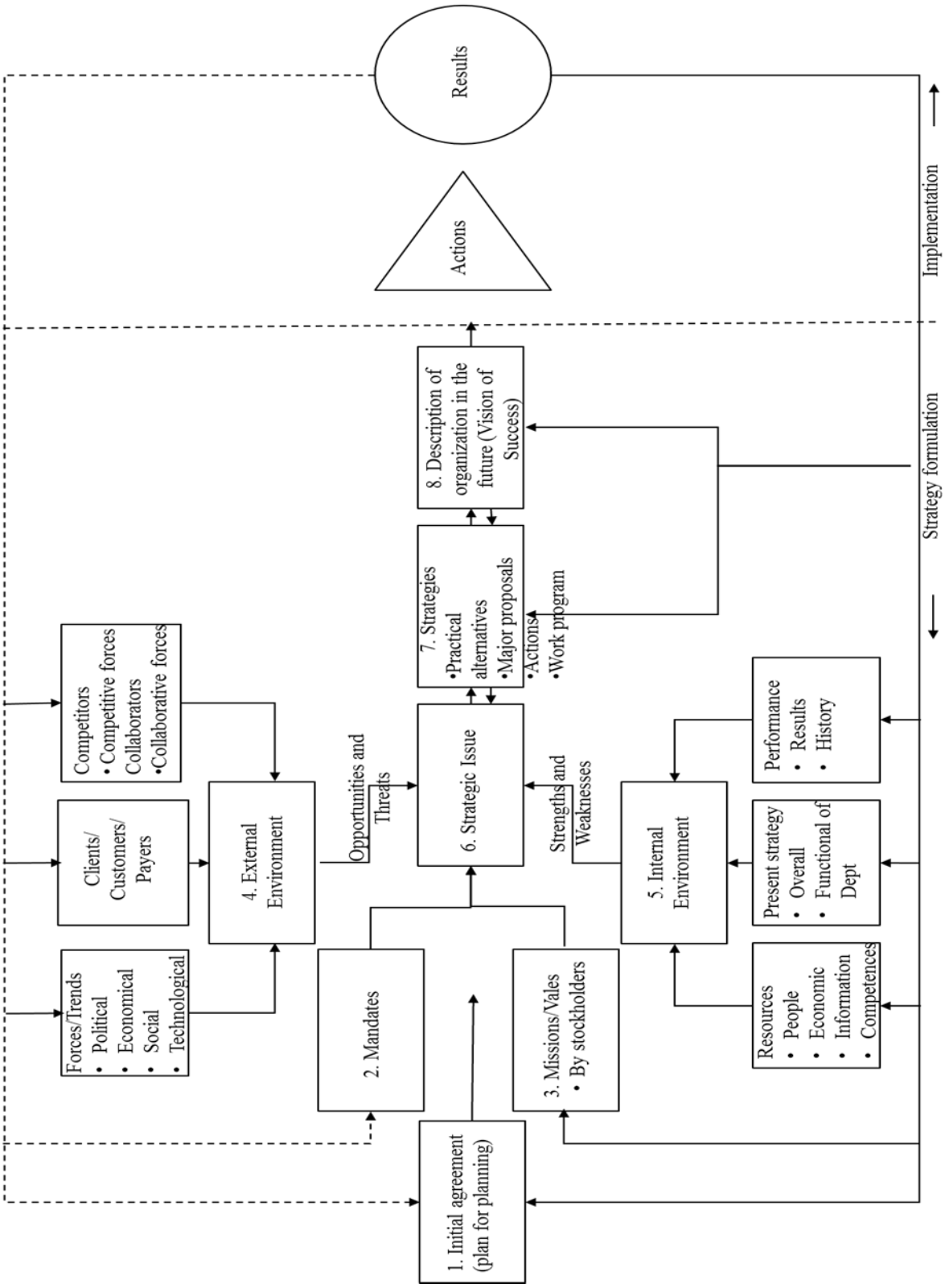

Figure 2.1 Bryson strategic planning model retrieved from Bryson (1988)

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Figure 2.2 Wright strategic planning model

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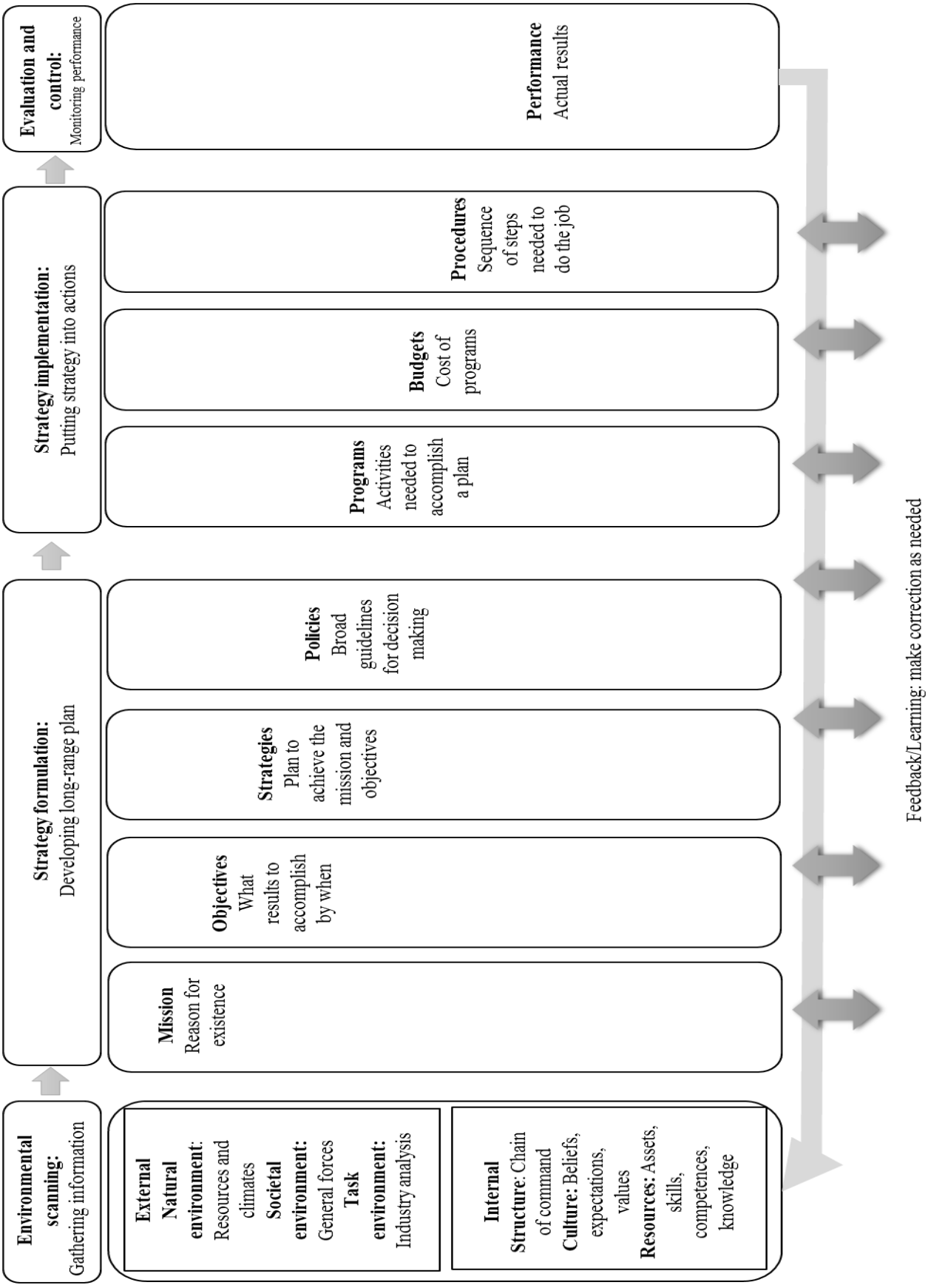

Figure 2.3 Wheelen and Hunger strategic planning model retrieved from (Wheelen and Hunger, 2012)

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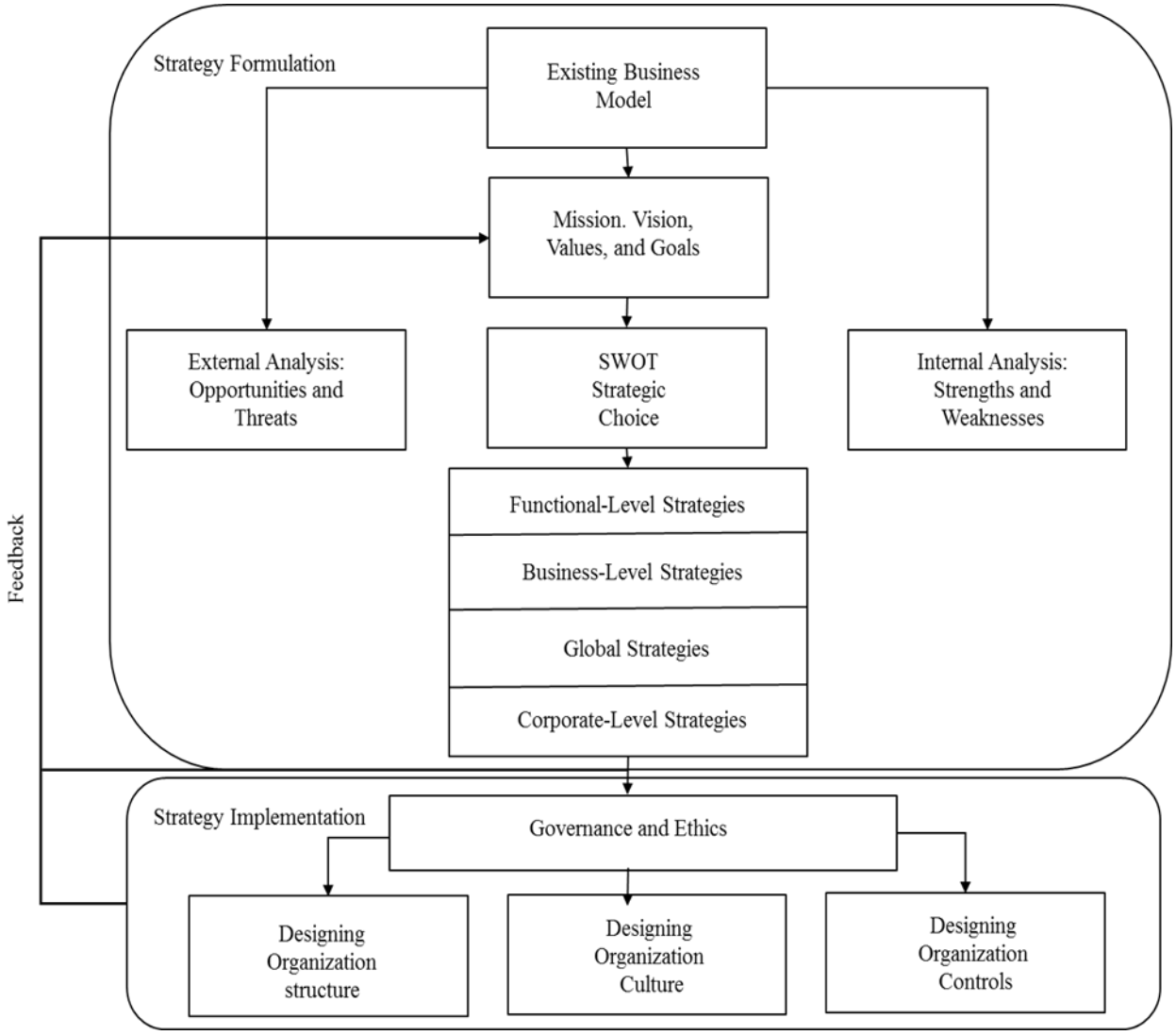

Figure 2.4 Hill and Jones strategic planning model retrieved from Hill, et al., 2014.

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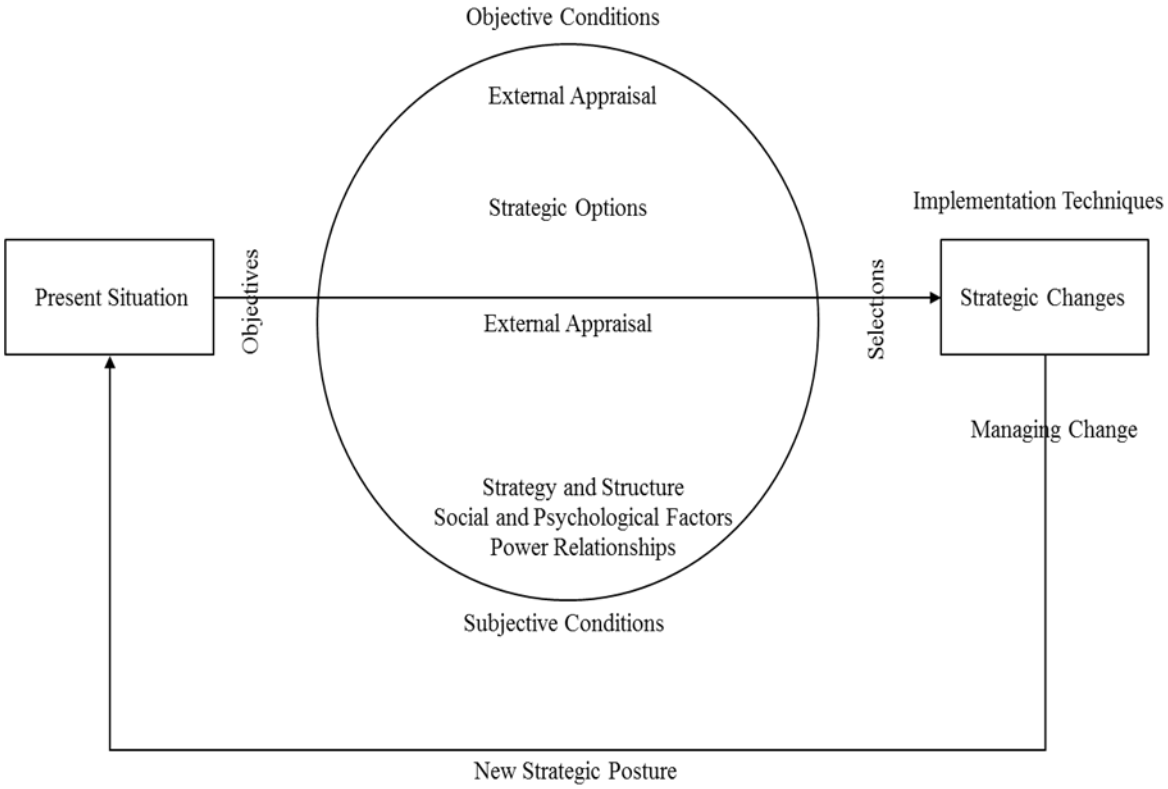

Figure 2.5 Bowman and Asch Strategic Planning Model Retrieved From Asch and Bowman (1989)

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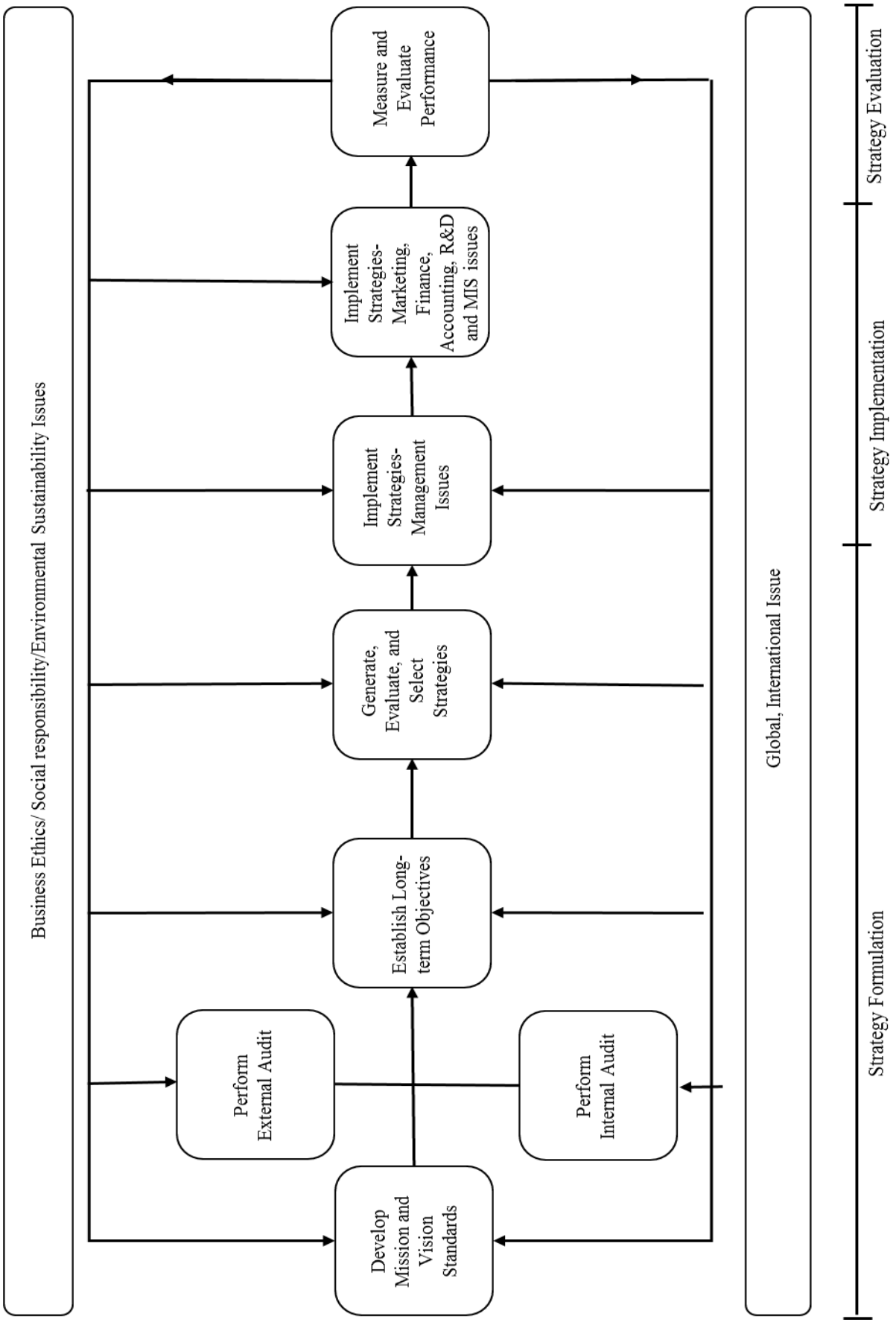

Figure 2.6 David Strategic Planning Model Retrieved From David (2011)

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Appendix C

Basic Operational Rules of Triangular Fuzzy Numbers.

Suppose two triangular fuzzy numbers $\tilde{a}_1 = (l_1, m_1, u_1)$, $\tilde{a}_2 = (l_2, m_2, u_2)$ and λ as a positive real number, the basic operational rules of Triangular Fuzzy Number are as follows (Kaufman and Gupta, 1991; Carlsson and Fullér, 2001; Gani and Assarudeen, 2012; Moslem et al.,2020; Li et al., 2021; Guo and Qi, 2021)

$$\tilde{a}_1 \oplus \tilde{a}_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \quad \text{Eq(3)}$$

$$\tilde{a}_1 \ominus \tilde{a}_2 = (l_1 - l_2, m_1 - m_2, u_1 - u_2) \quad \text{Eq(4)}$$

$$\tilde{a}_1 \otimes \tilde{a}_2 = (l_1 * l_2, m_1 * m_2, u_1 * u_2) \quad \text{Eq(5)}$$

$$\lambda \otimes \tilde{a}_1 = \lambda\tilde{a}_1 = (\lambda * l_1, \lambda * m_1, \lambda * u_1) \quad \text{Eq(6)}$$

$$-\tilde{a}_1 = (-l_1, -m_1, -u_1) \quad \text{Eq(7)}$$

$$\tilde{a}_1^{-1} = \frac{1}{\tilde{a}_1} = \left(\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1}\right) \quad \text{Eq(8)}$$

$\oplus$ is the singe of aggregate or addition

$\ominus$is the singe of subtraction

$\otimes$ is the singe of multiplication

Extended Model for Criteria Weights

Min $k_1^* + k_2^* + k_3^* + k_4^* + k_5^* + k_6^* + k_7^* + k_8^* + k_9^* + k_{10}^* + k_{11}^* + k_{12}^* + k_{13}^*$

s.t.

Decision maker1:

The best criterion (C_B): C_2 The worst criterion (C_W): C_5

$$\left| \frac{(l_2^1, m_2^1, u_2^1)}{(l_1^1, m_1^1, u_1^1)} - l_{21}^1, m_{21}^1, u_{21}^1 \right| \leq k_1^* \qquad \left| \frac{(l_1^1, m_1^1, u_1^1)}{(l_5^1, m_5^1, u_5^1)} - l_{15}^1, m_{15}^1, u_{15}^1 \right| \leq k_1^*$$

$$\left| \frac{(l_2^1, m_2^1, u_2^1)}{(l_2^1, m_2^1, u_2^1)} - l_{22}^1, m_{22}^1, u_{22}^1 \right| \leq k_1^* \qquad \left| \frac{(l_2^1, m_2^1, u_2^1)}{(l_5^1, m_5^1, u_5^1)} - l_{25}^1, m_{25}^1, u_{25}^1 \right| \leq k_1^*$$

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$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_3^1, m_3^1, u_3^1)} - l_{23}^1, m_{23}^1, u_{23}^1\right| \le k_1^* \qquad \left|\frac{(l_3^1, m_3^1, u_3^1)}{(l_5^1, m_5^1, u_5^1)} - l_{35}^1, m_{35}^1, u_{35}^1\right| \le k_1^*$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_4^1, m_4^1, u_4^1)} - l_{24}^1, m_{24}^1, u_{24}^1\right| \le k_1^* \qquad \left|\frac{(l_4^1, m_4^1, u_4^1)}{(l_5^1, m_5^1, u_5^1)} - l_{45}^1, m_{45}^1, u_{45}^1\right| \le k_1^*$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_5^1, m_5^1, u_5^1)} - l_{25}^1, m_{25}^1, u_{25}^1\right| \le k_1^* \qquad \left|\frac{(l_5^1, m_5^1, u_5^1)}{(l_5^1, m_5^1, u_5^1)} - l_{55}^1, m_{55}^1, u_{55}^1\right| \le k_1^*$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_6^1, m_6^1, u_6^1)} - l_{26}^1, m_{26}^1, u_{26}^1\right| \le k_1^* \qquad \left|\frac{(l_6^1, m_6^1, u_6^1)}{(l_5^1, m_5^1, u_5^1)} - l_{65}^1, m_{65}^1, u_{65}^1\right| \le k_1^*$$

Decision maker 2:

The best criterion (C_B): C_3 The worst criterion (C_W): C_6

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_1^2, m_1^2, u_1^2)} - l_{31}^2, m_{31}^2, u_{31}^2\right| \le k_2^* \qquad \left|\frac{(l_1^2, m_1^2, u_1^2)}{(l_6^2, m_6^2, u_6^2)} - l_{16}^2, m_{16}^2, u_{16}^2\right| \le k_2^*$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_2^2, m_2^2, u_2^2)} - l_{32}^2, m_{32}^2, u_{32}^2\right| \le k_2^* \qquad \left|\frac{(l_2^2, m_2^2, u_2^2)}{(l_6^2, m_6^2, u_6^2)} - l_{26}^2, m_{26}^2, u_{26}^2\right| \le k_2^*$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_3^2, m_3^2, u_3^2)} - l_{33}^2, m_{33}^2, u_{33}^2\right| \le k_2^* \qquad \left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_6^2, m_6^2, u_6^2)} - l_{36}^2, m_{36}^2, u_{36}^2\right| \le k_2^*$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_4^2, m_4^2, u_4^2)} - l_{34}^2, m_{34}^2, u_{34}^2\right| \le k_2^* \qquad \left|\frac{(l_4^2, m_4^2, u_4^2)}{(l_6^2, m_6^2, u_6^2)} - l_{46}^2, m_{46}^2, u_{46}^2\right| \le k_2^*$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_5^2, m_5^2, u_5^2)} - l_{35}^2, m_{35}^2, u_{35}^2\right| \le k_2^* \qquad \left|\frac{(l_5^2, m_5^2, u_5^2)}{(l_6^2, m_6^2, u_6^2)} - l_{56}^2, m_{56}^2, u_{56}^2\right| \le k_2^*$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_6^2, m_6^2, u_6^2)} - l_{36}^2, m_{36}^2, u_{36}^2\right| \le k_2^* \qquad \left|\frac{(l_6^2, m_6^2, u_6^2)}{(l_6^2, m_6^2, u_6^2)} - l_{16}^2, m_{16}^2, u_{16}^2\right| \le k_2^*$$

Decision maker 3:

The best criterion (C_B): C_1 The worst criterion (C_W): C_4

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_1^3, m_1^3, u_1^3)} - l_{11}^3, m_{11}^3, u_{11}^3\right| \le k_3^* \qquad \left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_4^3, m_4^3, u_4^3)} - l_{14}^3, m_{14}^3, u_{14}^3\right| \le k_3^*$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_2^3, m_2^3, u_2^3)} - l_{12}^3, m_{12}^3, u_{12}^3\right| \le k_3^* \qquad \left|\frac{(l_2^3, m_2^3, u_2^3)}{(l_4^3, m_4^3, u_4^3)} - l_{24}^3, m_{24}^3, u_{24}^3\right| \le k_3^*$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_3^3, m_3^3, u_3^3)} - l_{13}^3, m_{13}^3, u_{13}^3\right| \le k_3^* \qquad \left|\frac{(l_3^3, m_3^3, u_3^3)}{(l_4^3, m_4^3, u_4^3)} - l_{34}^3, m_{34}^3, u_{34}^3\right| \le k_3^*$$

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$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_4^3, m_4^3, u_4^3)} - l_{14}^3, m_{14}^3, u_{14}^3\right| \le k_3^* \qquad \left|\frac{(l_4^3, m_4^3, u_4^3)}{(l_4^3, m_4^3, u_4^3)} - l_{44}^3, m_{44}^3, u_{44}^3\right| \le k_3^*$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_5^3, m_5^3, u_5^3)} - l_{15}^3, m_{15}^3, u_{15}^3\right| \le k_3^* \qquad \left|\frac{(l_5^3, m_5^3, u_5^3)}{(l_4^3, m_4^3, u_4^3)} - l_{54}^3, m_{54}^3, u_{54}^3\right| \le k_3^*$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_6^3, m_6^3, u_6^3)} - l_{16}^3, m_{16}^3, u_{16}^3\right| \le k_3^* \qquad \left|\frac{(l_6^3, m_6^3, u_6^3)}{(l_4^3, m_4^3, u_4^3)} - l_{64}^3, m_{64}^3, u_{64}^3\right| \le k_3^*$$

Decision maker 4:

The best criterion (C_B): C_1 The worst criterion (C_W): C_2

$$\left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_1^4, m_1^4, u_1^4)} - l_{11}^4, m_{11}^4, u_{11}^4\right| \le k_4^* \qquad \left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_2^4, m_2^4, u_2^4)} - l_{12}^4, m_{12}^4, u_{12}^4\right| \le k_4^*$$

$$\left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_2^4, m_2^4, u_2^4)} - l_{12}^4, m_{12}^4, u_{12}^4\right| \le k_4^* \qquad \left|\frac{(l_2^4, m_2^4, u_2^4)}{(l_2^4, m_2^4, u_2^4)} - l_{22}^4, m_{22}^4, u_{22}^4\right| \le k_4^*$$

$$\left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_3^4, m_3^4, u_3^4)} - l_{13}^4, m_{13}^4, u_{13}^4\right| \le k_4^* \qquad \left|\frac{(l_3^4, m_3^4, u_3^4)}{(l_2^4, m_2^4, u_2^4)} - l_{32}^4, m_{32}^4, u_{32}^4\right| \le k_4^*$$

$$\left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_4^4, m_4^4, u_4^4)} - l_{14}^4, m_{14}^4, u_{14}^4\right| \le k_4^* \qquad \left|\frac{(l_4^4, m_4^4, u_4^4)}{(l_2^4, m_2^4, u_2^4)} - l_{42}^4, m_{42}^4, u_{42}^4\right| \le k_4^*$$

$$\left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_5^4, m_5^4, u_5^4)} - l_{15}^4, m_{15}^4, u_{15}^4\right| \le k_4^* \qquad \left|\frac{(l_5^4, m_5^4, u_5^4)}{(l_2^4, m_2^4, u_2^4)} - l_{52}^4, m_{52}^4, u_{52}^4\right| \le k_4^*$$

$$\left|\frac{(l_1^4, m_1^4, u_1^4)}{(l_6^4, m_6^4, u_6^4)} - l_{16}^4, m_{16}^4, u_{16}^4\right| \le k_4^* \qquad \left|\frac{(l_6^4, m_6^4, u_6^4)}{(l_2^4, m_2^4, u_2^4)} - l_{62}^4, m_{62}^4, u_{62}^4\right| \le k_4^*$$

Decision maker 5:

The best criterion (C_B): C_1 The worst criterion (C_W): C_6

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_1^5, m_1^5, u_1^5)} - l_{11}^5, m_{11}^5, u_{11}^5\right| \le k_5^* \qquad \left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_6^5, m_6^5, u_6^5)} - l_{16}^5, m_{16}^5, u_{16}^5\right| \le k_5^*$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_2^5, m_2^5, u_2^5)} - l_{12}^5, m_{12}^5, u_{12}^5\right| \le k_5^* \qquad \left|\frac{(l_2^5, m_2^5, u_2^5)}{(l_6^5, m_6^5, u_6^5)} - l_{26}^5, m_{26}^5, u_{26}^5\right| \le k_5^*$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_3^5, m_3^5, u_3^5)} - l_{13}^5, m_{13}^5, u_{13}^5\right| \le k_5^* \qquad \left|\frac{(l_3^5, m_3^5, u_3^5)}{(l_6^5, m_6^5, u_6^5)} - l_{36}^5, m_{36}^5, u_{36}^5\right| \le k_5^*$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_4^5, m_4^5, u_4^5)} - l_{14}^5, m_{14}^5, u_{14}^5\right| \le k_5^* \qquad \left|\frac{(l_4^5, m_4^5, u_4^5)}{(l_6^5, m_6^5, u_6^5)} - l_{46}^5, m_{46}^5, u_{46}^5\right| \le k_5^*$$

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$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_5^5, m_5^5, u_5^5)} - l_{15}^5, m_{15}^5, u_{15}^5\right| \le k_5^* \qquad \left|\frac{(l_5^5, m_5^5, u_5^5)}{(l_6^5, m_6^5, u_6^5)} - l_{56}^5, m_{56}^5, u_{56}^5\right| \le k_5^*$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_6^5, m_6^5, u_6^5)} - l_{16}^5, m_{16}^5, u_{16}^5\right| \le k_5^* \qquad \left|\frac{(l_6^5, m_6^5, u_6^5)}{(l_6^5, m_6^5, u_6^5)} - l_{66}^5, m_{66}^5, u_{66}^5\right| \le k_5^*$$

Decision maker 6:

The best criterion (C_B): C_6 The worst criterion (C_W): C_3

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_1^6, m_1^6, u_1^6)} - l_{61}^6, m_{61}^6, u_{61}^6\right| \le k_6^* \qquad \left|\frac{(l_1^6, m_1^6, u_1^6)}{(l_3^6, m_3^6, u_3^6)} - l_{13}^6, m_{13}^6, u_{13}^6\right| \le k_6^*$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_2^6, m_2^6, u_2^6)} - l_{62}^6, m_{62}^6, u_{62}^6\right| \le k_6^* \qquad \left|\frac{(l_2^6, m_2^6, u_2^6)}{(l_3^6, m_3^6, u_3^6)} - l_{23}^6, m_{23}^6, u_{23}^6\right| \le k_6^*$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_3^6, m_3^6, u_3^6)} - l_{63}^6, m_{63}^6, u_{63}^6\right| \le k_6^* \qquad \left|\frac{(l_3^6, m_3^6, u_3^6)}{(l_3^6, m_3^6, u_3^6)} - l_{33}^6, m_{33}^6, u_{33}^6\right| \le k_6^*$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_4^6, m_4^6, u_4^6)} - l_{64}^6, m_{64}^6, u_{64}^6\right| \le k_6^* \qquad \left|\frac{(l_4^6, m_4^6, u_4^6)}{(l_3^6, m_3^6, u_3^6)} - l_{43}^6, m_{43}^6, u_{43}^6\right| \le k_6^*$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_5^6, m_5^6, u_5^6)} - l_{65}^6, m_{65}^6, u_{65}^6\right| \le k_6^* \qquad \left|\frac{(l_5^6, m_5^6, u_5^6)}{(l_3^6, m_3^6, u_3^6)} - l_{53}^6, m_{53}^6, u_{53}^6\right| \le k_6^*$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_6^6, m_6^6, u_6^6)} - l_{66}^6, m_{66}^6, u_{66}^6\right| \le k_6^* \qquad \left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_3^6, m_3^6, u_3^6)} - l_{63}^6, m_{63}^6, u_{63}^6\right| \le k_6^*$$

Decision maker 7:

The best criterion (C_B): C_5 The worst criterion (C_W): C_6

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_1^7, m_1^7, u_1^7)} - l_{51}^7, m_{51}^7, u_{51}^7\right| \le k_7^* \qquad \left|\frac{(l_1^7, m_1^7, u_1^7)}{(l_6^7, m_6^7, u_6^7)} - l_{16}^7, m_{16}^7, u_{16}^7\right| \le k_7^*$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_2^7, m_2^7, u_2^7)} - l_{52}^7, m_{52}^7, u_{53}^7\right| \le k_7^* \qquad \left|\frac{(l_2^7, m_2^7, u_2^7)}{(l_6^7, m_6^7, u_6^7)} - l_{26}^7, m_{26}^7, u_{26}^7\right| \le k_7^*$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_3^7, m_3^7, u_3^7)} - l_{53}^7, m_{53}^7, u_{53}^7\right| \le k_7^* \qquad \left|\frac{(l_3^7, m_3^7, u_3^7)}{(l_6^7, m_6^7, u_6^7)} - l_{36}^7, m_{36}^7, u_{36}^7\right| \le k_7^*$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_4^7, m_4^7, u_4^7)} - l_{54}^7, m_{54}^7, u_{54}^7\right| \le k_7^* \qquad \left|\frac{(l_4^7, m_4^7, u_4^7)}{(l_6^7, m_6^7, u_6^7)} - l_{46}^7, m_{46}^7, u_{46}^7\right| \le k_7^*$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_5^7, m_5^7, u_5^7)} - l_{55}^7, m_{55}^7, u_{55}^7\right| \le k_7^* \qquad \left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_6^7, m_6^7, u_6^7)} - l_{56}^7, m_{56}^7, u_{56}^7\right| \le k_7^*$$

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$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_6^7, m_6^7, u_6^7)} - l_{56}^7, m_{56}^7, u_{56}^7\right| \le k_7^* \qquad \left|\frac{(l_6^7, m_6^7, u_6^7)}{(l_6^7, m_6^7, u_6^7)} - l_{16}^7, m_{16}^7, u_{16}^7\right| \le k_7^*$$

Decision maker 8:

The best criterion (C_B): C_1 The worst criterion (C_W): C_5

$$\left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_1^8, m_1^8, u_1^8)} - l_{11}^8, m_{11}^8, u_{11}^8\right| \le k_8^* \qquad \left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_5^8, m_5^8, u_5^8)} - l_{15}^8, m_{15}^8, u_{15}^8\right| \le k_8^*$$

$$\left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_2^8, m_2^8, u_2^8)} - l_{12}^8, m_{12}^8, u_{12}^8\right| \le k_8^* \qquad \left|\frac{(l_2^8, m_2^8, u_2^8)}{(l_5^8, m_5^8, u_5^8)} - l_{25}^8, m_{25}^8, u_{25}^8\right| \le k_8^*$$

$$\left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_3^8, m_3^8, u_3^8)} - l_{13}^8, m_{13}^8, u_{13}^8\right| \le k_8^* \qquad \left|\frac{(l_3^8, m_3^8, u_3^8)}{(l_5^8, m_5^8, u_5^8)} - l_{35}^8, m_{35}^8, u_{35}^8\right| \le k_8^*$$

$$\left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_4^8, m_4^8, u_4^8)} - l_{14}^8, m_{14}^8, u_{14}^8\right| \le k_8^* \qquad \left|\frac{(l_4^8, m_4^8, u_4^8)}{(l_5^8, m_5^8, u_5^8)} - l_{45}^8, m_{45}^8, u_{45}^8\right| \le k_8^*$$

$$\left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_5^8, m_5^8, u_5^8)} - l_{15}^8, m_{15}^8, u_{15}^8\right| \le k_8^* \qquad \left|\frac{(l_5^8, m_5^8, u_5^8)}{(l_5^8, m_5^8, u_5^8)} - l_{55}^8, m_{55}^8, u_{55}^8\right| \le k_8^*$$

$$\left|\frac{(l_1^8, m_1^8, u_1^8)}{(l_6^8, m_6^8, u_6^8)} - l_{16}^8, m_{16}^8, u_{16}^8\right| \le k_8^* \qquad \left|\frac{(l_6^8, m_6^8, u_6^8)}{(l_5^8, m_5^8, u_5^8)} - l_{65}^8, m_{65}^8, u_{65}^8\right| \le k_8^*$$

Decision maker 9:

The best criterion (C_B): C_3 The worst criterion (C_W): C_4

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_1^9, m_1^9, u_1^9)} - l_{31}^9, m_{31}^9, u_{31}^9\right| \le k_9^* \qquad \left|\frac{(l_1^9, m_1^9, u_1^9)}{(l_4^9, m_4^9, u_4^9)} - l_{14}^9, m_{14}^9, u_{14}^9\right| \le k_9^*$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_2^9, m_2^9, u_2^9)} - l_{32}^9, m_{32}^9, u_{32}^9\right| \le k_9^* \qquad \left|\frac{(l_2^9, m_2^9, u_2^9)}{(l_4^9, m_4^9, u_4^9)} - l_{24}^9, m_{24}^9, u_{24}^9\right| \le k_9^*$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_3^9, m_3^9, u_3^9)} - l_{33}^9, m_{33}^9, u_{33}^9\right| \le k_9^* \qquad \left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_4^9, m_4^9, u_4^9)} - l_{34}^9, m_{34}^9, u_{34}^9\right| \le k_9^*$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_4^9, m_4^9, u_4^9)} - l_{34}^9, m_{34}^9, u_{34}^9\right| \le k_9^* \qquad \left|\frac{(l_4^9, m_4^9, u_4^9)}{(l_4^9, m_4^9, u_4^9)} - l_{44}^9, m_{44}^9, u_{44}^9\right| \le k_9^*$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_5^9, m_5^9, u_5^9)} - l_{35}^9, m_{35}^9, u_{35}^9\right| \le k_9^* \qquad \left|\frac{(l_5^9, m_5^9, u_5^9)}{(l_4^9, m_4^9, u_4^9)} - l_{54}^9, m_{54}^9, u_{54}^9\right| \le k_9^*$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_6^9, m_6^9, u_6^9)} - l_{36}^9, m_{36}^9, u_{36}^9\right| \le k_9^* \qquad \left|\frac{(l_6^9, m_6^9, u_{46}^9)}{(l_4^9, m_4^9, u_4^9)} - l_{64}^9, m_{64}^9, u_{64}^9\right| \le k_9^*$$

Decision maker 10:

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The best criterion (C_B): C_1 The worst criterion (C_W): C_5

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_1^{10},m_1^{10},u_1^{10})}-l_{11}^{10},m_{11}^{10},u_{11}^{10}\right|\le k_{10}^{*} \qquad \left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{15}^{10},m_{15}^{10},u_{15}^{10}\right|\le k_{10}^{*}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_2^{10},m_2^{10},u_2^{10})}-l_{12}^{10},m_{12}^{10},u_{12}^{10}\right|\le k_{10}^{*} \qquad \left|\frac{(l_2^{10},m_2^{10},u_2^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{25}^{10},m_{25}^{10},u_{25}^{10}\right|\le k_{10}^{*}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_3^{10},m_3^{10},u_3^{10})}-l_{13}^{10},m_{13}^{10},u_{13}^{10}\right|\le k_{10}^{*} \qquad \left|\frac{(l_3^{10},m_3^{10},u_3^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{35}^{10},m_{35}^{10},u_{35}^{10}\right|\le k_{10}^{*}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_4^{10},m_4^{10},u_4^{10})}-l_{14}^{10},m_{14}^{10},u_{14}^{10}\right|\le k_{10}^{*} \qquad \left|\frac{(l_4^{10},m_4^{10},u_4^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{45}^{10},m_{45}^{10},u_{45}^{10}\right|\le k_{10}^{*}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{15}^{10},m_{15}^{10},u_{15}^{10}\right|\le k_{10}^{*} \qquad \left|\frac{(l_5^{10},m_5^{10},u_5^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{55}^{10},m_{55}^{10},u_{55}^{10}\right|\le k_{10}^{*}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_6^{10},m_6^{10},u_6^{10})}-l_{16}^{10},m_{16}^{10},u_{16}^{10}\right|\le k_{10}^{*} \qquad \left|\frac{(l_6^{10},m_6^{10},u_6^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-l_{65}^{10},m_{65}^{10},u_{65}^{10}\right|\le k_{10}^{*}$$

Decision maker 11:

The best criterion (C_B): C_3 The worst criterion (C_W): C_4

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_1^{11},m_1^{11},u_1^{11})}-l_{31}^{11},m_{31}^{11},u_{31}^{11}\right|\le k_{11}^{*} \qquad \left|\frac{(l_1^{11},m_1^{11},u_1^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{14}^{11},m_{14}^{11},u_{14}^{11}\right|\le k_{11}^{*}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_2^{11},m_2^{11},u_2^{11})}-l_{32}^{11},m_{32}^{11},u_{32}^{11}\right|\le k_{11}^{*} \qquad \left|\frac{(l_2^{11},m_2^{11},u_2^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{24}^{11},m_{24}^{11},u_{24}^{11}\right|\le k_{11}^{*}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_3^{11},m_3^{11},u_3^{11})}-l_{33}^{11},m_{33}^{11},u_{33}^{11}\right|\le k_{11}^{*} \qquad \left|\frac{(l_3^{11},m_3^{11},u_{31}^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{34}^{11},m_{34}^{11},u_{34}^{11}\right|\le k_{11}^{*}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{34}^{11},m_{34}^{11},u_{34}^{11}\right|\le k_{11}^{*} \qquad \left|\frac{(l_4^{11},m_4^{11},u_4^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{44}^{11},m_{44}^{11},u_{44}^{11}\right|\le k_{11}^{*}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_5^{11},m_5^{11},u_5^{11})}-l_{35}^{11},m_{35}^{11},u_{35}^{11}\right|\le k_{11}^{*} \qquad \left|\frac{(l_5^{11},m_5^{11},u_5^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{54}^{11},m_{54}^{11},u_{54}^{11}\right|\le k_{11}^{*}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_6^{11},m_6^{11},u_6^{11})}-l_{36}^{11},m_{36}^{11},u_{36}^{11}\right|\le k_{11}^{*} \qquad \left|\frac{(l_6^{11},m_6^{11},u_6^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-l_{64}^{11},m_{64}^{11},u_{64}^{11}\right|\le k_{11}^{*}$$

Decision maker 12:

The best criterion (C_B): C_3 The worst criterion (C_W): C_6

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$$\left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_1^{12},m_1^{12},u_1^{12})}-l_{31}^{12},m_{31}^{12},u_{31}^{12}\right|\le k_{12}^{*} \qquad \left|\frac{(l_1^{12},m_1^{12},u_1^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{16}^{12},m_{16}^{12},u_{16}^{12}\right|\le k_{12}^{*}$$

$$\left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_2^{12},m_2^{12},u_2^{12})}-l_{32}^{12},m_{32}^{12},u_{32}^{12}\right|\le k_{12}^{*} \qquad \left|\frac{(l_2^{12},m_2^{12},u_2^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{26}^{12},m_{26}^{12},u_{26}^{12}\right|\le k_{12}^{*}$$

$$\left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_3^{12},m_3^{12},u_3^{12})}-l_{33}^{12},m_{33}^{12},u_{33}^{12}\right|\le k_{12}^{*} \qquad \left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{36}^{12},m_{36}^{12},u_{36}^{12}\right|\le k_{12}^{*}$$

$$\left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_4^{12},m_4^{12},u_4^{12})}-l_{34}^{12},m_{34}^{12},u_{34}^{12}\right|\le k_{12}^{*} \qquad \left|\frac{(l_4^{12},m_4^{12},u_4^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{46}^{12},m_{46}^{12},u_{46}^{12}\right|\le k_{12}^{*}$$

$$\left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_5^{12},m_5^{12},u_5^{12})}-l_{35}^{12},m_{35}^{12},u_{35}^{12}\right|\le k_{12}^{*} \qquad \left|\frac{(l_5^{12},m_5^{12},u_5^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{56}^{12},m_{56}^{12},u_{56}^{12}\right|\le k_{12}^{*}$$

$$\left|\frac{(l_3^{12},m_3^{12},u_3^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{36}^{12},m_{36}^{12},u_{36}^{12}\right|\le k_{12}^{*} \qquad \left|\frac{(l_6^{12},m_6^{12},u_6^{12})}{(l_6^{12},m_6^{12},u_6^{12})}-l_{66}^{12},m_{66}^{12},u_{66}^{12}\right|\le k_{12}^{*}$$

Decision maker 13:

The best criterion (C_B): C_6 The worst criterion (C_W): C_4

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_1^{13},m_1^{13},u_1^{13})}-l_{61}^{13},m_{61}^{13},u_{61}^{13}\right|\le k_{13}^{*} \qquad \left|\frac{(l_1^{13},m_1^{13},u_1^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{14}^{13},m_{14}^{13},u_{14}^{13}\right|\le k_{13}^{*}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_2^{13},m_2^{13},u_2^{13})}-l_{62}^{13},m_{62}^{13},u_{62}^{13}\right|\le k_{13}^{*} \qquad \left|\frac{(l_2^{13},m_2^{13},u_2^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{24}^{13},m_{24}^{13},u_{24}^{13}\right|\le k_{13}^{*}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_3^{13},m_3^{13},u_3^{13})}-l_{63}^{13},m_{63}^{13},u_{63}^{13}\right|\le k_{13}^{*} \qquad \left|\frac{(l_3^{13},m_3^{13},u_3^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{34}^{13},m_{34}^{13},u_{34}^{13}\right|\le k_{13}^{*}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{64}^{13},m_{64}^{13},u_{64}^{13}\right|\le k_{13}^{*} \qquad \left|\frac{(l_4^{13},m_4^{13},u_4^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{44}^{13},m_{44}^{13},u_{44}^{13}\right|\le k_{13}^{*}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_5^{13},m_5^{13},u_5^{13})}-l_{65}^{13},m_{65}^{13},u_{65}^{13}\right|\le k_{13}^{*} \qquad \left|\frac{(l_5^{13},m_5^{13},u_5^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{54}^{13},m_{54}^{13},u_{54}^{13}\right|\le k_{13}^{*}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_6^{13},m_6^{13},u_6^{13})}-l_{66}^{13},m_{66}^{13},u_{66}^{13}\right|\le k_{13}^{*} \qquad \left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-l_{64}^{13},m_{64}^{13},u_{64}^{13}\right|\le k_{13}^{*}$$

$$\sum_{j=1}^{6} R(\widetilde{W}_j^i)=1\,, \qquad R\left(\widetilde{W}_j^i\right)=\frac{l_j^i+4*m_j^i+u_j^i}{6}$$

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$$\sum_{j=1}^{6} R\left(\tilde{W}_j^1\right) = R\left(\tilde{W}_1^1\right) + R\left(\tilde{W}_2^1\right) + R\left(\tilde{W}_3^1\right) + R\left(\tilde{W}_4^1\right) + R\left(\tilde{W}_5^1\right) + R\left(\tilde{W}_6^1\right) =$$

$$\frac{l_1^1+4*m_1^1+u_1^1}{6} + \frac{l_2^1+4*m_2^1+u_2^1}{6} + \frac{l_3^1+4*m_3^1+u_3^1}{6} + \frac{l_4^1+4*m_4^1+u_4^1}{6} + \frac{l_5^1+4*m_5^1+u_5^1}{6} + \frac{l_6^1+4*m_6^1+u_6^1}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^2\right) = R\left(\tilde{W}_1^2\right) + R\left(\tilde{W}_2^2\right) + R\left(\tilde{W}_3^2\right) + R\left(\tilde{W}_4^2\right) + R\left(\tilde{W}_5^2\right) + R\left(\tilde{W}_6^2\right) =$$

$$\frac{l_1^2+4*m_1^2+u_1^2}{6} + \frac{l_2^2+4*m_2^2+u_2^2}{6} + \frac{l_3^2+4*m_3^2+u_3^2}{6} + \frac{l_4^2+4*m_4^2+u_4^2}{6} + \frac{l_5^2+4*m_5^2+u_5^2}{6} + \frac{l_6^2+4*m_6^2+u_6^2}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^3\right) = R\left(\tilde{W}_1^3\right) + R\left(\tilde{W}_2^3\right) + R\left(\tilde{W}_3^3\right) + R\left(\tilde{W}_4^3\right) + R\left(\tilde{W}_5^3\right) + R\left(\tilde{W}_6^3\right) =$$

$$\frac{l_1^3+4*m_1^3+u_1^3}{6} + \frac{l_2^3+4*m_2^3+u_2^3}{6} + \frac{l_3^3+4*m_3^3+u_3^3}{6} + \frac{l_4^3+4*m_4^3+u_4^3}{6} + \frac{l_5^3+4*m_5^3+u_5^3}{6} + \frac{l_6^3+4*m_6^3+u_6^3}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^4\right) = R\left(\tilde{W}_1^4\right) + R\left(\tilde{W}_2^4\right) + R\left(\tilde{W}_3^4\right) + R\left(\tilde{W}_4^4\right) + R\left(\tilde{W}_5^4\right) + R\left(\tilde{W}_6^4\right) =$$

$$\frac{l_1^4+4*m_1^4+u_1^4}{6} + \frac{l_2^4+4*m_2^4+u_2^4}{6} + \frac{l_3^4+4*m_3^4+u_3^4}{6} + \frac{l_4^4+4*m_4^4+u_4^4}{6} + \frac{l_5^4+4*m_5^4+u_5^4}{6} + \frac{l_6^4+4*m_6^4+u_6^4}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^5\right) = R\left(\tilde{W}_1^5\right) + R\left(\tilde{W}_2^5\right) + R\left(\tilde{W}_3^5\right) + R\left(\tilde{W}_4^5\right) + R\left(\tilde{W}_5^5\right) + R\left(\tilde{W}_6^5\right) =$$

$$\frac{l_1^5+4*m_1^5+u_1^5}{6} + \frac{l_2^5+4*m_2^5+u_2^5}{6} + \frac{l_3^5+4*m_3^5+u_3^5}{6} + \frac{l_4^5+4*m_4^5+u_4^5}{6} + \frac{l_5^5+4*m_5^5+u_5^5}{6} + \frac{l_6^5+4*m_6^5+u_6^5}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^6\right) = R\left(\tilde{W}_1^6\right) + R\left(\tilde{W}_2^6\right) + R\left(\tilde{W}_3^6\right) + R\left(\tilde{W}_4^6\right) + R\left(\tilde{W}_5^6\right) + R\left(\tilde{W}_6^6\right) =$$

$$\frac{l_1^6+4*m_1^6+u_1^6}{6} + \frac{l_2^6+4*m_2^6+u_2^6}{6} + \frac{l_3^6+4*m_3^6+u_3^6}{6} + \frac{l_4^6+4*m_4^6+u_4^6}{6} + \frac{l_5^6+4*m_5^6+u_5^6}{6} + \frac{l_6^6+4*m_6^6+u_6^6}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^7\right) = R\left(\tilde{W}_1^7\right) + R\left(\tilde{W}_2^7\right) + R\left(\tilde{W}_3^7\right) + R\left(\tilde{W}_4^7\right) + R\left(\tilde{W}_5^7\right) + R\left(\tilde{W}_6^7\right) =$$

$$\frac{l_1^7+4*m_1^7+u_1^7}{6} + \frac{l_2^7+4*m_2^7+u_2^7}{6} + \frac{l_3^7+4*m_3^7+u_3^7}{6} + \frac{l_4^7+4*m_4^7+u_4^7}{6} + \frac{l_5^7+4*m_5^7+u_5^7}{6} + \frac{l_6^7+4*m_6^7+u_6^7}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^8\right) = R\left(\tilde{W}_1^8\right) + R\left(\tilde{W}_2^8\right) + R\left(\tilde{W}_3^8\right) + R\left(\tilde{W}_4^8\right) + R\left(\tilde{W}_5^8\right) + R\left(\tilde{W}_6^8\right) =$$

$$\frac{l_1^8+4*m_1^8+u_1^8}{6} + \frac{l_2^8+4*m_2^8+u_2^8}{6} + \frac{l_3^8+4*m_3^8+u_3^8}{6} + \frac{l_4^8+4*m_4^8+u_4^8}{6} + \frac{l_5^8+4*m_5^8+u_5^8}{6} + \frac{l_6^8+4*m_6^8+u_6^8}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^9\right) = R\left(\tilde{W}_1^9\right) + R\left(\tilde{W}_2^9\right) + R\left(\tilde{W}_3^9\right) + R\left(\tilde{W}_4^9\right) + R\left(\tilde{W}_5^9\right) + R\left(\tilde{W}_6^9\right) =$$

$$\frac{l_1^9+4*m_1^9+u_1^9}{6} + \frac{l_2^9+4*m_2^9+u_2^9}{6} + \frac{l_3^9+4*m_3^9+u_3^9}{6} + \frac{l_4^9+4*m_4^9+u_4^9}{6} + \frac{l_5^9+4*m_5^9+u_5^9}{6} + \frac{l_6^9+4*m_6^9+u_6^9}{6} = 1$$

$$\sum_{j=1}^{6} R\left(\tilde{W}_j^{10}\right) = R\left(\tilde{W}_1^{10}\right) + R\left(\tilde{W}_2^{10}\right) + R\left(\tilde{W}_3^{10}\right) + R\left(\tilde{W}_4^{10}\right) + R\left(\tilde{W}_5^{10}\right) + R\left(\tilde{W}_6^{10}\right) =$$

$$\frac{l_1^{10}+4*m_1^{10}+u_1^{10}}{6} +$$

$$\frac{l_2^{10}+4*m_2^{10}+u_2^{10}}{6} + \frac{l_3^{10}+4*m_3^{10}+u_3^{10}}{6} + \frac{l_4^{10}+4*m_4^{10}+u_4^{10}}{6} + \frac{l_5^{10}+4*m_5^{10}+u_5^{10}}{6} + \frac{l_6^{10}+4*m_6^{10}+u_6^{10}}{6} = 1$$

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$$\sum_{j=1}^{6} R\left(\widetilde{W}_j^{11}\right) = R\left(\widetilde{W}_1^{11}\right) + R\left(\widetilde{W}_2^{11}\right) + R\left(\widetilde{W}_3^{11}\right) + R\left(\widetilde{W}_4^{11}\right) + R\left(\widetilde{W}_5^{11}\right) + R\left(\widetilde{W}_6^{11}\right) =$$

$$\frac{l_1^{11}+4*m_1^{11}+u_1^{11}}{6} +$$

$$\frac{l_2^{11}+4*m_2^{11}+u_2^{11}}{6}+\frac{l_3^{11}+4*m_3^{11}+u_3^{11}}{6}+\frac{l_4^{11}+4*m_4^{11}+u_4^{11}}{6}+\frac{l_5^{11}+4*m_5^{11}+u_5^{11}}{6}+\frac{l_6^{11}+4*m_6^{11}+u_6^{11}}{6}=1$$

$$\sum_{j=1}^{6} R\left(\widetilde{W}_j^{12}\right) = R\left(\widetilde{W}_1^{12}\right) + R\left(\widetilde{W}_2^{12}\right) + R\left(\widetilde{W}_3^{12}\right) + R\left(\widetilde{W}_4^{12}\right) + R\left(\widetilde{W}_5^{12}\right) + R\left(\widetilde{W}_6^{12}\right) =$$

$$\frac{l_1^{12}+4*m_1^{12}+u_1^{12}}{6} +$$

$$\frac{l_2^{12}+4*m_2^{12}+u_2^{12}}{6}+\frac{l_3^{12}+4*m_3^{12}+u_3^{12}}{6}+\frac{l_4^{12}+4*m_4^{12}+u_4^{12}}{6}+\frac{l_5^{12}+4*m_5^{12}+u_5^{12}}{6}+\frac{l_6^{12}+4*m_6^{12}+u_6^{12}}{6}=1$$

$$\sum_{j=1}^{6} R\left(\widetilde{W}_j^{13}\right) = R\left(\widetilde{W}_1^{13}\right) + R\left(\widetilde{W}_2^{13}\right) + R\left(\widetilde{W}_3^{13}\right) + R\left(\widetilde{W}_4^{13}\right) + R\left(\widetilde{W}_5^{13}\right) + R\left(\widetilde{W}_6^{13}\right) =$$

$$\frac{l_1^{13}+4*m_1^{13}+u_1^{13}}{6} +$$

$$\frac{l_2^{13}+4*m_2^{13}+u_2^{13}}{6}+\frac{l_3^{13}+4*m_3^{13}+u_3^{13}}{6}+\frac{l_4^{13}+4*m_4^{13}+u_4^{13}}{6}+\frac{l_5^{13}+4*m_5^{13}+u_5^{13}}{6}+\frac{l_6^{13}+4*m_6^{13}+u_6^{13}}{6}=1$$

$$l_j^i \le m_j^i \le u_j^i$$

$l_1^1 \le m_1^1 \le u_1^1$	$l_2^1 \le m_2^1 \le u_2^1$	$l_3^1 \le m_3^1 \le u_3^1$	$l_4^1 \le m_4^1 \le u_4^1$	$l_5^1 \le m_5^1 \le u_5^1$	$l_6^1 \le m_6^1 \le u_6^1$
$l_1^2 \le m_1^2 \le u_1^2$	$l_2^2 \le m_2^2 \le u_2^2$	$l_3^2 \le m_3^2 \le u_3^2$	$l_4^2 \le m_4^2 \le u_4^2$	$l_5^2 \le m_5^2 \le u_5^2$	$l_6^2 \le m_6^2 \le u_6^2$
$l_1^3 \le m_1^3 \le u_1^3$	$l_2^3 \le m_2^3 \le u_2^3$	$l_3^3 \le m_3^3 \le u_3^3$	$l_4^3 \le m_4^3 \le u_4^3$	$l_5^3 \le m_5^3 \le u_5^3$	$l_6^3 \le m_6^3 \le u_6^3$
$l_1^4 \le m_1^4 \le u_1^4$	$l_2^4 \le m_2^4 \le u_2^4$	$l_3^4 \le m_3^4 \le u_3^4$	$l_4^4 \le m_4^4 \le u_4^4$	$l_5^4 \le m_5^4 \le u_5^4$	$l_6^4 \le m_6^4 \le u_6^4$
$l_1^5 \le m_1^5 \le u_1^5$	$l_2^5 \le m_2^5 \le u_2^5$	$l_3^5 \le m_3^5 \le u_3^5$	$l_4^5 \le m_4^5 \le u_4^5$	$l_5^5 \le m_5^5 \le u_5^5$	$l_6^5 \le m_6^5 \le u_6^5$
$l_1^6 \le m_1^6 \le u_1^6$	$l_2^6 \le m_2^6 \le u_2^6$	$l_3^6 \le m_3^6 \le u_3^6$	$l_4^6 \le m_4^6 \le u_4^6$	$l_5^6 \le m_5^6 \le u_5^6$	$l_6^6 \le m_6^6 \le u_6^6$
$l_1^7 \le m_1^7 \le u_1^7$	$l_2^7 \le m_2^7 \le u_2^7$	$l_3^7 \le m_3^7 \le u_3^7$	$l_4^7 \le m_4^7 \le u_4^7$	$l_5^7 \le m_5^7 \le u_5^7$	$l_6^7 \le m_6^7 \le u_6^7$
$l_1^8 \le m_1^8 \le u_1^8$	$l_2^8 \le m_2^8 \le u_2^8$	$l_3^8 \le m_3^8 \le u_3^8$	$l_4^8 \le m_4^8 \le u_4^8$	$l_5^8 \le m_5^8 \le u_5^8$	$l_6^8 \le m_6^8 \le u_6^8$
$l_1^9 \le m_1^9 \le u_1^9$	$l_2^9 \le m_2^9 \le u_2^9$	$l_3^9 \le m_3^9 \le u_3^9$	$l_4^9 \le m_4^9 \le u_4^9$	$l_5^9 \le m_5^9 \le u_5^9$	$l_6^9 \le m_6^9 \le u_6^9$
$l_1^{10} \le m_1^{10} \le u_1^{10}$	$l_2^{10} \le m_2^{10} \le u_2^{10}$	$l_3^{10} \le m_3^{10} \le u_3^{10}$	$l_4^{10} \le m_4^{10} \le u_4^{10}$	$l_5^{10} \le m_5^{10} \le u_5^{10}$	$l_6^{10} \le m_6^{10} \le u_6^{10}$
$l_1^{11} \le m_1^{11} \le u_1^{11}$	$l_2^{11} \le m_2^{11} \le u_2^{11}$	$l_3^{11} \le m_3^{11} \le u_3^{11}$	$l_4^{11} \le m_4^{11} \le u_4^{11}$	$l_5^{11} \le m_5^{11} \le u_5^{11}$	$l_6^{11} \le m_6^{11} \le u_6^{11}$
$l_1^{12} \le m_1^{12} \le u_1^{12}$	$l_2^{12} \le m_2^{12} \le u_2^{12}$	$l_3^{12} \le m_3^{12} \le u_3^{12}$	$l_4^{12} \le m_4^{12} \le u_4^{12}$	$l_5^{12} \le m_5^{12} \le u_5^{12}$	$l_6^{12} \le m_6^{12} \le u_6^{12}$
$l_1^{13} \le m_1^{13} \le u_1^{13}$	$l_2^{13} \le m_2^{13} \le u_2^{13}$	$l_3^{13} \le m_3^{13} \le u_3^{13}$	$l_4^{13} \le m_4^{13} \le u_4^{13}$	$l_5^{13} \le m_5^{13} \le u_5^{13}$	$l_6^{13} \le m_6^{13} \le u_6^{13}$

$$l_j^i > 0$$

$$l_1^1, l_1^2, l_1^3, l_1^4, l_1^5, l_1^6, l_1^7, l_1^8, l_1^9, l_1^{10}, l_1^{11}, l_1^{12}, l_1^{13} l_2^1, l_2^2, l_2^3, l_2^4, l_2^5, l_2^6, l_2^7, l_2^8, l_2^9, l_2^{10}, l_2^{11}, l_2^{12}, l_2^{13}, l_3^1, l_3^2, l_3^3, l_3^4, l_3^5, l_3^6, l_3^7, l_3^8, l_3^9, l_3^{10}, l_3^{11}, l_3^{12}, l_3^{13},$$

$$l_4^1, l_4^2, l_4^3, l_4^4, l_4^5, l_4^6, l_4^7, l_4^8, l_4^9, l_4^{10}, l_4^{11}, l_4^{12}, l_4^{13}, l_5^1, l_5^2, l_5^3, l_5^4, l_5^5, l_5^6, l_5^7, l_5^8, l_5^9, l_5^{10}, l_5^{11}, l_5^{12}, l_5^{13}, l_6^1, l_6^2, l_6^3, l_6^4, l_6^5, l_6^6, l_6^7, l_6^8, l_6^9, l_6^{10}, l_6^{11}, l_6^{12}, l_6^{13} > 0$$

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$$\mu_j = \frac{\sum_i \widetilde{W}_j^i}{d} \ , \ \forall j \ R\left(\widetilde{W}_j^i\right) = \frac{l_j^i + 4*m_j^i + u_j^i}{6}$$

$$\mu_1 = \frac{R(\widetilde{W}_1^1)+R(\widetilde{W}_1^2)+R(\widetilde{W}_1^3)+R(\widetilde{W}_1^4)+R(\widetilde{W}_1^5)+R(\widetilde{W}_1^6)+R(\widetilde{W}_1^7)+R(\widetilde{W}_1^8)+R(\widetilde{W}_1^9)+R(\widetilde{W}_1^{10})+R(\widetilde{W}_1^{11})+R(\widetilde{W}_1^{12})+R(\widetilde{W}_1^{13})}{13}$$

$$13 * \mu_1 = \frac{l_1^1+4*m_1^1+u_1^1}{6} + \frac{l_1^2+4*m_1^2+u_1^2}{6} + \frac{l_1^3+4*m_1^3+u_1^3}{6} + \frac{l_1^4+4*m_1^4+u_1^4}{6} + \frac{l_1^5+4*m_1^5+u_1^5}{6} + \frac{l_1^6+4*m_1^6+u_1^6}{6} + \frac{l_1^7+4*m_1^7+u_1^7}{6} + \frac{l_1^8+4*m_1^8+u_1^8}{6} + \frac{l_1^9+4*m_1^9+u_1^9}{6} + \frac{l_1^{10}+4*m_1^{10}+u_1^{10}}{6} + \frac{l_1^{11}+4*m_1^{11}+u_1^{11}}{6} + \frac{l_1^{12}+4*m_1^{12}+u_1^{12}}{6} + \frac{l_1^{13}+4*m_1^{13}+u_1^{13}}{6}$$

$$\mu_2 = \frac{R(\widetilde{W}_2^1)+R(\widetilde{W}_2^2)+R(\widetilde{W}_2^3)+R(\widetilde{W}_2^4)+R(\widetilde{W}_2^5)+R(\widetilde{W}_2^6)+R(\widetilde{W}_2^7)+R(\widetilde{W}_2^8)+R(\widetilde{W}_2^9)+R(\widetilde{W}_2^{10})+R(\widetilde{W}_2^{11})+R(\widetilde{W}_2^{12})+R(\widetilde{W}_1^{13})}{13}$$

$$13 * \mu_2 = \frac{l_2^1+4*m_2^1+u_2^1}{6} + \frac{l_2^2+4*m_2^2+u_2^2}{6} + \frac{l_2^3+4*m_2^3+u_2^3}{6} + \frac{l_2^4+4*m_2^4+u_2^4}{6} + \frac{l_2^5+4*m_2^5+u_2^5}{6} + \frac{l_2^6+4*m_2^6+u_2^6}{6} + \frac{l_2^7+4*m_2^7+u_2^7}{6} + \frac{l_2^8+4*m_2^8+u_2^8}{6} + \frac{l_2^9+4*m_2^9+u_2^9}{6} + \frac{l_2^{10}+4*m_2^{10}+u_2^{10}}{6} + \frac{l_2^{11}+4*m_2^{11}+u_2^{11}}{6} + \frac{l_2^{12}+4*m_2^{12}+u_2^{12}}{6} + \frac{l_2^{13}+4*m_2^{13}+u_2^{13}}{6}$$

$$\mu_3 = \frac{R(\widetilde{W}_3^1)+R(\widetilde{W}_3^2)+R(\widetilde{W}_3^3)+R(\widetilde{W}_3^4)+R(\widetilde{W}_3^5)+R(\widetilde{W}_3^6)+R(\widetilde{W}_3^7)+R(\widetilde{W}_3^8)+R(\widetilde{W}_3^9)+R(\widetilde{W}_3^{10})+R(\widetilde{W}_3^{11})+R(\widetilde{W}_3^{12})+R(\widetilde{W}_1^{13})}{13}$$

$$13 * \mu_3 = \frac{l_3^1+4*m_3^1+u_3^1}{6} + \frac{l_3^2+4*m_3^2+u_3^2}{6} + \frac{l_3^3+4*m_3^3+u_3^3}{6} + \frac{l_3^4+4*m_3^4+u_3^4}{6} + \frac{l_3^5+4*m_3^5+u_3^5}{6} + \frac{l_3^6+4*m_3^6+u_3^6}{6} + \frac{l_3^7+4*m_3^7+u_3^7}{6} + \frac{l_3^8+4*m_3^8+u_3^8}{6} + \frac{l_3^9+4*m_3^9+u_3^9}{6} + \frac{l_3^{10}+4*m_3^{10}+u_3^{10}}{6} + \frac{l_3^{11}+4*m_3^{11}+u_3^{11}}{6} + \frac{l_3^{12}+4*m_3^{12}+u_1^{12}}{6} + \frac{l_3^{13}+4*m_3^{13}+u_3^{13}}{6}$$

$$\mu_4 = \frac{R(\widetilde{W}_4^1)+R(\widetilde{W}_4^2)+R(\widetilde{W}_4^3)+R(\widetilde{W}_4^4)+R(\widetilde{W}_4^5)+R(\widetilde{W}_4^6)+R(\widetilde{W}_4^7)+R(\widetilde{W}_4^8)+R(\widetilde{W}_4^9)+R(\widetilde{W}_4^{10})+R(\widetilde{W}_4^{11})+R(\widetilde{W}_4^{12})+R(\widetilde{W}_1^{13})}{13}$$

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$$13 * \mu_4 = \frac{l_4^1+4*m_4^1+u_4^1}{6} + \frac{l_4^2+4*m_4^2+u_4^2}{6} + \frac{l_4^3+4*m_4^3+u_4^3}{6} + \frac{l_4^4+4*m_4^4+u_4^4}{6} + \frac{l_4^5+4*m_4^5+u_4^5}{6} + \frac{l_4^6+4*m_4^6+u_4^6}{6} + \frac{l_4^7+4*m_4^7+u_4^7}{6} + \frac{l_4^8+4*m_4^8+u_4^8}{6} + \frac{l_4^9+4*m_4^9+u_4^9}{6} + \frac{l_4^{10}+4*m_4^{10}+u_4^{10}}{6} + \frac{l_4^{11}+4*m_4^{11}+u_4^{11}}{6} + \frac{l_4^{12}+4*m_4^{12}+u_4^{12}}{6} + \frac{l_4^{13}+4*m_4^{13}+u_4^{13}}{6}$$

$$\mu_5 = \frac{R(\widetilde{W}_5^1)+R(\widetilde{W}_5^2)+R(\widetilde{W}_5^3)+R(\widetilde{W}_5^4)+R(\widetilde{W}_5^5)+R(\widetilde{W}_5^6)+R(\widetilde{W}_5^7)+R(\widetilde{W}_5^8)+R(\widetilde{W}_5^9)+R(\widetilde{W}_5^{10})+R(\widetilde{W}_5^{11})+R(\widetilde{W}_5^{12})+R(\widetilde{W}_1^{13})}{13}$$

$$13 * \mu_5 = \frac{l_5^1+4*m_5^1+u_5^1}{6} + \frac{l_5^2+4*m_5^2+u_5^2}{6} + \frac{l_5^3+4*m_5^3+u_5^3}{6} + \frac{l_5^4+4*m_5^4+u_5^4}{6} + \frac{l_5^5+4*m_5^5+u_5^5}{6} + \frac{l_5^6+4*m_5^6+u_5^6}{6} + \frac{l_5^7+4*m_5^7+u_5^7}{6} + \frac{l_5^8+4*m_5^8+u_5^8}{6} + \frac{l_5^9+4*m_5^9+u_5^9}{6} + \frac{l_5^{10}+4*m_5^{10}+u_5^{10}}{6} + \frac{l_5^{11}+4*m_5^{11}+u_5^{11}}{6} + \frac{l_5^{12}+4*m_5^{12}+u_5^{12}}{6} + \frac{l_5^{13}+4*m_5^{13}+u_5^{13}}{6}$$

$$\mu_6 = \frac{R(\widetilde{W}_6^1)+R(\widetilde{W}_6^2)+R(\widetilde{W}_6^3)+R(\widetilde{W}_6^4)+R(\widetilde{W}_6^5)+R(\widetilde{W}_6^6)+R(\widetilde{W}_6^7)+R(\widetilde{W}_6^8)+R(\widetilde{W}_6^9)+R(\widetilde{W}_6^{10})+R(\widetilde{W}_6^{11})+R(\widetilde{W}_6^{12})+R(\widetilde{W}_1^{13})}{13}$$

$$13 * \mu_6 = \frac{l_6^1+4*m_6^1+u_6^1}{6} + \frac{l_6^2+4*m_6^2+u_6^2}{6} + \frac{l_6^3+4*m_6^3+u_6^3}{6} + \frac{l_6^4+4*m_6^4+u_6^4}{6} + \frac{l_6^5+4*m_6^5+u_6^5}{6} + \frac{l_6^6+4*m_6^6+u_6^6}{6} + \frac{l_6^7+4*m_6^7+u_6^7}{6} + \frac{l_6^8+4*m_6^8+u_6^8}{6} + \frac{l_6^9+4*m_6^9+u_6^9}{6} + \frac{l_6^{10}+4*m_6^{10}+u_6^{10}}{6} + \frac{l_6^{11}+4*m_6^{11}+u_6^{11}}{6} + \frac{l_6^{12}+4*m_6^{12}+u_6^{12}}{6} + \frac{l_6^{13}+4*m_6^{13}+u_6^{13}}{6}$$

Putting the real values extracted from table 4.23 , 4.24 in the above formulas, the problem transfer as below:

$$\text{Min } k_1^* + k_2^* + k_3^* + k_4^* + k_5^* + k_6^* + k_7^* + k_8^* + k_9^* + k_{10}^* + k_{11}^* + k_{12}^* + k_{13}^*$$

s.t.

Decision maker1:

The best criterion (C_B): C_2 The worst criterion (C_W): C_5

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$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_1^1, m_1^1, u_1^1)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \le k_1^*$$

$$l_2^1 - 2.5 * u_1^1 \le k_1^* * u_1^1$$

$$l_2^1 - 2.5 * u_1^1 \ge -k_1^* * u_1^1$$

$$m_2^1 - 3 * m_1^1 \le k_1^* * m_1^1$$

$$m_2^1 - 3 * m_1^1 \ge -k_1^* * m_1^1$$

$$u_2^1 - 3.5 * l_1^1 \le k_1^* * l_1^1$$

$$u_2^1 - 3.5 * l_1^1 \ge -k_1^* * l_1^1$$

$$\left|\frac{(l_1^1, m_1^1, u_1^1)}{(l_5^1, m_5^1, u_5^1)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_1^*$$

$$l_1^1 - 1.5 * u_5^1 \le k_1^* * u_5^1$$

$$l_1^1 - 1.5 * u_5^1 \ge -k_1^* * u_5^1$$

$$m_1^1 - 2 * m_5^1 \le k_1^* * m_5^1$$

$$m_1^1 - 2 * m_5^1 \ge -k_1^* * m_5^1$$

$$u_1^1 - 2.5 * l_5^1 \le k_1^* * l_5^1$$

$$u_1^1 - 2.5 * l_5^1 \ge -k_1^* * l_5^1$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_2^1, m_2^1, u_2^1)} - (1,1,1)\right| \le k_1^*$$

$$l_2^1 - 1 * u_2^1 \le k_1^* * u_2^1$$

$$l_2^1 - 1 * u_2^1 \ge -k_1^* * u_2^1$$

$$m_2^1 - 1 * m_2^1 \le k_1^* * m_2^1$$

$$m_2^1 - 1 * m_2^1 \ge -k_1^* * m_2^1$$

$$u_2^1 - 1 * l_2^1 \le k_1^* * l_2^1$$

$$u_2^1 - 1 * l_2^1 \ge -k_1^* * l_2^1$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_5^1, m_5^1, u_5^1)} - (\frac{7}{2}, 4, \frac{9}{2})\right| \le k_1^*$$

$$l_2^1 - 3.5 * u_5^1 \le k_1^* * u_5^1$$

$$l_2^1 - 3.5 * u_5^1 \ge -k_1^* * u_5^1$$

$$m_2^1 - 4 * m_5^1 \le k_1^* * m_5^1$$

$$m_2^1 - 4 * m_5^1 \ge -k_1^* * m_5^1$$

$$u_2^1 - 4.5 * l_5^1 \le k_1^* * l_5^1$$

$$u_2^1 - 4.5 * l_5^1 \ge -k_1^* * l_5^1$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_3^1, m_3^1, u_3^1)} - (1,1,1)\right| \le k_1^*$$

$$l_2^1 - 1 * u_3^1 \le k_1^* * u_3^1$$

$$l_2^1 - 1 * u_3^1 \ge -k_1^* * u_3^1$$

$$m_2^1 - 1 * m_3^1 \le k_1^* * m_3^1$$

$$m_2^1 - 1 * m_3^1 \ge -k_1^* * m_3^1$$

$$u_2^1 - 1 * l_3^1 \le k_1^* * l_3^1$$

$$u_2^1 - 1 * l_3^1 \ge -k_1^* * l_3^1$$

$$\left|\frac{(l_3^1, m_3^1, u_3^1)}{(l_5^1, m_5^1, u_5^1)} - (\frac{7}{2}, 4, \frac{9}{2})\right| \le k_1^*$$

$$l_3^1 - 3.5 * u_5^1 \le k_1^* * u_5^1$$

$$l_3^1 - 3.5 * u_5^1 \ge -k_1^* * u_5^1$$

$$m_3^1 - 4 * m_5^1 \le k_1^* * m_5^1$$

$$m_3^1 - 4 * m_5^1 \ge -k_1^* * m_5^1$$

$$u_3^1 - 4.5 * l_5^1 \le k_1^* * l_5^1$$

$$u_3^1 - 4.5 * l_5^1 \ge -k_1^* * l_5^1$$

$$\left|\frac{(l_2^1, m_2^1, u_2^1)}{(l_4^1, m_4^1, u_4^1)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_1^*$$

$$l_2^1 - 1.5 * u_4^1 \le k_1^* * u_4^1$$

$$l_2^1 - 1.5 * u_4^1 \ge -k_1^* * u_4^1$$

$$m_2^1 - 2 * m_4^1 \le k_1^* * m_4^1$$

$$m_2^1 - 2 * m_4^1 \ge -k_1^* * m_4^1$$

$$\left|\frac{(l_4^1, m_4^1, u_4^1)}{(l_5^1, m_5^1, u_5^1)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_1^*$$

$$l_4^1 - 1.5 * u_5^1 \le k_1^* * u_5^1$$

$$l_4^1 - 1.5 * u_5^1 \ge -k_1^* * u_5^1$$

$$m_4^1 - 2 * m_5^1 \le k_1^* * m_5^1$$

$$m_4^1 - 2 * m_5^1 \ge -k_1^* * m_5^1$$

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$u_2^1 - 2.5 * l_4^1 \leq k_1^* * l_4^1$

$u_2^1 - 2.5 * l_4^1 \geq -k_1^* * l_4^1$

$u_4^1 - 2.5 * l_5^1 \leq k_1^* * l_5^1$

$u_4^1 - 2.5 * l_5^1 \geq -k_1^* * l_5^1$

$\left| \frac{(l_2^1, m_2^1, u_2^1)}{(l_5^1, m_5^1, u_5^1)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_1^*$

$l_2^1 - 2.5 * u_5^1 \leq k_1^* * u_5^1$

$l_2^1 - 2.5 * u_5^1 \geq -k_1^* * u_5^1$

$m_2^1 - 3 * m_5^1 \leq k_1^* * m_5^1$

$m_2^1 - 3 * m_5^1 \geq -k_1^* * m_5^1$

$u_2^1 - 3.5 * l_5^1 \leq k_1^* * l_5^1$

$u_2^1 - 3.5 * l_5^1 \geq -k_1^* * l_5^1$

$\left| \frac{(l_5^1, m_5^1, u_5^1)}{(l_5^1, m_5^1, u_5^1)} - (1,1,1) \right| \leq k_1^*$

$l_5^1 - 1 * u_5^1 \leq k_1^* * u_5^1$

$l_5^1 - 1 * u_5^1 \geq -k_1^* * u_5^1$

$m_5^1 - 1 * m_5^1 \leq k_1^* * m_5^1$

$m_5^1 - 1 * m_5^1 \geq -k_1^* * m_5^1$

$u_5^1 - 1 * l_5^1 \leq k_1^* * l_5^1$

$u_5^1 - 1 * l_5^1 \geq -k_1^* * l_5^1$

$\left| \frac{(l_2^1, m_2^1, u_2^1)}{(l_6^1, m_6^1, u_6^1)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_1^*$

$l_2^1 - 2.5 * u_6^1 \leq k_1^* * u_6^1$

$l_2^1 - 2.5 * u_6^1 \geq -k_1^* * u_6^1$

$m_2^1 - 3 * m_6^1 \leq k_1^* * m_6^1$

$m_2^1 - 3 * m_6^1 \geq -k_1^* * m_6^1$

$u_2^1 - 3.5 * l_6^1 \leq k_1^* * l_6^1$

$u_2^1 - 3.5 * l_6^1 \geq -k_1^* * l_6^1$

$\left| \frac{(l_6^1, m_6^1, u_6^1)}{(l_5^1, m_5^1, u_5^1)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_1^*$

$l_6^1 - 1.5 * u_5^1 \leq k_1^* * u_5^1$

$l_6^1 - 1.5 * u_5^1 \geq -k_1^* * u_5^1$

$m_6^1 - 2 * m_5^1 \leq k_1^* * m_5^1$

$m_6^1 - 2 * m_5^1 \geq -k_1^* * m_5^1$

$u_6^1 - 2.5 * l_5^1 \leq k_1^* * l_5^1$

$u_6^1 - 2.5 * l_5^1 \geq -k_1^* * l_5^1$

Decision maker 2:

The best criterion (C_B): C_3 The worst criterion (C_W): C_6

$\left| \frac{(l_3^2, m_3^2, u_3^2)}{(l_1^2, m_1^2, u_1^2)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_2^*$

$l_3^2 - 1.5 * u_1^2 \leq k_2^* * u_1^2$

$l_3^2 - 1.5 * u_1^2 \geq -k_2^* * u_1^2$

m_3^2-2*$m_1^2 \leq k_2^* * m_1^2$

m_3^2-2*$m_1^2 \geq -k_2^* * m_1^2$

$u_3^2 - 2.5 * l_1^2 \leq k_2^* * l_1^2$

$u_3^2 - 2.5 * l_1^2 \geq -k_2^* * l_1^2$

$\left| \frac{(l_1^2, m_1^2, u_1^2)}{(l_6^2, m_6^2, u_6^2)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_2^*$

$l_1^2 - 2.5 * u_6^2 \leq k_2^* * u_6^2$

$l_1^2 - 2.5 * u_6^2 \geq -k_2^* * u_6^2$

$m_1^2 - 3 * m_6^2 \leq k_2^* * m_6^2$

$m_1^2 - 3 * m_6^2 \geq -k_2^* * m_6^2$

$u_1^2 - 3.5 * l_6^2 \leq k_2^* * l_6^2$

$u_1^2 - 3.5 * l_6^2 \geq -k_2^* * l_6^2$

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$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_2^2, m_2^2, u_2^2)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \leq k_2^*$$

$$l_3^2 - 2.5 * u_2^2 \leq k_2^* * u_2^2$$

$$l_3^2 - 2.5 * u_2^2 \geq -k_2^* * u_2^2$$

$$m_3^2 - 3 * m_2^2 \leq k_2^* * m_2^2$$

$$m_3^2 - 3 * m_2^2 \geq -k_2^* * m_2^2$$

$$u_3^2 - 3.5 - l_2^2 \leq k_2^* * l_2^2$$

$$u_3^2 - 3.5 - l_2^2 \geq -k_2^* * l_2^2$$

$$\left|\frac{(l_2^2, m_2^2, u_2^2)}{(l_6^2, m_6^2, u_6^2)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_2^*$$

$$l_2^2 - 1.5 * u_6^2 \leq k_2^* * u_6^2$$

$$l_2^2 - 1.5 * u_6^2 \geq -k_2^* * u_6^2$$

$$m_2^2 - 2 * m_6^2 \leq k_2^* * m_6^2$$

$$m_2^2 - 2 * m_6^2 \geq -k_2^* * m_6^2$$

$$u_2^2 - 2.5 * l_6^2 \leq k_2^* * l_6^2$$

$$u_2^2 - 2.5 * l_6^2 \geq -k_2^* * l_6^2$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_3^2, m_3^2, u_3^2)} - (1,1,1)\right| \leq k_2^*$$

$$l_3^2 - 1 * u_3^2 \leq k_2^* * u_3^2$$

$$l_3^2 - 1 * u_3^2 \geq -k_2^* * u_3^2$$

$$m_3^2 - 1 * m_3^2 \leq k_2^* * m_3^2$$

$$m_3^2 - 1 * m_3^2 \geq -k_2^* * m_3^2$$

$$u_3^2 - 1 * l_3^2 \leq k_2^* * l_3^2$$

$$u_3^2 - 1 * l_3^2 \geq -k_2^* * l_3^2$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_6^2, m_6^2, u_6^2)} - (\frac{7}{2}, 3, \frac{9}{2})\right| \leq k_2^*$$

$$l_3^2 - 3.5 * u_6^2 \leq k_2^* * u_6^2$$

$$l_3^2 - 3.5 * u_6^2 \geq -k_2^* * u_6^2$$

$$m_3^2 - 3 * m_6^2 \leq k_2^* * m_6^2$$

$$m_3^2 - 3 * m_6^2 \geq -k_2^* * m_6^2$$

$$u_3^2 - 4.5 * l_6^2 \leq k_2^* * l_6^2$$

$$u_3^2 - 4.5 * l_6^2 \geq -k_2^* * l_6^2$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_4^2, m_4^2, u_4^2)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \leq k_2^*$$

$$l_3^2 - 2.5 * u_4^2 \leq k_2^* * u_4^2$$

$$l_3^2 - 2.5 * u_4^2 \geq -k_2^* * u_4^2$$

$$m_3^2 - 3 * m_4^2 \leq k_2^* * m_4^2$$

$$m_3^2 - 3 * m_4^2 \geq -k_2^* * m_4^2$$

$$u_3^2 - 3.5 * l_4^2 \leq k_2^* * l_4^2$$

$$u_3^2 - 3.5 * l_4^2 \geq -k_2^* * l_4^2$$

$$\left|\frac{(l_4^2, m_4^2, u_4^2)}{(l_6^2, m_6^2, u_6^2)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_2^*$$

$$l_4^2 - 1.5 * u_6^2 \leq k_2^* * u_6^2$$

$$l_4^2 - 1.5 * u_6^2 \geq -k_2^* * u_6^2$$

$$m_4^2 - 2 * m_6^2 \leq k_2^* * m_6^2$$

$$m_4^2 - 2 * m_6^2 \geq -k_2^* * m_6^2$$

$$u_4^2 - 2.5 * l_6^2 \leq k_2^* * u_6^2$$

$$u_4^2 - 2.5 * l_6^2 \geq -k_2^* * u_6^2$$

$$\left|\frac{(l_3^2, m_3^2, u_3^2)}{(l_5^2, m_5^2, u_5^2)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_2^*$$

$$l_3^2 - 1.5 * u_5^2 \leq k_2^* * u_5^2$$

$$l_3^2 - 1.5 * u_5^2 \geq -k_2^* * u_5^2$$

$$m_3^2 - 2 * m_5^2 \leq k_2^* * m_5^2$$

$$\left|\frac{(l_5^2, m_5^2, u_5^2)}{(l_6^2, m_6^2, u_6^2)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_2^*$$

$$l_5^2 - 1.5 * u_6^2 \leq k_2^* * u_6^2$$

$$l_5^2 - 1.5 * u_6^2 \geq -k_2^* * u_6^2$$

$$m_5^2 - 2 * m_6^2 \leq k_2^* * m_6^2$$

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$m_3^2 - 2 * m_5^2 \geq -k_2^* * m_5^2$

$u_3^2 - 2.5 * l_5^2 \leq k_2^* * l_5^2$

$u_3^2 - 2.5 * l_5^2 \geq -k_2^* * l_5^2$

$m_5^2 - 2 * m_6^2 \geq -k_2^* * m_6^2$

$u_5^2 - 2.5 * l_6^2 \leq k_2^* * l_6^2$

$u_5^2 - 2.5 * l_6^2 \geq -k_2^* * l_6^2$

$\left| \frac{(l_3^2, m_3^2, u_3^2)}{(l_6^2, m_6^2, u_6^2)} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_2^*$

$l_3^2 - 3.5 * u_6^2 \leq k_2^* * u_6^2$

$l_3^2 - 3.5 * u_6^2 \geq -k_2^* * u_6^2$

$m_3^2 - 4 * m_6^2 \leq k_2^* * m_6^2$

$m_3^2 - 4 * m_6^2 \geq -k_2^* * m_6^2$

$u_3^2 - 4.5 * l_6^2 \leq k_2^* * l_6^2$

$u_3^2 - 4.5 * l_6^2 \geq -k_2^* * l_6^2$

$\left| \frac{(l_6^2, m_6^2, u_6^2)}{(l_6^2, m_6^2, u_6^2)} - (1,1,1) \right| \leq k_2^*$

$l_6^2 - 1 * u_6^2 \leq k_2^* * u_6^2$

$l_6^2 - 1 * u_6^2 \geq -k_2^* * u_6^2$

$m_6^2 - 1 * m_6^2 \leq k_2^* * m_6^2$

$m_6^2 - 1 * m_6^2 \geq -k_2^* * m_6^2$

$u_6^2 - 1 * l_6^2 \leq k_2^* * l_6^2$

$u_6^2 - 1 * l_6^2 \geq -k_2^* * l_6^2$

Decision maker 3:

The best criterion (C_B): C_1 The worst criterion (C_W): C_4

$\left| \frac{(l_1^3, m_1^3, u_1^3)}{(l_1^3, m_1^3, u_1^3)} - (1,1,1) \right| \leq k_3^*$

$l_1^3 - 1 * u_1^3 \leq k_3^* * u_1^3$

$l_1^3 - 1 * u_1^3 \geq -k_3^* * u_1^3$

$m_1^3 - 1 * m_1^3 \leq k_3^* * m_1^3$

$m_1^3 - 1 * m_1^3 \geq -k_3^* * m_1^3$

$u_1^3 - 1 * l_1^3 \leq k_3^* * l_1^3$

$u_1^3 - 1 * l_1^3 \geq -k_3^* * l_1^3$

$\left| \frac{(l_1^3, m_1^3, u_1^3)}{(l_4^3, m_4^3, u_4^3)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_3^*$

$l_1^3 - 2.5 * u_4^3 \leq k_3^* * u_4^3$

$l_1^3 - 2.5 * u_4^3 \geq -k_3^* * u_4^3$

$m_1^3 - 3 * m_4^3 \leq k_3^* * m_4^3$

$m_1^3 - 3 * m_4^3 \geq -k_3^* * m_4^3$

$u_1^3 - 3.5 * l_4^3 \leq k_3^* * l_4^3$

$u_1^3 - 3.5 * l_4^3 \geq -k_3^* * l_4^3$

$\left| \frac{(l_1^3, m_1^3, u_1^3)}{(l_2^3, m_2^3, u_2^3)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_3^*$

$l_1^3 - 1.5 * u_2^3 \leq k_3^* * u_2^3$

$l_1^3 - 1.5 * u_2^3 \geq -k_3^* * u_2^3$

$m_1^3 - 2 * m_2^3 \leq k_3^* * m_2^3$

$m_1^3 - 2 * m_2^3 \geq -k_3^* * m_2^3$

$u_1^3 - 2.5 * l_2^3 \leq k_3^* * l_2^3$

$u_1^3 - 2.5 * l_2^3 \geq -k_3^* * l_2^3$

$\left| \frac{(l_2^3, m_2^3, u_2^3)}{(l_4^3, m_4^3, u_4^3)} - (1,1,1) \right| \leq k_3^*$

$l_2^3 - 1 * u_4^3 \leq k_3^* * u_4^3$

$l_2^3 - 1 * u_4^3 \geq -k_3^* * u_4^3$

$m_2^3 - 1 * m_4^3 \leq k_3^* * m_4^3$

$m_2^3 - 1 * m_4^3 \geq -k_3^* * m_4^3$

$u_2^3 - 1 * l_4^3 \leq k_3^* * l_4^3$

$u_2^3 - 1 * l_4^3 \geq -k_3^* * l_4^3$

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$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_3^3, m_3^3, u_3^3)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_3^*$$

$$l_1^3 - 1.5 * u_3^3 \leq k_3^* * u_3^3$$

$$l_1^3 - 1.5 * u_3^3 \geq -k_3^* * u_3^3$$

$$m_1^3 - 1.5 * m_3^3 \leq k_3^* * m_3^3$$

$$m_1^3 - 1.5 * m_3^3 \geq -k_3^* * m_3^3$$

$$u_1^3 - 2.5 * l_3^3 \leq k_3^* * l_3^3$$

$$u_1^3 - 2.5 * l_3^3 \geq -k_3^* * l_3^3$$

$$\left|\frac{(l_3^3, m_3^3, u_3^3)}{(l_4^3, m_4^3, u_4^3)} - (1,1,1)\right| \leq k_3^*$$

$$l_3^3 - 1 * u_4^3 \leq k_3^* * u_4^3$$

$$l_3^3 - 1 * u_4^3 \geq -k_3^* * u_4^3$$

$$m_3^3 - 1 * m_4^3 \leq k_3^* * m_4^3$$

$$m_3^3 - 1 * m_4^3 \geq -k_3^* * m_4^3$$

$$u_3^3 - 1 * l_4^3 \leq k_3^* * l_4^3$$

$$u_3^3 - 1 * l_4^3 \geq -k_3^* * l_4^3$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_4^3, m_4^3, u_4^3)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_3^*$$

$$l_1^3 - 1.5 * u_4^3 \leq k_3^* * u_4^3$$

$$l_1^3 - 1.5 * u_4^3 \geq -k_3^* * u_4^3$$

$$m_1^3 - 2 * m_4^3 \leq k_3^* * m_4^3$$

$$m_1^3 - 2 * m_4^3 \geq -k_3^* * m_4^3$$

$$u_1^3 - 2.5 * l_4^3 \leq k_3^* * l_4^3$$

$$u_1^3 - 2.5 * l_4^3 \geq -k_3^* * l_4^3$$

$$\left|\frac{(l_4^3, m_4^3, u_4^3)}{(l_4^3, m_4^3, u_4^3)} - (1,1,1)\right| \leq k_3^*$$

$$l_4^3 - 1 * u_4^3 \leq k_3^* * u_4^3$$

$$l_4^3 - 1 * u_4^3 \geq -k_3^* * u_4^3$$

$$m_4^3 - 1 * m_4^3 \leq k_3^* * m_4^3$$

$$m_4^3 - 1 * m_4^3 \geq -k_3^* * m_4^3$$

$$u_4^3 - 1 * l_4^3 \leq k_3^* * l_4^3$$

$$u_4^3 - 1 * l_4^3 \geq -k_3^* * l_4^3$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_5^3, m_5^3, u_5^3)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \leq k_3^*$$

$$l_1^3 - 2.5 * u_5^3 \leq k_3^* * u_5^3$$

$$l_1^3 - 2.5 * u_5^3 \geq -k_3^* * u_5^3$$

$$m_1^3 - 3 * m_5^3 \leq k_3^* * m_5^3$$

$$m_1^3 - 3 * m_5^3 \geq -k_3^* * m_5^3$$

$$u_1^3 - 3.5 * l_5^3 \leq k_3^* * l_5^3$$

$$u_1^3 - 3.5 * l_5^3 \geq -k_3^* * l_5^3$$

$$\left|\frac{(l_5^3, m_5^3, u_5^3)}{(l_4^3, m_4^3, u_4^3)} - (\frac{2}{3}, 1, \frac{3}{2})\right| \leq k_3^*$$

$$l_5^3 - 0.67 * u_4^3 \leq k_3^* * u_4^3$$

$$l_5^3 - 0.67 * u_4^3 \geq -k_3^* * u_4^3$$

$$m_5^3 - 1 * m_4^3 \leq k_3^* * m_4^3$$

$$m_5^3 - 1 * m_4^3 \geq -k_3^* * m_4^3$$

$$u_5^3 - 1.5 * l_4^3 \leq k_3^* * l_4^3$$

$$u_5^3 - 1.5 * l_4^3 \geq -k_3^* * l_4^3$$

$$\left|\frac{(l_1^3, m_1^3, u_1^3)}{(l_6^3, m_6^3, u_6^3)} - (1,1,1)\right| \leq k_3^*$$

$$l_1^3 - 1 * u_6^3 \leq k_3^* * u_6^3$$

$$l_1^3 - 1 * u_6^3 \geq -k_3^* * u_6^3$$

$$\left|\frac{(l_6^3, m_6^3, u_6^3)}{(l_4^3, m_4^3, u_4^3)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_3^*$$

$$l_6^3 - 1.5 * u_4^3 \leq k_3^* * u_4^3$$

$$l_6^3 - 1.5 * u_4^3 \geq -k_3^* * u_4^3$$

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$m_1^3 - 1 * m_6^3 \leq k_3^* * m_6^3$ $\quad$ $m_6^3 - 2 * m_4^3 \leq k_3^* * m_4^3$

$m_1^3 - 1 * m_6^3 \geq -k_3^* * m_6^3$ $\quad$ $m_6^3 - 2 * m_4^3 \geq -k_3^* * m_4^3$

$u_1^3 - 1 * l_6^3 \leq k_3^* * l_6^3$ $\quad$ $u_6^3 - 2.5 * l_4^3 \leq k_3^* * l_4^3$

$u_1^3 - 1 * l_6^3 \geq -k_3^* * l_6^3$ $\quad$ $u_6^3 - 2.5 * l_4^3 \geq -k_3^* * l_4^3$

Decision maker 4:

The best criterion (C_B): C_1 The worst criterion (C_W): C_2

$\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_1^4, m_1^4, u_1^4)} - (1,1,1) \right| \leq k_4^*$ $\quad$ $\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_2^4, m_2^4, u_2^4)} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_4^*$

$l_1^4 - 1 * u_1^4 \leq k_4^* * u_1^4$ $\quad$ $l_1^4 - 3.5 * u_2^4 \leq k_4^* * u_2^4$

$l_1^4 - 1 * u_1^4 \geq -k_4^* * u_1^4$ $\quad$ $l_1^4 - 3.5 * u_2^4 \geq -k_4^* * u_2^4$

$m_1^4 - 1 * m_1^4 \leq k_4^* * m_1^4$ $\quad$ $m_1^4 - 4 * m_2^4 \leq k_4^* * m_2^4$

$m_1^4 - 1 * m_1^4 \geq -k_4^* * m_1^4$ $\quad$ $m_1^4 - 4 * m_2^4 \geq -k_4^* * m_2^4$

$u_1^4 - 1 * l_1^4 \leq k_4^* * l_1^4$ $\quad$ $u_1^4 - 4.5 * l_2^4 \leq k_4^* * l_2^4$

$u_1^4 - 1 * l_1^4 \geq -k_4^* * l_1^4$ $\quad$ $u_1^4 - 4.5 * l_2^4 \geq -k_4^* * l_2^4$

$\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_2^4, m_2^4, u_2^4)} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_4^*$ $\quad$ $\left| \frac{(l_2^4, m_2^4, u_2^4)}{(l_2^4, m_2^4, u_2^4)} - (1,1,1) \right| \leq k_4^*$

$l_1^4 - 3.5 * u_2^4 \leq k_4^* * u_2^4$ $\quad$ $l_2^4 - 1 * u_2^4 \leq k_4^* * u_2^4$

$l_1^4 - 3.5 * u_2^4 \geq -k_4^* * u_2^4$ $\quad$ $l_2^4 - 1 * u_2^4 \geq -k_4^* * u_2^4$

$m_1^4 - 4 * m_2^4 \leq k_4^* * m_2^4$ $\quad$ $m_2^4 - 1 * m_2^4 \leq k_4^* * m_2^4$

$m_1^4 - 4 * m_2^4 \geq -k_4^* * m_2^4$ $\quad$ $m_2^4 - 1 * m_2^4 \geq -k_4^* * m_2^4$

$u_1^4 - 4.5 * l_2^4 \leq k_4^* * l_2^4$ $\quad$ $u_2^4 - 1 * l_2^4 \leq k_4^* * l_2^4$

$u_1^4 - 4.5 * l_2^4 \geq -k_4^* * l_2^4$ $\quad$ $u_2^4 - 1 * l_2^4 \geq -k_4^* * l_2^4$

$\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_3^4, m_3^4, u_3^4)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_4^*$ $\quad$ $\left| \frac{(l_3^4, m_3^4, u_3^4)}{(l_2^4, m_2^4, u_2^4)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_4^*$

$l_1^4 - 1.5 * u_3^4 \leq k_4^* * u_3^4$ $\quad$ $l_3^4 - 2.5 * u_2^4 \leq k_4^* * u_2^4$

$l_1^4 - 1.5 * u_3^4 \geq -k_4^* * u_3^4$ $\quad$ $l_3^4 - 2.5 * u_2^4 \geq -k_4^* * u_2^4$

$m_1^4 - 2 * m_3^4 \leq k_4^* * m_3^4$ $\quad$ $m_3^4 - 3 * m_2^4 \leq k_4^* * m_2^4$

$m_1^4 - 2 * m_3^4 \geq -k_4^* * m_3^4$ $\quad$ $m_3^4 - 3 * m_2^4 \geq -k_4^* * m_2^4$

$u_1^4 - 2.5 * l_3^4 \leq k_4^* * l_3^4$ $\quad$ $u_3^4 - 3.5 * l_2^4 \leq k_4^* * l_2^4$

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$u_1^4 - 2.5 * l_3^4 \geq -k_4^* * l_3^4$

$u_3^4 - 3.5 * l_2^4 \geq -k_4^* * l_2^4$

$\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_4^4, m_4^4, u_4^4)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right) \right| \leq k_4^*$

$l_1^4 - 1.5 * u_4^4 \leq k_4^* * u_4^4$

$l_1^4 - 1.5 * u_4^4 \geq -k_4^* * u_4^4$

$m_1^4 - 2 * m_4^4 \leq k_4^* * m_4^4$

$m_1^4 - 2 * m_4^4 \geq -k_4^* * m_4^4$

$u_1^4 - 2.5 * l_4^4 \leq k_4^* * l_4^4$

$u_1^4 - 2.5 * l_4^4 \geq -k_4^* * l_4^4$

$\left| \frac{(l_4^4, m_4^4, u_4^4)}{(l_2^4, m_2^4, u_2^4)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_4^*$

$l_4^4 - 2.5 * u_2^4 \leq k_4^* * u_2^4$

$l_4^4 - 2.5 * u_2^4 \geq -k_4^* * u_2^4$

$m_4^4 - 3 * m_2^4 \leq k_4^* * m_2^4$

$m_4^4 - 3 * m_2^4 \geq -k_4^* * m_2^4$

$u_4^4 - 3.5 * l_2^4 \leq k_4^* * l_2^4$

$u_4^4 - 3.5 * l_2^4 \geq -k_4^* * l_2^4$

$\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_5^4, m_5^4, u_5^4)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_4^*$

$l_1^4 - 2.5 * u_5^4 \leq k_4^* * u_5^4$

$l_1^4 - 2.5 * u_5^4 \geq -k_4^* * u_5^4$

$m_1^4 - 3 * m_5^4 \leq k_4^* * m_5^4$

$m_1^4 - 3 * m_5^4 \geq -k_4^* * m_5^4$

$u_1^4 - 3.5 * l_5^4 \leq k_4^* * l_5^4$

$u_1^4 - 3.5 * l_5^4 \geq -k_4^* * l_5^4$

$\left| \frac{(l_5^4, m_5^4, u_5^4)}{(l_2^4, m_2^4, u_2^4)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_4^*$

$l_5^4 - 1.5 * u_2^4 \leq k_4^* * u_2^4$

$l_5^4 - 1.5 * u_2^4 \geq -k_4^* * u_2^4$

$m_5^4 - 2 * m_2^4 \leq k_4^* * m_2^4$

$m_5^4 - 2 * m_2^4 \geq -k_4^* * m_2^4$

$u_5^4 - 2.5 * l_2^4 \leq k_4^* * l_2^4$

$u_5^4 - 2.5 * l_2^4 \geq -k_4^* * l_2^4$

$\left| \frac{(l_1^4, m_1^4, u_1^4)}{(l_6^4, m_6^4, u_6^4)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_4^*$

$l_1^4 - 1.5 * u_6^4 \leq k_4^* * u_6^4$

$l_1^4 - 1.5 * u_6^4 \geq -k_4^* * u_6^4$

$m_1^4 - 2 * m_6^4 \leq k_4^* * m_6^4$

$m_1^4 - 2 * m_6^4 \geq -k_4^* * m_6^4$

$u_1^4 - 2.5 * l_6^4 \leq k_4^* * l_6^4$

$u_1^4 - 2.5 * l_6^4 \geq -k_4^* * l_6^4$

$\left| \frac{(l_6^4, m_6^4, u_6^4)}{(l_2^4, m_2^4, u_2^4)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_4^*$

$l_6^4 - 2.5 * u_2^4 \leq k_4^* * u_2^4$

$l_6^4 - 2.5 * u_2^4 \geq -k_4^* * u_2^4$

$m_6^4 - 3 * m_2^4 \leq k_4^* * m_2^4$

$m_6^4 - 3 * m_2^4 \geq -k_4^* * m_2^4$

$u_6^4 - 3.5 * l_2^4 \leq k_4^* * l_2^4$

$u_6^4 - 3.5 * l_2^4 \geq -k_4^* * l_2^4$

Decision maker 5:

The best criterion (C_B): C_1 The worst criterion (C_W): C_6

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$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_1^5, m_1^5, u_1^5)} - (1,1,1)\right| \le k_5^*$$

$$l_1^5 - 1 * u_1^5 \le k_5^* * u_1^5$$

$$l_1^5 - 1 * u_1^5 \ge -k_5^* * u_1^5$$

$$m_1^5 - 1 * m_1^5 \le k_5^* * m_1^5$$

$$m_1^5 - 1 * m_1^5 \ge -k_5^* * m_1^5$$

$$u_1^5 - 1 * l_1^5 \le k_5^* * l_1^5$$

$$u_1^5 - 1 * l_1^5 \ge -k_5^* * l_1^5$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_6^5, m_6^5, u_6^5)} - \left(\frac{7}{2}, 4, \frac{9}{2}\right)\right| \le k_5^*$$

$$l_1^5 - 3.5 * u_6^5 \le k_5^* * u_6^5$$

$$l_1^5 - 3.5 * u_6^5 \ge -k_5^* * u_6^5$$

$$m_1^5 - 4 * m_6^5 \le k_5^* * m_6^5$$

$$m_1^5 - 4 * m_6^5 \ge -k_5^* * m_6^5$$

$$u_1^5 - 4.5 * l_6^5 \le k_5^* * l_6^5$$

$$u_1^5 - 4.5 * l_6^5 \ge -k_5^* * l_6^5$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_2^5, m_2^5, u_2^5)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right)\right| \le k_5^*$$

$$l_1^5 - 1.5 * u_2^5 \le k_5^* * u_2^5$$

$$l_1^5 - 1.5 * u_2^5 \ge -k_5^* * u_2^5$$

$$m_1^5 - 2 * m_2^5 \le k_5^* * m_2^5$$

$$m_1^5 - 2 * m_2^5 \ge -k_5^* * m_2^5$$

$$u_1^5 - 2.5 * l_2^5 \le k_5^* * l_2^5$$

$$u_1^5 - 2.5 * l_2^5 \ge -k_5^* * l_2^5$$

$$\left|\frac{(l_2^5, m_2^5, u_2^5)}{(l_6^5, m_6^5, u_6^5)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right)\right| \le k_5^*$$

$$l_2^5 - 1.5 * u_6^5 \le k_5^* * u_6^5$$

$$l_2^5 - 1.5 * u_6^5 \ge -k_5^* * u_6^5$$

$$m_2^5 - 2 * m_6^5 \le k_5^* * m_6^5$$

$$m_2^5 - 2 * m_6^5 \ge -k_5^* * m_6^5$$

$$u_2^5 - 2.5 * l_6^5 \le k_5^* * u_6^5$$

$$u_2^5 - 2.5 * l_6^5 \ge -k_5^* * u_6^5$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_3^5, m_3^5, u_3^5)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right)\right| \le k_5^*$$

$$l_1^5 - 1.5 * u_3^5 \le k_5^* * u_3^5$$

$$l_1^5 - 1.5 * u_3^5 \ge -k_5^* * u_3^5$$

$$m_1^5 - 2 * m_3^5 \le k_5^* * m_3^5$$

$$m_1^5 - 2 * m_3^5 \ge -k_5^* * m_3^5$$

$$u_1^5 - 2.5 * l_3^5 \le k_5^* * l_3^5$$

$$u_1^5 - 2.5 * l_3^5 \ge -k_5^* * l_3^5$$

$$\left|\frac{(l_3^5, m_3^5, u_3^5)}{(l_6^5, m_6^5, u_6^5)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right)\right| \le k_5^*$$

$$l_3^5 - 1.5 * u_6^5 \le k_5^* * u_6^5$$

$$l_3^5 - 1.5 * u_6^5 \ge -k_5^* * u_6^5$$

$$m_3^5 - 2 * m_6^5 \le k_5^* * m_6^5$$

$$m_3^5 - 2 * m_6^5 \ge -k_5^* * m_6^5$$

$$u_3^5 - 2.5 * l_6^5 \le k_5^* * l_6^5$$

$$u_3^5 - 2.5 * l_6^5 \ge -k_5^* * l_6^5$$

$$\left|\frac{(l_1^5, m_1^5, u_1^5)}{(l_4^5, m_4^5, u_4^5)} - \left(\frac{5}{2}, 3, \frac{7}{2}\right)\right| \le k_5^*$$

$$l_1^5 - 2.5 * u_4^5 \le k_5^* * u_4^5$$

$$l_1^5 - 2.5 * u_4^5 \ge -k_5^* * u_4^5$$

$$m_1^5 - 3 * m_4^5 \le k_5^* * m_4^5$$

$$\left|\frac{(l_4^5, m_4^5, u_4^5)}{(l_6^5, m_6^5, u_6^5)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right)\right| \le k_5^*$$

$$l_4^5 - 1.5 * u_6^5 \le k_5^* * u_6^5$$

$$l_4^5 - 1.5 * u_6^5 \ge -k_5^* * u_6^5$$

$$m_4^5 - 2 * m_6^5 \le k_5^* * m_6^5$$

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$$m_1^5 - 3 * m_4^5 \geq -k_5^* * m_4^5$$
$$u_1^5 - 3.5 * l_4^5 \leq k_5^* * l_4^5$$
$$u_1^5 - 3.5 * l_4^5 \geq -k_5^* * l_4^5$$

$$m_4^5 - 2 * m_6^5 \geq -k_5^* * m_6^5$$
$$u_4^5 - 2.5 * l_6^5 \leq k_5^* * l_6^5$$
$$u_4^5 - 2.5 * l_6^5 \geq -k_5^* * l_6^5$$

$$\left| \frac{(l_1^5, m_1^5, u_1^5)}{(l_5^5, m_5^5, u_5^5)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_5^*$$
$$l_1^5 - 2.5 * u_5^5 \leq k_5^* * u_5^5$$
$$l_1^5 - 2.5 * u_5^5 \geq -k_5^* * u_5^5$$
$$m_1^5 - 3 * m_5^5 \leq k_5^* * m_5^5$$
$$m_1^5 - 3 * m_5^5 \geq -k_5^* * m_5^5$$
$$u_1^5 - 3.5 * l_5^5 \leq k_5^* * l_5^5$$
$$u_1^5 - 3.5 * l_5^5 \geq -k_5^* * l_5^5$$

$$\left| \frac{(l_5^5, m_5^5, u_5^5)}{(l_6^5, m_6^5, u_6^5)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_5^*$$
$$l_5^5 - 1.5 * u_6^5 \leq k_5^* * u_6^5$$
$$l_5^5 - 1.5 * u_6^5 \geq -k_5^* * u_6^5$$
$$m_5^5 - 2 * m_6^5 \leq k_5^* * m_6^5$$
$$m_5^5 - 2 * m_6^5 \geq -k_5^* * m_6^5$$
$$u_5^5 - 2.5 * l_6^5 \leq k_5^* * l_6^5$$
$$u_5^5 - 2.5 * l_6^5 \geq -k_5^* * l_6^5$$

$$\left| \frac{(l_1^5, m_1^5, u_1^5)}{(l_6^5, m_6^5, u_6^5)} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_5^*$$
$$l_1^5 - 3.5 * u_6^5 \leq k_5^* * u_6^5$$
$$l_1^5 - 3.5 * u_6^5 \geq -k_5^* * u_6^5$$
$$m_1^5 - 4 * m_6^5 \leq k_5^* * m_6^5$$
$$m_1^5 - 4 * m_6^5 \geq -k_5^* * m_6^5$$
$$u_1^5 - 4.5 * l_6^5 \leq k_5^* * l_6^5$$
$$u_1^5 - 4.5 * l_6^5 \geq -k_5^* * l_6^5$$

$$\left| \frac{(l_6^5, m_6^5, u_6^5)}{(l_6^5, m_6^5, u_6^5)} - (1,1,1) \right| \leq k_5^*$$
$$l_6^5 - 1 * u_6^5 \leq k_5^* * u_6^5$$
$$l_6^5 - 1 * u_6^5 \geq -k_5^* * u_6^5$$
$$m_6^5 - 1 * m_6^5 \leq k_5^* * m_6^5$$
$$m_6^5 - 1 * m_6^5 \geq -k_5^* * m_6^5$$
$$u_6^5 - 1 * l_6^5 \leq k_5^* * l_6^5$$
$$u_6^5 - 1 * l_6^5 \geq -k_5^* * l_6^5$$

Decision maker 6:

The best criterion (C_B): C_6 The worst criterion (C_W): C_3

$$\left| \frac{(l_6^6, m_6^6, u_6^6)}{(l_1^6, m_1^6, u_1^6)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_6^*$$
$$l_6^6 - 1.5 * u_1^6 \leq k_6^* * u_1^6$$
$$l_6^6 - 1.5 * u_1^6 \geq -k_6^* * u_1^6$$
$$m_6^6 - 2 * m_1^6 \leq k_6^* * m_1^6$$
$$m_6^6 - 2 * m_1^6 \geq -k_6^* * m_1^6$$
$$u_6^6 - 2.5 * l_1^6 \leq k_6^* * l_1^6$$
$$u_6^6 - 2.5 * l_1^6 \geq -k_6^* * l_1^6$$

$$\left| \frac{(l_1^6, m_1^6, u_1^6)}{(l_3^6, m_3^6, u_3^6)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_6^*$$
$$l_1^6 - 2.5 * u_3^6 \leq k_6^* * u_3^6$$
$$l_1^6 - 2.5 * u_3^6 \geq -k_6^* * u_3^6$$
$$m_1^6 - 3 * m_3^6 \leq k_6^* * m_3^6$$
$$m_1^6 - 3 * m_3^6 \geq -k_6^* * m_3^6$$
$$u_1^6 - 3.5 * l_3^6 \leq k_6^* * l_3^6$$
$$u_1^6 - 3.5 * l_3^6 \geq -k_6^* * l_3^6$$

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$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_2^6, m_2^6, u_2^6)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_6^*$$

$$l_6^6 - 1.5 * u_2^6 \leq k_6^* * u_2^6$$

$$l_6^6 - 1.5 * u_2^6 \geq -k_6^* * u_2^6$$

$$m_6^6 - 2 * m_2^6 \leq k_6^* * m_2^6$$

$$m_6^6 - 2 * m_2^6 \geq -k_6^* * m_2^6$$

$$u_6^6 - 2.5 * l_2^6 \leq k_6^* * l_2^6$$

$$u_6^6 - 2.5 * l_2^6 \geq -k_6^* * l_2^6$$

$$\left|\frac{(l_2^6, m_2^6, u_2^6)}{(l_3^6, m_3^6, u_3^6)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \leq k_6^*$$

$$l_2^6 - 2.5 * u_3^6 \leq k_6^* * u_3^6$$

$$l_2^6 - 2.5 * u_3^6 \geq -k_6^* * u_3^6$$

$$m_2^6 - 3 * m_3^6 \leq k_6^* * m_3^6$$

$$m_2^6 - 3 * m_3^6 \geq -k_6^* * m_3^6$$

$$u_2^6 - 3.5 * l_3^6 \leq k_6^* * l_3^6$$

$$u_2^6 - 3.5 * l_3^6 \geq -k_6^* * l_3^6$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_3^6, m_3^6, u_3^6)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \leq k_6^*$$

$$l_6^6 - 2.5 * u_3^6 \leq k_6^* * u_3^6$$

$$l_6^6 - 2.5 * u_3^6 \geq -k_6^* * u_3^6$$

$$m_6^6 - 3 * m_3^6 \leq k_6^* * m_3^6$$

$$m_6^6 - 3 * m_3^6 \geq -k_6^* * m_3^6$$

$$u_6^6 - 3.5 * l_3^6 \leq k_6^* * l_3^6$$

$$u_6^6 - 3.5 * l_3^6 \geq -k_6^* * l_3^6$$

$$\left|\frac{(l_3^6, m_3^6, u_3^6)}{(l_3^6, m_3^6, u_3^6)} - (1,1,1)\right| \leq k_6^*$$

$$l_3^6 - 1 * u_3^6 \leq k_6^* * u_3^6$$

$$l_3^6 - 1 * u_3^6 \geq -k_6^* * u_3^6$$

$$m_3^6 - 1 * m_3^6 \leq k_6^* * m_3^6$$

$$m_3^6 - 1 * m_3^6 \geq -k_6^* * m_3^6$$

$$u_3^6 - 1 * l_3^6 \leq k_6^* * l_3^6$$

$$u_3^6 - 1 * l_3^6 \geq -k_6^* * l_3^6$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_4^6, m_4^6, u_4^6)} - (1,1,1)\right| \leq k_6^*$$

$$l_6^6 - 1 * u_4^6 \leq k_6^* * u_4^6$$

$$l_6^6 - 1 * u_4^6 \geq -k_6^* * u_4^6$$

$$m_6^6 - 1 * m_4^6 \leq k_6^* * m_4^6$$

$$m_6^6 - 1 * m_4^6 \geq -k_6^* * m_4^6$$

$$u_6^6 - 1 * l_4^6 \leq k_6^* * l_4^6$$

$$u_6^6 - 1 * l_4^6 \geq -k_6^* * l_4^6$$

$$\left|\frac{(l_4^6, m_4^6, u_4^6)}{(l_3^6, m_3^6, u_3^6)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_6^*$$

$$l_4^6 - 1.5 * u_3^6 \leq k_6^* * u_3^6$$

$$l_4^6 - 1.5 * u_3^6 \geq -k_6^* * u_3^6$$

$$m_4^6 - 2 * m_3^6 \leq k_6^* * m_3^6$$

$$m_4^6 - 2 * m_3^6 \geq -k_6^* * m_3^6$$

$$u_4^6 - 2.5 * l_3^6 \leq k_6^* * l_3^6$$

$$u_4^6 - 2.5 * l_3^6 \geq -k_6^* * l_3^6$$

$$\left|\frac{(l_6^6, m_6^6, u_6^6)}{(l_5^6, m_5^6, u_5^6)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \leq k_6^*$$

$$l_6^6 - 1.5 * u_5^6 \leq k_6^* * u_5^6$$

$$l_6^6 - 1.5 * u_5^6 \geq -k_6^* * u_5^6$$

$$m_6^6 - 2 * m_5^6 \leq k_6^* * m_5^6$$

$$\left|\frac{(l_5^6, m_5^6, u_5^6)}{(l_3^6, m_3^6, u_3^6)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right)\right| \leq k_6^*$$

$$l_5^6 - 1.5 * u_3^6 \leq k_6^* * u_3^6$$

$$l_5^6 - 1.5 * u_3^6 \geq -k_6^* * u_3^6$$

$$m_5^6 - 2 * m_3^6 \leq k_6^* * m_3^6$$

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$m_6^6 - 2 * m_5^6 \geq -k_6^* * m_5^6$

$u_6^6 - 2.5 * l_5^6 \leq k_6^* * l_5^6$

$u_6^6 - 2.5 * l_5^6 \geq -k_6^* * l_5^6$

$m_5^6 - 2 * m_3^6 \geq -k_6^* * m_3^6$

$u_5^6 - 2.5 * l_3^6 \leq k_6^* * l_3^6$

$u_5^6 - 2.5 * l_3^6 \geq -k_6^* * l_3^6$

$\left| \frac{(l_6^6, m_6^6, u_6^6)}{(l_6^6, m_6^6, u_6^6)} - (1,1,1) \right| \leq k_6^*$

$l_6^6 - 1 * u_6^6 \leq k_6^* * u_6^6$

$l_6^6 - 1 * u_6^6 \geq -k_6^* * u_6^6$

$m_6^6 - 1 * m_6^6 \leq k_6^* * m_6^6$

$m_6^6 - 1 * m_6^6 \geq -k_6^* * m_6^6$

$u_6^6 - 1 * l_6^6 \leq k_6^* * l_6^6$

$u_6^6 - 1 * l_6^6 \geq -k_6^* * l_6^6$

$\left| \frac{(l_6^6, m_6^6, u_6^6)}{(l_3^6, m_3^6, u_3^6)} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_6^*$

$l_6^6 - 3.5 * u_3^6 \leq k_6^* * u_3^6$

$l_6^6 - 3.5 * u_3^6 \geq -k_6^* * u_3^6$

$m_6^6 - 4 * m_3^6 \leq k_6^* * m_3^6$

$m_6^6 - 4 * m_3^6 \geq -k_6^* * m_3^6$

$u_6^6 - 4.5 * l_3^6 \leq k_6^* * u_3^6$

$u_6^6 - 4.5 * l_3^6 \geq -k_6^* * u_3^6$

Decision maker 7:

The best criterion (C_B): C_5 The worst criterion (C_W): C_6

$\left| \frac{(l_5^7, m_5^7, u_5^7)}{(l_1^7, m_1^7, u_1^7)} - (1,1,1) \right| \leq k_7^*$

$l_5^7 - 1 * u_1^7 \leq k_7^* * u_1^7$

$l_5^7 - 1 * u_1^7 \geq -k_7^* * u_1^7$

$m_5^7 - 1 * m_1^7 \leq k_7^* * m_1^7$

$m_5^7 - 1 * m_1^7 \geq -k_7^* * m_1^7$

$u_5^7 - 1 * l_1^7 \leq k_7^* * l_1^7$

$u_5^7 - 1 * l_1^7 \geq -k_7^* * l_1^7$

$\left| \frac{(l_1^7, m_1^7, u_1^7)}{(l_6^7, m_6^7, u_6^7)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_7^*$

$l_1^7 - 1.5 * u_6^7 \leq k_7^* * u_6^7$

$l_1^7 - 1.5 * u_6^7 \geq -k_7^* * u_6^7$

$m_1^7 - 2 * m_6^7 \leq k_7^* * m_6^7$

$m_1^7 - 2 * m_6^7 \geq -k_7^* * m_6^7$

$u_1^7 - 2.5 * l_6^7 \leq k_7^* * l_6^7$

$u_1^7 - 2.5 * l_6^7 \geq -k_7^* * l_6^7$

$\left| \frac{(l_5^7, m_5^7, u_5^7)}{(l_2^7, m_2^7, u_2^7)} - (\frac{2}{3}, 1, \frac{3}{2}) \right| \leq k_7^*$

$l_5^7 - 0.67 * u_2^7 \leq k_7^* * u_2^7$

$l_5^7 - 0.67 * u_2^7 \geq -k_7^* * u_2^7$

$m_5^7 - 1 * m_2^7 \leq k_7^* * m_2^7$

$m_5^7 - 1 * m_2^7 \geq -k_7^* * m_2^7$

$u_5^7 - 1.5 * l_2^7 \leq k_7^* * l_2^7$

$u_5^7 - 1.5 * l_2^7 \geq -k_7^* * l_2^7$

$\left| \frac{(l_2^7, m_2^7, u_2^7)}{(l_6^7, m_6^7, u_6^7)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_7^*$

$l_2^7 - 1.5 * u_6^7 \leq k_7^* * u_6^7$

$l_2^7 - 1.5 * u_6^7 \geq -k_7^* * u_6^7$

$m_2^7 - 2 * m_6^7 \leq k_7^* * m_6^7$

$m_2^7 - 2 * m_6^7 \geq -k_7^* * m_6^7$

$u_2^7 - 2.5 * l_6^7 \leq k_7^* * l_6^7$

$u_2^7 - 2.5 * l_6^7 \geq -k_7^* * l_6^7$

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$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_3^7, m_3^7, u_3^7)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_7^*$$

$$l_5^7 - 1.5 * u_3^7 \le k_7^* * u_3^7$$

$$l_5^7 - 1.5 * u_3^7 \ge -k_7^* * u_3^7$$

$$m_5^7 - 2 * m_3^7 \le k_7^* * m_3^7$$

$$m_5^7 - 2 * m_3^7 \ge -k_7^* * m_3^7$$

$$u_5^7 - 2.5 * l_3^7 \le k_7^* * l_3^7$$

$$u_5^7 - 2.5 * l_3^7 \ge -k_7^* * l_3^7$$

$$\left|\frac{(l_3^7, m_3^7, u_3^7)}{(l_6^7, m_6^7, u_6^7)} - (1,1,1)\right| \le k_7^*$$

$$l_3^7 - 1 * u_6^7 \le k_7^* * u_6^7$$

$$l_3^7 - 1 * u_6^7 \ge -k_7^* * u_6^7$$

$$m_3^7 - 1 * m_6^7 \le k_7^* * m_6^7$$

$$m_3^7 - 1 * m_6^7 \ge -k_7^* * m_6^7$$

$$u_3^7 - 1 * l_6^7 \le k_7^* * l_6^7$$

$$u_3^7 - 1 * l_6^7 \ge -k_7^* * l_6^7$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_4^7, m_4^7, u_4^7)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \le k_7^*$$

$$l_5^7 - 2.5 * u_4^7 \le k_7^* * u_4^7$$

$$l_5^7 - 2.5 * u_4^7 \ge -k_7^* * u_4^7$$

$$m_5^7 - 3 * m_4^7 \le k_7^* * m_4^7$$

$$m_5^7 - 3 * m_4^7 \ge -k_7^* * m_4^7$$

$$u_5^7 - 3.5 * l_4^7 \le k_7^* * l_4^7$$

$$u_5^7 - 3.5 * l_4^7 \ge -k_7^* * l_4^7$$

$$\left|\frac{(l_4^7, m_4^7, u_4^7)}{(l_6^7, m_6^7, u_6^7)} - (1,1,1)\right| \le k_7^*$$

$$l_4^7 - 1 * u_6^7 \le k_7^* * u_6^7$$

$$l_4^7 - 1 * u_6^7 \ge -k_7^* * u_6^7$$

$$m_4^7 - 1 * m_6^7 \le k_7^* * m_6^7$$

$$m_4^7 - 1 * m_6^7 \ge -k_7^* * m_6^7$$

$$u_4^7 - 1 * l_6^7 \le k_7^* * l_6^7$$

$$u_4^7 - 1 * l_6^7 \ge -k_7^* * l_6^7$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_5^7, m_5^7, u_5^7)} - (1,1,1)\right| \le k_7^*$$

$$l_5^7 - 1 * u_5^7 \le k_7^* * u_5^7$$

$$l_5^7 - 1 * u_5^7 \ge -k_7^* * u_5^7$$

$$m_5^7 - 1 * m_5^7 \le k_7^* * m_5^7$$

$$m_5^7 - 1 * m_5^7 \ge -k_7^* * m_5^7$$

$$u_5^7 - 1 * l_5^7 \le k_7^* * l_5^7$$

$$u_5^7 - 1 * l_5^7 \ge -k_7^* * l_5^7$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_6^7, m_6^7, u_6^7)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \le k_7^*$$

$$l_5^7 - 2.5 * u_6^7 \le k_7^* * u_6^7$$

$$l_5^7 - 2.5 * u_6^7 \ge -k_7^* * u_6^7$$

$$m_5^7 - 3 * m_6^7 \le k_7^* * m_6^7$$

$$m_5^7 - 3 * m_6^7 \ge -k_7^* * m_6^7$$

$$u_5^7 - 3.5 * l_6^7 \le k_7^* * l_6^7$$

$$u_5^7 - 3.5 * l_6^7 \ge -k_7^* * l_6^7$$

$$\left|\frac{(l_5^7, m_5^7, u_5^7)}{(l_6^7, m_6^7, u_6^7)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_7^*$$

$$l_5^7 - 2.5 * u_6^7 \le k_7^* * u_6^7$$

$$l_5^7 - 2.5 * u_6^7 \ge -k_7^* * u_6^7$$

$$m_5^7 - 3 * m_6^7 \le k_7^* * m_6^7$$

$$\left|\frac{(l_6^7, m_6^7, u_6^7)}{(l_6^7, m_6^7, u_6^7)} - (1,1,1)\right| \le k_7^*$$

$$l_6^7 - 1 * u_6^7 \le k_7^* * u_6^7$$

$$l_6^7 - 1 * u_6^7 \ge -k_7^* * u_6^7$$

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$m_5^7 - 3 * m_6^7 \geq -k_7^* * m_6^7$

$u_5^7 - 3.5 * l_6^7 \leq k_7^* * l_6^7$

$u_5^7 - 3.5 * l_6^7 \geq -k_7^* * l_6^7$

$m_6^7 - 1 * m_6^7 \leq k_7^* * m_6^7$

$m_6^7 - 1 * m_6^7 \geq -k_7^* * m_6^7$

$u_6^7 - 1 * l_6^7 \leq k_7^* * l_6^7$

$u_6^7 - 1 * l_6^7 \geq -k_7^* * l_6^7$

Decision maker 8:

The best criterion (C_B): C_1 The worst criterion (C_W): C_5

$$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_1^8, m_1^8, u_1^8)} - (1,1,1) \right| \leq k_8^*$$

$l_1^8 - 1 * u_1^8 \leq k_8^* * u_1^8$

$l_1^8 - 1 * u_1^8 \geq -k_8^* * u_1^8$

$m_1^8 - 1 * m_1^8 \leq k_8^* * m_1^8$

$m_1^8 - 1 * m_1^8 \geq -k_8^* * m_1^8$

$u_1^8 - 1 * l_1^8 \leq k_8^* * l_1^8$

$u_1^8 - 1 * l_1^8 \geq -k_8^* * l_1^8$

$$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_5^8, m_5^8, u_5^8)} - \left(\frac{7}{2}, 4, \frac{9}{2}\right) \right| \leq k_8^*$$

$l_1^8 - 3.5 * u_5^8 \leq k_8^* * u_5^8$

$l_1^8 - 3.5 * u_5^8 \geq -k_8^* * u_5^8$

$m_1^8 - 4 * m_5^8 \leq k_8^* * m_5^8$

$m_1^8 - 4 * m_5^8 \geq -k_8^* * m_5^8$

$u_1^8 - 4.5 * l_5^8 \leq k_8^* * l_5^8$

$u_1^8 - 4.5 * l_5^8 \geq -k_8^* * l_5^8$

$$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_2^8, m_2^8, u_2^8)} - \left(\frac{5}{2}, 3, \frac{7}{2}\right) \right| \leq k_8^*$$

$l_1^8 - 2.5 * u_2^8 \leq k_8^* * u_2^8$

$l_1^8 - 2.5 * u_2^8 \geq -k_8^* * u_2^8$

$m_1^8 - 3 * m_2^8 \leq k_8^* * m_2^8$

$m_1^8 - 3 * m_2^8 \geq -k_8^* * m_2^8$

$u_1^8 - 3.5 * l_2^8 \leq k_8^* * l_2^8$

$u_1^8 - 3.5 * l_2^8 \geq -k_8^* * l_2^8$

$$\left| \frac{(l_2^8, m_2^8, u_2^8)}{(l_5^8, m_5^8, u_5^8)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right) \right| \leq k_8^*$$

$l_2^8 - 1.5 * u_5^8 \leq k_8^* * u_5^8$

$l_2^8 - 1.5 * u_5^8 \geq -k_8^* * u_5^8$

$m_2^8 - 2 * m_5^8 \leq k_8^* * m_5^8$

$m_2^8 - 2 * m_5^8 \geq -k_8^* * m_5^8$

$u_2^8 - 2.5 * l_5^8 \leq k_8^* * l_5^8$

$u_2^8 - 2.5 * l_5^8 \geq -k_8^* * l_5^8$

$$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_3^8, m_3^8, u_3^8)} - \left(\frac{3}{2}, 2, \frac{5}{2}\right) \right| \leq k_8^*$$

$l_1^8 - 1.5 * u_3^8 \leq k_8^* * u_3^8$

$l_1^8 - 1.5 * u_3^8 \geq -k_8^* * u_3^8$

$m_1^8 - 2 * m_3^8 \leq k_8^* * m_3^8$

$m_1^8 - 2 * m_3^8 \geq -k_8^* * m_3^8$

$u_1^8 - 2.5 * l_3^8 \leq k_8^* * l_3^8$

$$\left| \frac{(l_3^8, m_3^8, u_3^8)}{(l_5^8, m_5^8, u_5^8)} - \left(\frac{5}{2}, 3, \frac{7}{2}\right) \right| \leq k_8^*$$

$l_3^8 - 2.5 * u_5^8 \leq k_8^* * u_5^8$

$l_3^8 - 2.5 * u_5^8 \geq -k_8^* * u_5^8$

$m_3^8 - 3 * m_5^8 \leq k_8^* * m_5^8$

$m_3^8 - 3 * m_5^8 \geq -k_8^* * m_5^8$

$u_3^8 - 3.5 * l_5^8 \leq k_8^* * l_5^8$

$u_1^8 - 2.5 * l_3^8 \geq -k_8^* * l_3^8$

$u_3^8 - 3.5 * l_5^8 \geq -k_8^* * l_5^8$

$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_4^8, m_4^8, u_4^8)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_8^*$

$l_1^8 - 1.5 * u_4^8 \leq k_8^* * u_4^8$

$l_1^8 - 1.5 * u_4^8 \geq -k_8^* * u_4^8$

$m_1^8 - 2 * m_4^8 \leq k_8^* * m_4^8$

$m_1^8 - 2 * m_4^8 \geq -k_8^* * m_4^8$

$u_1^8 - 2.5 * l_4^8 \leq k_8^* * l_4^8$

$u_1^8 - 2.5 * l_4^8 \geq -k_8^* * l_4^8$

$\left| \frac{(l_4^8, m_4^8, u_4^8)}{(l_5^8, m_5^8, u_5^8)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_8^*$

$l_4^8 - 1.5 * u_5^8 \leq k_8^* * u_5^8$

$l_4^8 - 1.5 * u_5^8 \geq -k_8^* * u_5^8$

$m_4^8 - 2 * m_5^8 \leq k_8^* * m_5^8$

$m_4^8 - 2 * m_5^8 \geq -k_8^* * m_5^8$

$u_4^8 - 2.5 * l_5^8 \leq k_8^* * m_5^8$

$u_4^8 - 2.5 * l_5^8 \geq -k_8^* * m_5^8$

$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_5^8, m_5^8, u_5^8)} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_8^*$

$l_1^8 - 3.5 * u_5^8 \leq k_8^* * u_5^8$

$l_1^8 - 3.5 * u_5^8 \geq -k_8^* * u_5^8$

$m_1^8 - 4 * m_5^8 \leq k_8^* * m_5^8$

$m_1^8 - 4 * m_5^8 \geq -k_8^* * m_5^8$

$u_1^8 - 4.5 * l_5^8 \leq k_8^* * l_5^8$

$u_1^8 - 4.5 * l_5^8 \geq -k_8^* * l_5^8$

$\left| \frac{(l_5^8, m_5^8, u_5^8)}{(l_5^8, m_5^8, u_5^8)} - (1,1,1) \right| \leq k_8^*$

$l_5^8 - 1 * u_5^8 \leq k_8^* * u_5^8$

$l_5^8 - 1 * u_5^8 \geq -k_8^* * u_5^8$

$m_5^8 - 1 * m_5^8 \leq k_8^* * m_5^8$

$m_5^8 - 1 * m_5^8 \geq -k_8^* * m_5^8$

$u_5^8 - 1 * l_5^8 \leq k_8^* * l_5^8$

$u_5^8 - 1 * l_5^8 \geq -k_8^* * l_5^8$

$\left| \frac{(l_1^8, m_1^8, u_1^8)}{(l_6^8, m_6^8, u_6^8)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_8^*$

$l_1^8 - 1.5 * u_6^8 \leq k_8^* * u_6^8$

$l_1^8 - 1.5 * u_6^8 \geq -k_8^* * u_6^8$

$m_1^8 - 2 * m_6^8 \leq k_8^* * m_6^8$

$m_1^8 - 2 * m_6^8 \geq -k_8^* * m_6^8$

$u_1^8 - 2.5 * l_6^8 \leq k_8^* * l_6^8$

$u_1^8 - 2.5 * l_6^8 \geq -k_8^* * l_6^8$

$\left| \frac{(l_6^8, m_6^8, u_6^8)}{(l_5^8, m_5^8, u_5^8)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_8^*$

$l_6^8 - 2.5 * u_5^8 \leq k_8^* * u_5^8$

$l_6^8 - 2.5 * u_5^8 \geq -k_8^* * u_5^8$

$m_6^8 - 3 * m_5^8 \leq k_8^* * m_5^8$

$m_6^8 - 3 * m_5^8 \geq k_8^* * m_5^8$

$u_6^8 - 3.5 * l_5^8 \leq k_8^* * l_5^8$

$u_6^8 - 3.5 * l_5^8 \geq -k_8^* * l_5^8$

Decision maker 9:

The best criterion (C_B): C_3 The worst criterion (C_W): C_4

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$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_1^9, m_1^9, u_1^9)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_9^*$$

$$l_3^9 - 1.5 * u_1^9 \le k_9^* * u_1^9$$

$$l_3^9 - 1.5 * u_1^9 \ge -k_9^* * u_1^9$$

$$m_3^9 - 2 * m_1^9 \le k_9^* * m_1^9$$

$$m_3^9 - 2 * m_1^9 \ge -k_9^* * m_1^9$$

$$u_3^9 - 2.5 * l_1^9 \le k_9^* * l_1^9$$

$$u_3^9 - 2.5 * l_1^9 \ge -k_9^* * l_1^9$$

$$\left|\frac{(l_1^9, m_1^9, u_1^9)}{(l_4^9, m_4^9, u_4^9)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_9^*$$

$$l_1^9 - 1.5 * u_4^9 \le k_9^* * u_4^9$$

$$l_1^9 - 1.5 * u_4^9 \ge -k_9^* * u_4^9$$

$$m_1^9 - 2 * m_4^9 \le k_9^* * m_4^9$$

$$m_1^9 - 2 * m_4^9 \ge -k_9^* * m_4^9$$

$$u_1^9 - 2.5 * l_4^9 \le k_9^* * l_4^9$$

$$u_1^9 - 2.5 * l_4^9 \ge -k_9^* * l_4^9$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_2^9, m_2^9, u_2^9)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_9^*$$

$$l_3^9 - 1.5 * u_2^9 \le k_9^* * u_2^9$$

$$l_3^9 - 1.5 * u_2^9 \ge -k_9^* * u_2^9$$

$$m_3^9 - 2 * m_2^9 \le k_9^* * m_2^9$$

$$m_3^9 - 2 * m_2^9 \ge -k_9^* * m_2^9$$

$$u_3^9 - 2.5 * l_2^9 \le k_9^* * l_2^9$$

$$u_3^9 - 2.5 * l_2^9 \ge -k_9^* * l_2^9$$

$$\left|\frac{(l_2^9, m_2^9, u_2^9)}{(l_4^9, m_4^9, u_4^9)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_9^*$$

$$l_2^9 - 1.5 * u_4^9 \le k_9^* * u_4^9$$

$$l_2^9 - 1.5 * u_4^9 \ge -k_9^* * u_4^9$$

$$m_2^9 - 2 * m_4^9 \le k_9^* * m_4^9$$

$$m_2^9 - 2 * m_4^9 \ge -k_9^* * m_4^9$$

$$u_2^9 - 2.5 * l_4^9 \le k_9^* * l_4^9$$

$$u_2^9 - 2.5 * l_4^9 \ge -k_9^* * l_4^9$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_3^9, m_3^9, u_3^9)} - (1,1,1)\right| \le k_9^*$$

$$l_3^9 - 1 * u_3^9 \le k_9^* * u_3^9$$

$$l_3^9 - 1 * u_3^9 \ge -k_9^* * u_3^9$$

$$m_3^9 - 1 * m_3^9 \le k_9^* * m_3^9$$

$$m_3^9 - 1 * m_3^9 \ge -k_9^* * m_3^9$$

$$u_3^9 - 1 * l_3^9 \le k_9^* * l_3^9$$

$$u_3^9 - 1 * l_3^9 \ge -k_9^* * l_3^9$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_4^9, m_4^9, u_4^9)} - (\frac{5}{2}, 3, \frac{7}{2})\right| \le k_9^*$$

$$l_3^9 - 2.5 * u_4^9 \le k_9^* * u_4^9$$

$$l_3^9 - 2.5 * u_4^9 \ge -k_9^* * u_4^9$$

$$m_3^9 - 3 * m_4^9 \le k_9^* * m_4^9$$

$$m_3^9 - 3 * m_4^9 \ge -k_9^* * m_4^9$$

$$u_3^9 - 3.5 * l_4^9 \le k_9^* * l_4^9$$

$$u_3^9 - 3.5 * l_4^9 \ge -k_9^* * l_4^9$$

$$\left|\frac{(l_3^9, m_3^9, u_3^9)}{(l_4^9, m_4^9, u_4^9)} - (\frac{3}{2}, 2, \frac{5}{2})\right| \le k_9^*$$

$$l_3^9 - 1.5 * u_4^9 \le k_9^* * u_4^9$$

$$l_3^9 - 1.5 * u_4^9 \ge -k_9^* * u_4^9$$

$$m_3^9 - 2 * m_4^9 \le k_9^* * m_4^9$$

$$m_3^9 - 2 * m_4^9 \ge -k_9^* * m_4^9$$

$$\left|\frac{(l_4^9, m_4^9, u_4^9)}{(l_4^9, m_4^9, u_4^9)} - (1,1,1)\right| \le k_9^*$$

$$l_4^9 - 1 * u_4^9 \le k_9^* * u_4^9$$

$$l_4^9 - 1 * u_4^9 \ge -k_9^* * u_4^9$$

$$m_4^9 - 1 * m_4^9 \le k_9^* * m_4^9$$

$$m_4^9 - 1 * m_4^9 \ge -k_9^* * m_4^9$$

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$u_3^9 - 2.5 * l_4^9 \leq k_9^* * l_4^9$ $\quad$ $u_4^9 - 1 * l_4^9 \leq k_9^* * l_4^9$

$u_3^9 - 2.5 * l_4^9 \geq -k_9^* * l_4^9$ $\quad$ $u_4^9 - 1 * l_4^9 \geq -k_9^* * l_4^9$

$\left| \frac{(l_3^9, m_3^9, u_3^9)}{(l_5^9, m_5^9, u_5^9)} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_9^*$ $\quad$ $\left| \frac{(l_5^9, m_5^9, u_5^9)}{(l_4^9, m_4^9, u_4^9)} - (\frac{2}{3}, 1, \frac{3}{2}) \right| \leq k_9^*$

$l_3^9 - 2.5 * u_5^9 \leq k_9^* * u_5^9$ $\quad$ $l_5^9 - 0.67 * u_4^9 \leq k_9^* * u_4^9$

$l_3^9 - 2.5 * u_5^9 \geq -k_9^* * u_5^9$ $\quad$ $l_5^9 - 0.67 * u_4^9 \geq -k_9^* * u_4^9$

$m_3^9 - 3 * m_5^9 \leq k_9^* * m_5^9$ $\quad$ $m_5^9 - 1 * m_4^9 \leq k_9^* * m_4^9$

$m_3^9 - 3 * m_5^9 \geq -k_9^* * m_5^9$ $\quad$ $m_5^9 - 1 * m_4^9 \geq -k_9^* * m_4^9$

$u_3^9 - 3.5 * l_5^9 \leq k_9^* * l_5^9$ $\quad$ $u_5^9 - 1.5 * l_4^9 \leq k_9^* * l_4^9$

$u_3^9 - 3.5 * l_5^9 \geq -k_9^* * l_5^9$ $\quad$ $u_5^9 - 1.5 * l_4^9 \geq -k_9^* * l_4^9$

$\left| \frac{(l_3^9, m_3^9, u_3^9)}{(l_6^9, m_6^9, u_6^9)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_9^*$ $\quad$ $\left| \frac{(l_6^9, m_6^9, u_6^9)}{(l_4^9, m_4^9, u_4^9)} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_9^*$

$l_3^9 - 1.5 * u_6^9 \leq k_9^* * u_6^9$ $\quad$ $l_6^9 - 1.5 * u_4^9 \leq k_9^* * u_4^9$

$l_3^9 - 1.5 * u_6^9 \geq -k_9^* * u_6^9$ $\quad$ $l_6^9 - 1.5 * u_4^9 \geq -k_9^* * u_4^9$

$m_3^9 - 2 * m_6^9 \leq k_9^* * m_6^9$ $\quad$ $m_6^9 - 2 * m_4^9 \leq k_9^* * m_4^9$

$m_3^9 - 2 * m_6^9 \geq k_9^* * m_6^9$ $\quad$ $m_6^9 - 2 * m_4^9 \geq -k_9^* * m_4^9$

$u_3^9 - 2.5 * l_6^9 \leq k_9^* * l_6^9$ $\quad$ $u_6^9 - 2.5 * l_4^9 \leq k_9^* * l_4^9$

$u_3^9 - 2.5 * l_6^9 \geq -k_9^* * l_6^9$ $\quad$ $u_6^9 - 2.5 * l_4^9 \geq -k_9^* * l_4^9$

Decision maker 10:

The best criterion (C_B): C_1 $\quad$ The worst criterion (C_W): C_5

$\left| \frac{(l_1^{10}, m_1^{10}, u_1^{10})}{(l_1^{10}, m_1^{10}, u_1^{10})} - (1,1,1) \right| \leq k_{10}^*$ $\quad$ $\left| \frac{(l_1^{10}, m_1^{10}, u_1^{10})}{(l_5^{10}, m_5^{10}, u_5^{10})} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_{10}^*$

$l_1^{10} - 1 * u_1^{10} \leq k_{10}^* * u_1^{10}$ $\quad$ $l_1^{10} - 2.5 * u_5^{10} \leq k_{10}^* * u_5^{10}$

$l_1^{10} - 1 * u_1^{10} \geq -k_{10}^* * u_1^{10}$ $\quad$ $l_1^{10} - 2.5 * u_5^{10} \geq -k_{10}^* * u_5^{10}$

$m_1^{10} - 1 * m_1^{10} \leq k_{10}^* * m_1^{10}$ $\quad$ $m_1^{10} - 3 * m_5^{10} \leq k_{10}^* * m_5^{10}$

$m_1^{10} - 1 * m_1^{10} \geq -k_{10}^* * m_1^{10}$ $\quad$ $m_1^{10} - 3 * m_5^{10} \geq -k_{10}^* * m_5^{10}$

$u_1^{10} - 1 * l_1^{10} \leq k_{10}^* * l_1^{10}$ $\quad$ $u_1^{10} - 3.5 * l_5^{10} \leq k_{10}^* * l_5^{10}$

$u_1^{10} - 1 * l_1^{10} \geq -k_{10}^* * l_1^{10}$ $\quad$ $u_1^{10} - 3.5 * l_5^{10} \geq -k_{10}^* * l_5^{10}$

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$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_2^{10},m_2^{10},u_2^{10})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{10}^{*}$$

$$l_1^{10}-1.5*u_2^{10}\le k_{10}^{*}*u_2^{10}$$

$$l_1^{10}-1.5*u_2^{10}\ge -k_{10}^{*}*u_2^{10}$$

$$m_1^{10}-2*m_2^{10}\le k_{10}^{*}*m_2^{10}$$

$$m_1^{10}-2*m_2^{10}\ge -k_{10}^{*}*m_2^{10}$$

$$u_1^{10}-2.5*l_2^{10}\le k_{10}^{*}*l_2^{10}$$

$$u_1^{10}-2.5*l_2^{10}\ge -k_{10}^{*}*l_2^{10}$$

$$\left|\frac{(l_2^{10},m_2^{10},u_2^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{10}^{*}$$

$$l_2^{10}-1.5*u_5^{10}\le k_{10}^{*}*u_5^{10}$$

$$l_2^{10}-1.5*u_5^{10}\ge -k_{10}^{*}*u_5^{10}$$

$$m_2^{10}-2*m_5^{10}\le k_{10}^{*}*m_5^{10}$$

$$m_2^{10}-2*m_5^{10}\ge -k_{10}^{*}*m_5^{10}$$

$$u_2^{10}-2.5*l_5^{10}\le k_{10}^{*}*l_5^{10}$$

$$u_2^{10}-2.5*l_5^{10}\ge -k_{10}^{*}*l_5^{10}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_3^{10},m_3^{10},u_3^{10})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{10}^{*}$$

$$l_1^{10}-1.5*u_3^{10}\le k_{10}^{*}*u_3^{10}$$

$$l_1^{10}-1.5*u_3^{10}\ge -k_{10}^{*}*u_3^{10}$$

$$m_1^{10}-2*m_3^{10}\le k_{10}^{*}*m_3^{10}$$

$$m_1^{10}-2*m_3^{10}\ge -k_{10}^{*}*m_3^{10}$$

$$u_1^{10}-2.5*l_3^{10}\le k_{10}^{*}*l_3^{10}$$

$$u_1^{10}-2.5*l_3^{10}\ge -k_{10}^{*}*l_3^{10}$$

$$\left|\frac{(l_3^{10},m_3^{10},u_3^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{10}^{*}$$

$$l_3^{10}-1.5*u_5^{10}\le k_{10}^{*}*u_5^{10}$$

$$l_3^{10}-1.5*u_5^{10}\ge -k_{10}^{*}*u_5^{10}$$

$$m_3^{10}-2*m_5^{10}\le k_{10}^{*}*m_5^{10}$$

$$m_3^{10}-2*m_5^{10}\ge -k_{10}^{*}*m_5^{10}$$

$$u_3^{10}-2.5*l_5^{10}\le k_{10}^{*}*l_5^{10}$$

$$u_3^{10}-2.5*l_5^{10}\ge -k_{10}^{*}*l_5^{10}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_4^{10},m_4^{10},u_4^{10})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{10}^{*}$$

$$l_1^{10}-1.5*u_4^{10}\le k_{10}^{*}*u_4^{10}$$

$$l_1^{10}-1.5*u_4^{10}\ge -k_{10}^{*}*u_4^{10}$$

$$m_1^{10}-2*m_4^{10}\le k_{10}^{*}*m_4^{10}$$

$$m_1^{10}-2*m_4^{10}\ge -k_{10}^{*}*m_4^{10}$$

$$u_1^{10}-2.5*l_4^{10}\le k_{10}^{*}*l_4^{10}$$

$$u_1^{10}-2.5*l_4^{10}\ge -k_{10}^{*}*l_4^{10}$$

$$\left|\frac{(l_4^{10},m_4^{10},u_4^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-(\frac{5}{2},3,\frac{7}{2})\right|\le k_{10}^{*}$$

$$l_4^{10}-2.5*u_5^{10}\le k_{10}^{*}*u_5^{10}$$

$$l_4^{10}-2.5*u_5^{10}\ge -k_{10}^{*}*u_5^{10}$$

$$m_4^{10}-3*m_5^{10}\le k_{10}^{*}*m_5^{10}$$

$$m_4^{10}-3*m_5^{10}\ge -k_{10}^{*}*m_5^{10}$$

$$u_4^{10}-3.5*l_5^{10}\le k_{10}^{*}*l_5^{10}$$

$$u_4^{10}-3.5*l_5^{10}\ge -k_{10}^{*}*l_5^{10}$$

$$\left|\frac{(l_1^{10},m_1^{10},u_1^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-(\frac{5}{2},3,\frac{7}{2})\right|\le k_{10}^{*}$$

$$l_1^{10}-2.5*u_5^{10}\le k_{10}^{*}*u_5^{10}$$

$$l_1^{10}-2.5*u_5^{10}\ge -k_{10}^{*}*u_5^{10}$$

$$m_1^{10}-3*m_5^{10}\le k_{10}^{*}*m_5^{10}$$

$$m_1^{10}-3*m_5^{10}\ge -k_{10}^{*}*m_5^{10}$$

$$\left|\frac{(l_5^{10},m_5^{10},u_5^{10})}{(l_5^{10},m_5^{10},u_5^{10})}-(1,1,1)\right|\le k_{10}^{*}$$

$$l_5^{10}-1*u_5^{10}\le k_{10}^{*}*u_5^{10}$$

$$l_5^{10}-1*u_5^{10}\ge -k_{10}^{*}*u_5^{10}$$

$$m_5^{10}-1*m_5^{10}\le k_{10}^{*}*m_5^{10}$$

$$m_5^{10}-1*m_5^{10}\ge -k_{10}^{*}*m_5^{10}$$

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$u_1^{10} - 3.5 * l_5^{10} \le k_{10}^* * l_5^{10}$ $\quad$ $u_5^{10} - 1 * l_5^{10} \le k_{10}^* * l_5^{10}$

$u_1^{10} - 3.5 * l_5^{10} \ge -k_{10}^* * l_5^{10}$ $\quad$ $u_5^{10} - 1 * l_5^{10} \ge -k_{10}^* * l_5^{10}$

$\left| \frac{(l_1^{10}, m_1^{10}, u_1^{10})}{(l_6^{10}, m_6^{10}, u_6^{10})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \le k_{10}^*$ $\quad$ $\left| \frac{(l_6^{10}, m_6^{10}, u_6^{10})}{(l_5^{10}, m_5^{10}, u_5^{10})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \le k_{10}^*$

$l_1^{10} - 1.5 * u_6^{10} \le k_{10}^* * u_6^{10}$ $\quad$ $l_6^{10} - 1.5 * u_5^{10} \le k_{10}^* * u_5^{10}$

$l_1^{10} - 1.5 * u_6^{10} \ge -k_{10}^* * u_6^{10}$ $\quad$ $l_6^{10} - 1.5 * u_5^{10} \ge -k_{10}^* * u_5^{10}$

$m_1^{10} - 2 * m_6^{10} \le k_{10}^* * m_6^{10}$ $\quad$ $m_6^{10} - 2 * m_5^{10} \le k_{10}^* * m_5^{10}$

$m_1^{10} - 2 * m_6^{10} \ge -k_{10}^* * m_6^{10}$ $\quad$ $m_6^{10} - 2 * m_5^{10} \ge -k_{10}^* * m_5^{10}$

$u_1^{10} - 2.5 * l_6^{10} \le k_{10}^* * l_6^{10}$ $\quad$ $u_6^{10} - 2.5 * l_5^{10} \le k_{10}^* * l_5^{10}$

$u_1^{10} - 2.5 * l_6^{10} \ge -k_{10}^* * l_6^{10}$ $\quad$ $u_6^{10} - 2.5 * l_5^{10} \ge -k_{10}^* * l_5^{10}$

Decision maker 11:

The best criterion (C_B): C_3 $\quad$ The worst criterion (C_W): C_4

$\left| \frac{(l_3^{11}, m_3^{11}, u_3^{11})}{(l_1^{11}, m_1^{11}, u_1^{11})} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \le k_{11}^*$ $\quad$ $\left| \frac{(l_1^{11}, m_1^{11}, u_1^{11})}{(l_4^{11}, m_4^{11}, u_4^{11})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \le k_{11}^*$

$l_3^{11} - 2.5 * u_1^{11} \le k_{11}^* * u_1^{11}$ $\quad$ $l_1^{11} - 1.5 * u_4^{11} \le k_{11}^* * u_4^{11}$

$l_3^{11} - 2.5 * u_1^{11} \ge -k_{11}^* * u_1^{11}$ $\quad$ $l_1^{11} - 1.5 * u_4^{11} \ge -k_{11}^* * u_4^{11}$

$m_3^{11} - 3 * m_1^{11} \le k_{11}^* * u_1^{11}$ $\quad$ $m_1^{11} - 2 * m_4^{11} \le k_{11}^* * m_4^{11}$

$m_3^{11} - 3 * m_1^{11} \ge -k_{11}^* * u_1^{11}$ $\quad$ $m_1^{11} - 2 * m_4^{11} \ge -k_{11}^* * m_4^{11}$

$u_3^{11} - 3.5 * l_1^{11} \le k_{11}^* * l_1^{11}$ $\quad$ $u_1^{11} - 2.5 * l_4^{11} \le k_{11}^* * l_4^{11}$

$u_3^{11} - 3.5 * l_1^{11} \ge -k_{11}^* * l_1^{11}$ $\quad$ $u_1^{11} - 2.5 * l_4^{11} \ge -k_{11}^* * l_4^{11}$

$\left| \frac{(l_3^{11}, m_3^{11}, u_3^{11})}{(l_2^{11}, m_2^{11}, u_2^{11})} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \le k_{11}^*$ $\quad$ $\left| \frac{(l_2^{11}, m_2^{11}, u_2^{11})}{(l_4^{11}, m_4^{11}, u_4^{11})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \le k_{11}^*$

$l_3^{11} - 2.5 * u_2^{11} \le k_{11}^* * u_2^{11}$ $\quad$ $l_2^{11} - 1.5 * u_4^{11} \le k_{11}^* * u_4^{11}$

$l_3^{11} - 2.5 * u_2^{11} \ge -k_{11}^* * u_2^{11}$ $\quad$ $l_2^{11} - 1.5 * u_4^{11} \ge -k_{11}^* * u_4^{11}$

$m_3^{11} - 3 * m_2^{11} \le k_{11}^* * m_2^{11}$ $\quad$ $m_2^{11} - 2 * m_4^{11} \le k_{11}^* * m_4^{11}$

$m_3^{11} - 3 * m_2^{11} \ge -k_{11}^* * m_2^{11}$ $\quad$ $m_2^{11} - 2 * m_4^{11} \ge -k_{11}^* * m_4^{11}$

$u_3^{11} - 3.5 * l_2^{11} \le k_{11}^* * l_2^{11}$ $\quad$ $u_2^{11} - 2.5 * l_4^{11} \le k_{11}^* * l_4^{11}$

$u_3^{11} - 3.5 * l_2^{11} \ge -k_{11}^* * l_2^{11}$ $\quad$ $u_2^{11} - 2.5 * l_4^{11} \ge -k_{11}^* * l_4^{11}$

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$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_3^{11},m_3^{11},u_3^{11})}-(1,1,1)\right|\le k_{11}^{*}$$

$$l_3^{11}-1*u_3^{11}\le k_{11}^{*}*u_3^{11}$$

$$l_3^{11}-1*u_3^{11}\ge -k_{11}^{*}*u_3^{11}$$

$$m_3^{11}-1*m_3^{11}\le k_{11}^{*}*m_3^{11}$$

$$m_3^{11}-1*m_3^{11}\ge -k_{11}^{*}*m_3^{11}$$

$$u_3^{11}-1*l_3^{11}\le k_{11}^{*}*l_3^{11}$$

$$u_3^{11}-1*l_3^{11}\ge k_{11}^{*}*l_3^{11}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-\left(\frac{7}{2},4,\frac{9}{2}\right)\right|\le k_{11}^{*}$$

$$l_3^{11}-3.5*u_4^{11}\le k_{11}^{*}*u_4^{11}$$

$$l_3^{11}-3.5*u_4^{11}\ge -k_{11}^{*}*u_4^{11}$$

$$m_3^{11}-4*m_4^{11}\le k_{11}^{*}*m_4^{11}$$

$$m_3^{11}-4*m_4^{11}\ge -k_{11}^{*}*m_4^{11}$$

$$u_3^{11}-4.5*l_4^{11}\le k_{11}^{*}*l_4^{11}$$

$$u_3^{11}-4.5*l_4^{11}\ge -k_{11}^{*}*l_4^{11}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-(\frac{7}{2},4,\frac{9}{2})\right|\le k_{11}^{*}$$

$$l_3^{11}-3.5*u_4^{11}\le k_{11}^{*}*u_4^{11}$$

$$l_3^{11}-3.5*u_4^{11}\ge -k_{11}^{*}*u_4^{11}$$

$$m_3^{11}-4*m_4^{11}\le k_{11}^{*}*m_4^{11}$$

$$m_3^{11}-4*m_4^{11}\ge -k_{11}^{*}*m_4^{11}$$

$$u_3^{11}-4.5*l_4^{11}\le k_{11}^{*}*l_4^{11}$$

$$u_3^{11}-4.5*l_4^{11}\ge -k_{11}^{*}*l_4^{11}$$

$$\left|\frac{(l_4^{11},m_4^{11},u_4^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-(1,1,1)\right|\le k_{11}^{*}$$

$$l_4^{11}-1*u_4^{11}\le k_{11}^{*}*u_4^{11}$$

$$l_4^{11}-1*u_4^{11}\ge -k_{11}^{*}*u_4^{11}$$

$$m_4^{11}-1*m_4^{11}\le k_{11}^{*}*m_4^{11}$$

$$m_4^{11}-1*m_4^{11}\ge -k_{11}^{*}*m_4^{11}$$

$$u_4^{11}-1*l_4^{11}\le k_{11}^{*}*l_4^{11}$$

$$u_4^{11}-1*l_4^{11}\ge -k_{11}^{*}*l_4^{11}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_5^{11},m_5^{11},u_5^{11})}-(\frac{5}{2},3,\frac{7}{2})\right|\le k_{11}^{*}$$

$$l_3^{11}-2.5*u_5^{11}\le k_{11}^{*}*u_5^{11}$$

$$l_3^{11}-2.5*u_5^{11}\ge -k_{11}^{*}*u_5^{11}$$

$$m_3^{11}-3*m_5^{11}\le k_{11}^{*}*m_5^{11}$$

$$m_3^{11}-3*m_5^{11}\ge -k_{11}^{*}*m_5^{11}$$

$$\left|\frac{(l_5^{11},m_5^{11},u_5^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{11}^{*}$$

$$l_5^{11}-1.5*u_4^{11}\le k_{11}^{*}*u_4^{11}$$

$$l_5^{11}-1.5*u_4^{11}\ge -k_{11}^{*}*u_4^{11}$$

$$m_5^{11}-2*m_4^{11}\le k_{11}^{*}*m_4^{11}$$

$$m_5^{11}-2*m_4^{11}\ge -k_{11}^{*}*m_4^{11}$$

$$u_3^{11}-3.5*l_5^{11}\le k_{11}^{*}*l_5^{11}$$

$$u_3^{11}-3.5*l_5^{11}\ge -k_{11}^{*}*l_5^{11}$$

$$u_5^{11}-2.5*l_4^{11}\le k_{11}^{*}*l_4^{11}$$

$$u_5^{11}-2.5*l_4^{11}\ge -k_{11}^{*}*l_4^{11}$$

$$\left|\frac{(l_3^{11},m_3^{11},u_3^{11})}{(l_6^{11},m_6^{11},u_6^{11})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{11}^{*}$$

$$l_3^{11}-1.5*u_6^{11}\le k_{11}^{*}*u_6^{11}$$

$$l_3^{11}-1.5*u_6^{11}\ge -k_{11}^{*}*u_6^{11}$$

$$m_3^{11}-2*m_6^{11}\le k_{11}^{*}*m_6^{11}$$

$$\left|\frac{(l_6^{11},m_6^{11},u_6^{11})}{(l_4^{11},m_4^{11},u_4^{11})}-(\frac{5}{2},3,\frac{7}{2})\right|\le k_{11}^{*}$$

$$l_6^{11}-2.5*u_4^{11}\le k_{11}^{*}*u_4^{11}$$

$$l_6^{11}-2.5*u_4^{11}\ge -k_{11}^{*}*u_4^{11}$$

$$m_6^{11}-3*m_4^{11}\le k_{11}^{*}*m_4^{11}$$

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$m_3^{11} - 2 * m_6^{11} \geq -k_{11}^* * m_6^{11}$ $\quad$ $m_6^{11} - 3 * m_4^{11} \geq -k_{11}^* * m_4^{11}$

$u_3^{11} - 2.5 * l_6^{11} \leq k_{11}^* * l_6^{11}$ $\quad$ $u_6^{11} - 3.5 * l_4^{11} \leq k_{11}^* * l_4^{11}$

$u_3^{11} - 2.5 * l_6^{11} \geq -k_{11}^* * l_6^{11}$ $\quad$ $u_6^{11} - 3.5 * l_4^{11} \geq -k_{11}^* * l_4^{11}$

Decision maker 12:

The best criterion (C_B): C_3 $\quad$ The worst criterion (C_W): C_6

$\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_1^{12}, m_1^{12}, u_1^{12})} - (1,1,1) \right| \leq k_{12}^*$ $\quad$ $\left| \frac{(l_1^{12}, m_1^{12}, u_1^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_{12}^*$

$l_3^{12} - 1 * u_1^{12} \leq k_{12}^* * u_1^{12}$ $\quad$ $l_1^{12} - 2.5 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_3^{12} - 1 * u_1^{12} \geq -k_{12}^* * u_1^{12}$ $\quad$ $l_1^{12} - 2.5 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_3^{12} - 1 * m_1^{12} \leq k_{12}^* * m_1^{12}$ $\quad$ $m_1^{12} - 3 * m_6^{12} \leq k_{12}^* * m_6^{12}$

$m_3^{12} - 1 * m_1^{12} \geq -k_{12}^* * m_1^{12}$ $\quad$ $m_1^{12} - 3 * m_6^{12} \geq -k_{12}^* * m_6^{12}$

$u_3^{12} - 1 * l_1^{12} \leq k_{12}^* * l_1^{12}$ $\quad$ $u_1^{12} - 3.5 * l_6^{12} \leq k_{12}^* * l_6^{12}$

$u_3^{12} - 1 * l_1^{12} \geq -k_{12}^* * l_1^{12}$ $\quad$ $u_1^{12} - 3.5 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

$\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_2^{12}, m_2^{12}, u_2^{12})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_{12}^*$ $\quad$ $\left| \frac{(l_2^{12}, m_2^{12}, u_2^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_{12}^*$

$l_3^{12} - 1.5 * u_2^{12} \leq k_{12}^* * u_2^{12}$ $\quad$ $l_2^{12} - 1.5 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_3^{12} - 1.5 * u_2^{12} \geq -k_{12}^* * u_2^{12}$ $\quad$ $l_2^{12} - 1.5 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_3^{12} - 2 * m_2^{12} \leq k_{12}^* * m_2^{12}$ $\quad$ $m_2^{12} - 2 * m_6^{12} \leq k_{12}^* * m_6^{12}$

$m_3^{12} - 2 * m_2^{12} \geq -k_{12}^* * m_2^{12}$ $\quad$ $m_2^{12} - 2 * m_6^{12} \geq -k_{12}^* * m_6^{12}$

$u_3^{12} - 2.5 * l_2^{12} \leq k_{12}^* * l_2^{12}$ $\quad$ $u_2^{12} - 2.5 * l_6^{12} \leq k_{12}^* * l_6^{12}$

$u_3^{12} - 2.5 * l_2^{12} \geq -k_{12}^* * l_2^{12}$ $\quad$ $u_2^{12} - 2.5 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

$\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_3^{12}, m_3^{12}, u_3^{12})} - (1,1,1) \right| \leq k_{12}^*$ $\quad$ $\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (1,1,1) \right| \leq k_{12}^*$

$l_3^{12} - 1 * u_3^{12} \leq k_{12}^* * u_3^{12}$ $\quad$ $l_3^{12} - 1 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_3^{12} - 1 * u_3^{12} \geq -k_{12}^* * u_3^{12}$ $\quad$ $l_3^{12} - 1 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_3^{12} - 1 * m_3^{12} \leq k_{12}^* * m_3^{12}$ $\quad$ $m_3^{12} - 1 * m_6^{12} \leq k_{12}^* * m_6^{12}$

$m_3^{12} - 1 * m_3^{12} \geq -k_{12}^* * m_3^{12}$ $\quad$ $m_3^{12} - 1 * m_6^{12} \geq -k_{12}^* * m_6^{12}$

$u_3^{12} - 1 * l_3^{12} \leq k_{12}^* * l_3^{12}$ $\quad$ $u_3^{12} - 1 * l_6^{12} \leq k_{12}^* * l_6^{12}$

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$u_3^{12} - 1 * l_3^{12} \geq -k_{12}^* * l_3^{12}$

$u_3^{12} - 1 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

$\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_4^{12}, m_4^{12}, u_4^{12})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_{12}^*$

$l_3^{12} - 1.5 * u_4^{12} \leq k_{12}^* * u_4^{12}$

$l_3^{12} - 1.5 * u_4^{12} \geq -k_{12}^* * u_4^{12}$

$m_3^{12} - 2 * u_4^{12} \leq k_{12}^* * u_4^{12}$

$m_3^{12} - 2 * u_4^{12} \geq -k_{12}^* * u_4^{12}$

$u_3^{12} - 2.5 * u_3^{12} \leq k_{12}^* * u_3^{12}$

$u_3^{12} - 2.5 * u_3^{12} \geq -k_{12}^* * u_3^{12}$

$\left| \frac{(l_4^{12}, m_4^{12}, u_4^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (1,1,1) \right| \leq k_{12}^*$

$l_4^{12} - 1 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_4^{12} - 1 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_4^{12} - 1 * m_6^{12} \leq k_{12}^* * u_6^{12}$

$m_4^{12} - 1 * m_6^{12} \geq -k_{12}^* * u_6^{12}$

$u_4^{12} - 1 * l_6^{12} \leq k_{12}^* * l_6^{12}$

$u_4^{12} - 1 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

$\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_5^{12}, m_5^{12}, u_5^{12})} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_{12}^*$

$l_3^{12} - 3.5 * u_5^{12} \leq k_{12}^* * u_5^{12}$

$l_3^{12} - 3.5 * u_5^{12} \geq -k_{12}^* * u_5^{12}$

$m_3^{12} - 4 * m_5^{12} \leq k_{12}^* * m_5^{12}$

$m_3^{12} - 4 * m_5^{12} \geq -k_{12}^* * m_5^{12}$

$u_3^{12} - 4.5 * l_5^{12} \leq k_{12}^* * l_5^{12}$

$u_3^{12} - 4.5 * l_5^{12} \geq -k_{12}^* * l_5^{12}$

$\left| \frac{(l_5^{12}, m_5^{12}, u_5^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_{12}^*$

$l_5^{12} - 2.5 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_5^{12} - 2.5 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_5^{12} - 3 * m_6^{12} \leq k_{12}^* * m_6^{12}$

$m_5^{12} - 3 * m_6^{12} \geq -k_{12}^* * m_6^{12}$

$u_5^{12} - 3.5 * l_6^{12} \leq k_{12}^* * l_6^{12}$

$u_5^{12} - 3.5 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

$\left| \frac{(l_3^{12}, m_3^{12}, u_3^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (1,1,1) \right| \leq k_{12}^*$

$l_3^{12} - 1 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_3^{12} - 1 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_3^{12} - 1 * m_6^{12} \leq k_{12}^* * m_6^{12}$

$m_3^{12} - 1 * m_6^{12} \geq -k_{12}^* * m_6^{12}$

$u_3^{12} - 1 * l_6^{12} \leq k_{12}^* * l_6^{12}$

$u_3^{12} - 1 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

$\left| \frac{(l_6^{12}, m_6^{12}, u_6^{12})}{(l_6^{12}, m_6^{12}, u_6^{12})} - (1,1,1) \right| \leq k_{12}^*$

$l_6^{12} - 1 * u_6^{12} \leq k_{12}^* * u_6^{12}$

$l_6^{12} - 1 * u_6^{12} \geq -k_{12}^* * u_6^{12}$

$m_6^{12} - 1 * m_6^{12} \leq k_{12}^* * u_6^{12}$

$m_6^{12} - 1 * m_6^{12} \geq -k_{12}^* * u_6^{12}$

$u_6^{12} - 1 * l_6^{12} \leq k_{12}^* * l_6^{12}$

$u_6^{12} - 1 * l_6^{12} \geq -k_{12}^* * l_6^{12}$

Decision maker 13:

The best criterion (C_B): C_6 The worst criterion (C_W): C_4

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$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_1^{13},m_1^{13},u_1^{13})}-(\frac{5}{2},3,\frac{7}{2})\right|\le k_{13}^*$$

$$l_6^{13}-2.5*u_1^{13}\le k_{13}^**u_1^{13}$$

$$l_6^{13}-2.5*u_1^{13}\ge -k_{13}^**u_1^{13}$$

$$m_6^{13}-3*m_1^{13}\le k_{13}^**m_1^{13}$$

$$m_6^{13}-3*m_1^{13}\ge -k_{13}^**m_1^{13}$$

$$u_6^{13}\text{-}3.5*l_1^{13}\le k_{13}^**m_1^{13}$$

$$u_6^{13}\text{-}3.5*l_1^{13}\ge -k_{13}^**m_1^{13}$$

$$\left|\frac{(l_1^{13},m_1^{13},u_1^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{13}^*$$

$$l_1^{13}-1.5*u_4^{13}\le k_{13}^**u_4^{13}$$

$$l_1^{13}-1.5*u_4^{13}\ge -k_{13}^**u_4^{13}$$

$$m_1^{13}-2*\ m_4^{13}\le k_{13}^**m_4^{13}$$

$$m_1^{13}-2*\ m_4^{13}\ge -k_{13}^**m_4^{13}$$

$$u_1^{13}-2.5*l_4^{13}\le k_{13}^**l_4^{13}$$

$$u_1^{13}-2.5*l_4^{13}\ge -k_{13}^**l_4^{13}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_2^{13},m_2^{13},u_2^{13})}-\left(\frac{5}{2},3,\frac{7}{2}\right)\right|\le k_{13}^*$$

$$l_6^{13}-2.5*u_2^{13}\le k_{13}^**u_2^{13}$$

$$l_6^{13}-2.5*u_2^{13}\ge -k_{13}^**u_2^{13}$$

$$m_6^{13}-3*m_2^{13}\le k_{13}^**m_2^{13}$$

$$m_6^{13}-3*m_2^{13}\ge -k_{13}^**m_2^{13}$$

$$u_6^{13}-3.5*l_2^{13}\le k_{13}^**l_2^{13}$$

$$u_6^{13}-3.5*l_2^{13}\ge -k_{13}^**l_2^{13}$$

$$\left|\frac{(l_2^{13},m_2^{13},u_2^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{13}^*$$

$$l_2^{13}-1.5*u_4^{13}\le k_{13}^**u_4^{13}$$

$$l_2^{13}-1.5*u_4^{13}\ge -k_{13}^**u_4^{13}$$

$$m_2^{13}-2*m_4^{13}\le k_{13}^**m_4^{13}$$

$$m_2^{13}-2*m_4^{13}\ge -k_{13}^**m_4^{13}$$

$$u_2^{13}-2.5*l_4^{13}\le k_{13}^**l_4^{13}$$

$$u_2^{13}-2.5*l_4^{13}\ge -k_{13}^**l_4^{13}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_3^{13},m_3^{13},u_3^{13})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{13}^*$$

$$l_6^{13}-1.5*u_3^{13}\le k_{13}^**u_3^{13}$$

$$l_6^{13}-1.5*u_3^{13}\ge -k_{13}^**u_3^{13}$$

$$m_6^{13}-2*m_3^{13}\le k_{13}^**m_3^{13}$$

$$m_6^{13}-2*m_3^{13}\ge -k_{13}^**m_3^{13}$$

$$u_6^{13}-2.5*l_3^{13}\le k_{13}^**l_3^{13}$$

$$u_6^{13}-2.5*l_3^{13}\ge -k_{13}^**l_3^{13}$$

$$\left|\frac{(l_3^{13},m_3^{13},u_3^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-(\frac{3}{2},2,\frac{5}{2})\right|\le k_{13}^*$$

$$l_3^{13}-1.5*u_4^{13}\le k_{13}^**u_4^{13}$$

$$l_3^{13}-1.5*u_4^{13}\ge -k_{13}^**u_4^{13}$$

$$m_3^{13}-2*m_4^{13}\le k_{13}^**m_4^{13}$$

$$m_3^{13}-2*m_4^{13}\ge -k_{13}^**m_4^{13}$$

$$u_3^{13}-2.5*l_4^{13}\le k_{13}^**l_4^{13}$$

$$u_3^{13}-2.5*l_4^{13}\ge -k_{13}^**l_4^{13}$$

$$\left|\frac{(l_6^{13},m_6^{13},u_6^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-(\frac{7}{2},4,\frac{9}{2})\right|\le k_{13}^*$$

$$l_6^{13}-3.5*u_4^{13}\le k_{13}^**u_4^{13}$$

$$l_6^{13}-3.5*u_4^{13}\ge -k_{13}^**u_4^{13}$$

$$m_6^{13}-4*m_4^{13}\le k_{13}^**u_4^{13}$$

$$\left|\frac{(l_4^{13},m_4^{13},u_4^{13})}{(l_4^{13},m_4^{13},u_4^{13})}-(1,1,1)\right|\le k_{13}^*$$

$$l_4^{13}-1*u_4^{13}\le k_{13}^**u_4^{13}$$

$$l_4^{13}-1*u_4^{13}\ge -k_{13}^**u_4^{13}$$

$$m_4^{13}-1*m_4^{13}\le k_{13}^**m_4^{13}$$

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$$m_6^{13} - 4 * m_4^{13} \geq -k_{13}^* * u_4^{13}$$
$$u_6^{13} - 4.5 * l_4^{13} \leq k_{13}^* * l_4^{13}$$
$$u_6^{13} - 4.5 * l_4^{13} \geq -k_{13}^* * l_4^{13}$$

$$m_4^{13} - 1 * m_4^{13} \geq -k_{13}^* * m_4^{13}$$
$$u_4^{13} - 1 * l_4^{13} \leq k_{13}^* * l_4^{13}$$
$$u_4^{13} - 1 * l_4^{13} \geq -k_{13}^* * l_4^{13}$$

$$\left| \frac{(l_6^{13}, m_6^{13}, u_6^{13})}{(l_5^{13}, m_5^{13}, u_5^{13})} - (\frac{5}{2}, 3, \frac{7}{2}) \right| \leq k_{13}^*$$
$$l_6^{13} - 2.5 * u_5^{13} \leq k_{13}^* * u_5^{13}$$
$$l_6^{13} - 2.5 * u_5^{13} \geq -k_{13}^* * u_5^{13}$$
$$m_6^{13} - 3 * m_5^{13} \leq k_{13}^* * m_5^{13}$$
$$m_6^{13} - 3 * m_5^{13} \geq -k_{13}^* * m_5^{13}$$
$$u_6^{13} - 3.5 * l_5^{13} \leq k_{13}^* * l_5^{13}$$
$$u_6^{13} - 3.5 * l_5^{13} \geq -k_{13}^* * l_5^{13}$$

$$\left| \frac{(l_5^{13}, m_5^{13}, u_5^{13})}{(l_4^{13}, m_4^{13}, u_4^{13})} - (\frac{3}{2}, 2, \frac{5}{2}) \right| \leq k_{13}^*$$
$$l_5^{13} - 1.5 * u_4^{13} \leq k_{13}^* * u_4^{13}$$
$$l_5^{13} - 1.5 * u_4^{13} \geq -k_{13}^* * u_4^{13}$$
$$m_5^{13} - 2 * m_4^{13} \leq k_{13}^* * m_4^{13}$$
$$m_5^{13} - 2 * m_4^{13} \geq -k_{13}^* * m_4^{13}$$
$$u_5^{13} - 2.5 * l_4^{13} \leq k_{13}^* * l_4^{13}$$
$$u_5^{13} - 2.5 * l_4^{13} \geq -k_{13}^* * l_4^{13}$$

$$\left| \frac{(l_6^{13}, m_6^{13}, u_6^{13})}{(l_6^{13}, m_6^{13}, u_6^{13})} - (1,1,1) \right| \leq k_{13}^*$$
$$l_6^{13} - 1 * u_6^{13} \leq k_{13}^* * u_6^{13}$$
$$l_6^{13} - 1 * u_6^{13} \geq -k_{13}^* * u_6^{13}$$
$$m_6^{13} - 1 * m_6^{13} \leq k_{13}^* * m_6^{13}$$
$$m_6^{13} - 1 * m_6^{13} \geq -k_{13}^* * m_6^{13}$$
$$u_6^{13} - 1 * l_6^{13} \leq k_{13}^* * l_6^{13}$$
$$u_6^{13} - 1 * l_6^{13} \geq -k_{13}^* * l_6^{13}$$

$$\left| \frac{(l_6^{13}, m_6^{13}, u_6^{13})}{(l_4^{13}, m_4^{13}, u_4^{13})} - (\frac{7}{2}, 4, \frac{9}{2}) \right| \leq k_{13}^*$$
$$l_6^{13} - 3.5 * u_4^{13} \leq k_{13}^* * u_4^{13}$$
$$l_6^{13} - 3.5 * u_4^{13} \geq -k_{13}^* * u_4^{13}$$
$$m_6^{13} - 4 * m_4^{13} \leq k_{13}^* * m_4^{13}$$
$$m_6^{13} - 4 * m_4^{13} \geq -k_{13}^* * m_4^{13}$$
$$u_6^{13} - 4.5 * l_4^{13} \leq k_{13}^* * l_4^{13}$$
$$u_6^{13} - 4.5 * l_4^{13} \geq -k_{13}^* * l_4^{13}$$

$$0.17 * l_1^1 + 0.67 * m_1^1 + 0.17 * u_1^1 + 0.17 * l_2^1 + 0.67 * m_2^1 + 0.17 * u_2^1 + 0.17 * l_3^1 + 0.67 * m_3^1 + 0.17 * u_3^1 + 0.17 + 0.17 * l_4^1 + 0.67 * m_4^1$$
$$+0.1 * u_4^1 + 0.17 * l_5^1 + 0.67 * m_5^1 + 0.17 * u_5^1 + 0.17 * l_6^1 + 0.67 * m_6^1 * u_6^1 = 1$$

$$0.17 * l_1^2 + 0.67 * m_1^2 + 0.17 * u_1^2 + 0.17 * l_2^2 + 0.67 * m_2^2 + 0.17 * u_2^2 + 0.17 * l_3^2 + 0.67 * m_3^2 + 0.17 * u_3^2 + 0.17 * l_4^2 + 0.67 * m_4^2 + 0.17$$
$$*u_4^2 + 0.17 * l_5^2 + 0.67 * m_5^2 + 0.17 * u_5^2 + 0.17 * l_6^2 + 0.67 * m_6^2 + 0.17 * u_6^2 = 1$$

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$$0.17 * l_1^3 + 0.67 * m_1^3 + 0.17 * u_1^3 + 0.17 * l_2^3 + 0.67 * m_2^3 + 0.17 * u_2^3 + 0.17 * l_3^3 + 0.67 * m_3^3 + 0.17 * u_3^3 + 0.17 * l_4^3 + 0.67 * m_4^3 + 0.17 * u_4^3 + 0.17 * l_5^3 + 0.67 * m_5^3 + 0.17 * u_5^3 + 0.17 * l_6^3 + 0.67 * m_6^3 + 0.17 * u_6^3 = 1$$

$$0.17 * l_1^4 + 0.67 * m_1^4 + 0.17 * u_1^4 + 0.17 * l_2^4 + 0.67 * m_2^4 + 0.17 * u_2^4 + 0.17 * l_3^4 + 0.67 * m_3^4 + 0.17 * u_3^4 + 0.17 * l_4^4 + 0.67 * m_4^4 + 0.17 * u_4^4 + 0.17 * l_5^4 + 0.67 * m_5^4 + 0.17 * u_5^4 + 0.17 * l_6^4 + 0.67 * m_6^4 + 0.17 * u_6^4 = 1$$

$$0.17 * l_1^5 + 0.67 * m_1^5 + 0.17 * u_1^5 + 0.17 * l_2^5 + 0.67 * m_2^5 + 0.17 * u_2^5 + 0.17 * l_3^5 + 0.67 * m_3^5 + 0.17 * u_3^5 + 0.17 * l_4^5 + 0.67 * m_4^5 + 0.17 u_4^5 + 0.17 * l_5^5 + 0.67 * m_5^5 + 0.17 * u_5^5 + 0.17 * l_6^5 + 0.67 * m_6^5 + 0.17 * u_6^5 = 1$$

$$0.17 * l_1^6 + 0.67 * m_1^6 + 0.17 * u_1^6 + 0.17 * l_2^6 + 0.67 * m_2^6 + 0.17 * u_2^6 + 0.17 * l_3^6 + 0.67 * m_3^6 + 0.17 * u_3^6 + 0.17 * l_4^6 + 0.67 * m_4^6 + 0.17 * u_4^6 + 0.17 * l_5^6 + 0.67 * m_5^6 + 0.17 * u_5^6 + 0.17 * l_6^6 + 0.67 * m_6^6 + 0.17 * u_6^6 = 1$$

$$0.17 * l_1^7 + 0.67 * m_1^7 + 0.17 * u_1^7 + 0.17 * l_2^7 + 0.67 * m_2^7 + 0.17 * u_2^7 + 0.17 * l_3^7 + 0.67 * m_3^7 + 0.17 * u_3^7 + 0.17 * l_4^7 + 0.67 * m_4^7 + 0.17 * u_4^7 + 0.17 * l_5^7 + 0.67 * m_5^7 + 0.17 * u_5^7 + 0.17 * l_6^7 + 0.67 * m_6^7 + 0.17 * u_6^7 = 1$$

$$0.17 * l_1^8 + 0.67 * m_1^8 + 0.17 * u_1^8 + 0.17 * l_2^8 + 0.67 * m_2^8 + 0.17 * u_2^8 + 0.17 * l_3^8 + 0.67 * m_3^8 + 0.17 * u_3^8 + 0.17 * l_4^8 + 0.67 * m_4^8 + 0.17 * u_4^8 + 0.17 * l_5^8 + 0.67 * m_5^8 + 0.17 * u_5^8 + 0.17 * l_6^8 + 0.67 * m_6^8 + 0.17 * u_6^8 = 1$$

$$0.17 * l_1^9 + 0.67 * m_1^9 + 0.17 * u_1^8 + 0.17 * l_2^8 + 0.67 * m_2^8 + 0.17 * u_2^8 + 0.17 * l_3^8 + 0.67 * m_3^8 + 0.17 * u_3^8 + 0.17 * l_4^8 + 0.67 * m_4^8 + 0.1 * u_4^8 + 0.17 * l_5^8 + 0.67 * m_5^8 + 0.17 * u_5^8 + 0.17 * l_6^8 + 0.67 * m_6^8 + 0.17 * u_6^8 = 1$$

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$$0.17 * l_1^{10} + 0.67 * m_1^{10} + 0.17 * u_1^{10} + 0.17 * l_2^{10} + 0.67 * m_2^{10} + 0.17 * u_2^{10} + 0.17 * l_3^{10} + 0.67 * m_3^{10} + 0.17 * u_3^{10} + 0.17 * l_4^{10} + 0.67 * m_4^{10} + 0.17 * u_4^{10} + 0.17 * l_5^{10} + 0.67 * m_5^{10} + 0.17 * u_5^{10} + 0.17 * l_6^{10} + 0.67 * m_6^{10} + 0.17 * u_6^{10} = 1$$

$$0.17 * l_1^{11} + 0.67 * m_1^{11} + 0.17 * u_1^{11} + 0.17 * l_2^{11} + 0.67 * m_2^{11} + 0.17 * u_2^{11} + 0.17 * l_3^{11} + 0.67 * m_3^{11} + 0.17 * u_3^{11} + 0.17 * l_4^{11} + 0.67 * m_4^{11} + 0.17 * u_4^{11} + 0.17 * l_5^{11} + 0.67 * m_5^{11} + 0.17 * u_5^{11} + 0.17 * l_6^{11} + 0.67 * m_6^{11} + 0.17 * u_6^{11} = 1$$

$$0.17 * l_1^{12} + 0.67 * m_1^{12} + 0.17 * u_1^{12} + 0.17 * l_2^{12} + 0.67 * m_2^{12} + 0.17 * u_2^{12} + 0.17 * l_3^{12} + 0.67 * m_3^{12} + 0.17 * u_3^{12} + 0.17 * l_4^{12} + 0.67 * m_4^{12} + 0.17 * u_4^{12} + 0.17 * l_5^{12} + 0.67 * m_5^{12} + 0.17 * u_5^{12} + 0.17 * l_6^{12} + 0.67 * m_6^{12} + 0.17 * u_6^{12} = 1$$

$$0.17 * l_1^{13} + 0.67 * m_1^{13} + 0.17 * u_1^{13} + 0.17 * l_2^{13} + 0.67 * m_2^{13} + 0.17 * u_2^{13} + 0.17 * l_3^{13} + 0.67 * m_3^{13} + 0.17 * u_3^{13} + 0.17 * l_4^{13} + 0.67 * m_4^{13} + 0.17 * u_4^{13} + 0.17 * l_5^{13} + 0.67 * m_5^{13} + 0.17 * u_5^{13} + 0.17 * l_6^{13} + 0.67 * m_6^{13} + 0.17 * u_6^{13} = 1$$

$l_1^1 \le m_1^1 \le u_1^1$	$l_2^1 \le m_2^1 \le u_2^1$	$l_3^1 \le m_3^1 \le u_3^1$	$l_4^1 \le m_4^1 \le u_4^1$	$l_5^1 \le m_5^1 \le u_5^1$	$l_6^1 \le m_6^1 \le u_6^1$
$l_1^2 \le m_1^2 \le u_1^2$	$l_2^2 \le m_2^2 \le u_2^2$	$l_3^2 \le m_3^2 \le u_3^2$	$l_4^2 \le m_4^2 \le u_4^2$	$l_5^2 \le m_5^2 \le u_5^2$	$l_6^2 \le m_6^2 \le u_6^2$
$l_1^3 \le m_1^3 \le u_1^3$	$l_2^3 \le m_2^3 \le u_2^3$	$l_3^3 \le m_3^3 \le u_3^3$	$l_4^3 \le m_4^3 \le u_4^3$	$l_5^3 \le m_5^3 \le u_5^3$	$l_6^3 \le m_6^3 \le u_6^3$
$l_1^4 \le m_1^4 \le u_1^4$	$l_2^4 \le m_2^4 \le u_2^4$	$l_3^4 \le m_3^4 \le u_3^4$	$l_4^4 \le m_4^4 \le u_4^4$	$l_5^4 \le m_5^4 \le u_5^4$	$l_6^4 \le m_6^4 \le u_6^4$
$l_1^5 \le m_1^5 \le u_1^5$	$l_2^5 \le m_2^5 \le u_2^5$	$l_3^5 \le m_3^5 \le u_3^5$	$l_4^5 \le m_4^5 \le u_4^5$	$l_5^5 \le m_5^5 \le u_5^5$	$l_6^5 \le m_6^5 \le u_6^5$
$l_1^6 \le m_1^6 \le u_1^6$	$l_2^6 \le m_2^6 \le u_2^6$	$l_3^6 \le m_3^6 \le u_3^6$	$l_4^6 \le m_4^6 \le u_4^6$	$l_5^6 \le m_5^6 \le u_5^6$	$l_6^6 \le m_6^6 \le u_6^6$
$l_1^7 \le m_1^7 \le u_1^7$	$l_2^7 \le m_2^7 \le u_2^7$	$l_3^7 \le m_3^7 \le u_3^7$	$l_4^7 \le m_4^7 \le u_4^7$	$l_5^7 \le m_5^7 \le u_5^7$	$l_6^7 \le m_6^7 \le u_6^7$
$l_1^8 \le m_1^8 \le u_1^8$	$l_2^8 \le m_2^8 \le u_2^8$	$l_3^8 \le m_3^8 \le u_3^8$	$l_4^8 \le m_4^8 \le u_4^8$	$l_5^8 \le m_5^8 \le u_5^8$	$l_6^8 \le m_6^8 \le u_6^8$
$l_1^9 \le m_1^9 \le u_1^9$	$l_2^9 \le m_2^9 \le u_2^9$	$l_3^9 \le m_3^9 \le u_3^9$	$l_4^9 \le m_4^9 \le u_4^9$	$l_5^9 \le m_5^9 \le u_5^9$	$l_6^9 \le m_6^9 \le u_6^9$

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$l_1^{10} \le m_1^{10} \le u_1^{10}$ $l_2^{10} \le m_2^{10} \le u_2^{10}$ $l_3^{10} \le m_3^{10} \le u_3^{10}$ $l_4^{10} \le m_4^{10} \le u_4^{10}$ $l_5^{10} \le m_5^{10} \le u_5^{10}$ $l_6^{10} \le m_6^{10} \le u_6^{10}$
$l_1^{11} \le m_1^{11} \le u_1^{11}$ $l_2^{11} \le m_2^{11} \le u_2^{11}$ $l_3^{11} \le m_3^{11} \le u_3^{11}$ $l_4^{11} \le m_4^{11} \le u_4^{11}$ $l_5^{11} \le m_5^{11} \le u_5^{11}$ $l_6^{11} \le m_6^{11} \le u_6^{11}$
$l_1^{12} \le m_1^{12} \le u_1^{12}$ $l_2^{12} \le m_2^{12} \le u_2^{12}$ $l_3^{12} \le m_3^{12} \le u_3^{12}$ $l_4^{12} \le m_4^{12} \le u_4^{12}$ $l_5^{12} \le m_5^{12} \le u_5^{12}$ $l_6^{12} \le m_6^{12} \le u_6^{12}$
$l_1^{13} \le m_1^{13} \le u_1^{13}$ $l_2^{13} \le m_2^{13} \le u_2^{13}$ $l_3^{13} \le m_3^{13} \le u_3^{13}$ $l_4^{13} \le m_4^{13} \le u_4^{13}$ $l_5^{13} \le m_5^{13} \le u_5^{13}$ $l_6^{13} \le m_6^{13} \le u_6^{13}$

$l_1^1, l_1^2, l_1^3, l_1^4, l_1^5, l_1^6, l_1^7, l_1^8, l_1^9, l_1^{10}, l_1^{11}, l_1^{12}, l_1^{13} l_2^1, l_2^2, l_2^3, l_2^4, l_2^5, l_2^6, l_2^7, l_2^8, l_2^9, l_2^{10}, l_2^{11}, l_2^{12}, l_2^{13}, l_3^1, l_3^2, l_3^3, l_3^4, l_3^5, l_3^6, l_3^7, l_3^8, l_3^9, l_3^{10}, l_3^{11}, l_3^{12}, l_3^{13},$

$l_4^1, l_4^2, l_4^3, l_4^4, l_4^5, l_4^6, l_4^7, l_4^8, l_4^9, l_4^{10}, l_4^{11}, l_4^{12}, l_4^{13}, l_5^1, l_5^2, l_5^3, l_5^4, l_5^5, l_5^6, l_5^7, l_5^8, l_5^9, l_5^{10}, l_5^{11}, l_5^{12}, l_5^{13}, l_6^1, l_6^2, l_6^3, l_6^4, l_6^5, l_6^6, l_6^7, l_6^8, l_6^9, l_6^{10}, l_6^{11}, l_6^{12}, l_6^{13} > 0$

$k_1, k_2, k_3, k_4, k_5, k_6, k_7, k_8, k_9, k_{10}, k_{11}, k_{12}, k_{13} \geq 0$

To calculate the aggregated weights (μ_j) for each criterion, the following calculations should be done.

$13 * \tilde{\mu}_1 = 0.17 * l_1^1 + 0.67 * m_1^1 + 0.17 * u_1^1 + 0.17 * l_1^2 + 0.67 * m_1^2 + 0.17 * u_1^2 + 0.17 * l_1^3 + 0.67 * m_1^3 + 0.17 * u_1^3 + 0.17 * l_1^4 + 0.67 * m_1^4 + 0.17 * u_1^4 + 0.17 * l_1^5 + 0.67 * m_1^5 + 0.17 * u_1^5 + 0.17 * l_1^6 + 0.67 * m_1^6 + 0.17 * u_1^6 + 0.17 * l_1^7 + 0.67 * m_1^7 + 0.17 * u_1^7 + 0.17 * l_1^8 + 0.67 * m_1^8 + 0.17 * u_1^8 + 0.17 * l_1^9 + 0.67 * m_1^9 + 0.17 * u_1^9 + 0.17 * l_1^{10} + 0.67 * m_1^{10} + 0.17 * u_1^{10} + 0.17 * l_1^{11} + 0.67 * m_1^{11} + 0.17 * u_1^{11} + +0.17 * l_1^{12} + 0.67 * m_1^{12} + 0.17 * u_1^{12} + 0.17 * l_1^{13} + 0.67 * m_1^{13} + 0.17 * u_1^{13}$

$13 * \tilde{\mu}_2 = 0.17 * l_2^1 + 0.67 * m_2^1 + 0.17 * u_2^1 + 0.17 * l_2^2 + 0.67 * m_2^2 + 0.17 * u_2^2 + 0.17 * l_2^3 + 0.67 * m_2^3 + 0.17 * u_2^3 + 0.17 * l_2^4 + 0.67 * m_2^4 + 0.17 * u_2^4 + 0.17 * l_2^5 + 0.67 * m_2^5 + 0.17 * u_2^5 + 0.17 * l_2^6 + 0.67 * m_2^6 + 0.17 * u_2^6 + 0.17 * l_2^7 + 0.67 * m_2^7 + 0.17 * u_2^7 + 0.17 * l_2^8 + 0.67 * m_2^8 + 0.17 * u_2^8 + 0.17 * l_2^9 + 0.67 * m_2^9 + 0.17 * u_2^9 + 0.17 * l_2^{10} + 0.67 * m_2^{10} + 0.17 * u_2^{10} + 0.17 * l_2^{11} + 0.67 * m_2^{11} + 0.17 * u_2^{11} + + 0.17 * l_2^{12} + 0.67 * m_2^{12} + 0.17 * u_2^{12} + 0.17 * l_2^{13} + 0.67 * m_2^{13} + 0.17 * u_2^{13}$

$13 * \tilde{\mu}_3 = 0.17 * l_3^1 + 0.67 * m_3^1 + 0.17 * u_3^1 + 0.17 * l_3^2 + 0.67 * m_3^2 + 0.17 * u_3^2 + 0.17 * l_3^3 + 0.67 * m_3^3 + 0.17 * u_3^3 + 0.17 * l_3^4 + 0.67 * m_3^4 + 0.17 * u_3^4 + 0.17 * l_3^5 + 0.67 * m_3^5 + 0.17 * u_3^5 + 0.17 * l_3^6 + 0.67 * m_3^6 + 0.17 * u_3^6 + 0.17 * l_3^7 + 0.67 * m_3^7 + 0.17 * u_3^7 + 0.17 * l_3^8 + 0.67 * m_3^8 + 0.17 * u_3^8 + 0.17 * l_3^9 + 0.67 * m_3^9 + 0.17 * u_3^9 + 0.17 * l_3^{10} + 0.67 * m_3^{10} + 0.17 * u_3^{10} + 0.17 * l_3^{11} + 0.67 * m_3^{11} + 0.17 * u_3^{11} + 0.17 * l_3^{12} + 0.67 * m_3^{12} + 0.17 * u_3^{12} + 0.17 * l_3^{13} + 0.67 * m_3^{13} + 0.17 * u_3^{13}$

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$$13 * \tilde{\mu}_4 = 0.17 * l_4^1 + 0.67 * m_4^1 + 0.17 * u_4^1 + 0.17 * l_4^2 + 0.67 * m_4^2 + 0.17 * u_4^2 + 0.17 * l_4^3 + 0.67 * m_4^3 + 0.17 * u_4^3 + 0.17 * l_4^4 + 0.67 * m_4^4 + 0.17 * u_4^4 + 0.17 * l_4^5 + 0.67 * m_4^5 + 0.17 * u_4^5 + 0.17 * l_4^6 + 0.67 * m_4^6 + 0.17 * u_4^6 + 0.17 * l_4^7 + 0.67 * m_4^7 + 0.17 * u_4^7 + 0.17 * l_4^8 + 0.67 * m_4^8 + 0.17 * u_4^8 + 0.17 * l_4^9 + 0.67 * m_4^9 + 0.17 * u_4^9 + 0.17 * l_4^{10} + 0.67 * m_4^{10} + 0.17 * u_4^{10} + 0.17 * l_4^{11} + 0.67 * m_4^{11} + 0.17 * u_4^{11} + 0.17 * l_4^{12} + 0.67 * m_4^{12} + 0.17 * u_4^{12} + 0.17 * l_4^{13} + 0.67 * m_4^{13} + 0.17 * u_4^{13}$$

$$13 * \tilde{\mu}_5 = 0.17 * l_5^1 + 0.67 * m_5^1 + 0.17 * u_5^1 + 0.17 * l_5^2 + 0.67 * m_5^2 + 0.17 * u_5^2 + 0.17 * l_5^3 + 0.67 * m_5^3 + 0.17 * u_5^3 + 0.17 * l_5^4 + 0.67 * m_5^4 + 0.17 * u_5^4 + 0.17 * l_5^5 + 0.67 * m_5^5 + 0.17 * u_5^5 + 0.17 * l_5^6 + 0.67 * m_5^6 + 0.17 * u_5^6 + 0.17 * l_5^7 + 0.67 * m_5^7 + 0.17 * u_5^7 + 0.17 * l_5^8 + 0.67 * m_5^8 + 0.17 * u_5^8 + 0.17 * l_5^9 + 0.67 * m_5^9 + 0.17 * u_5^9 + 0.17 * l_5^{10} + 0.67 * m_5^{10} + 0.17 * u_5^{10} + 0.17 * l_5^{11} + 0.67 * m_5^{11} + 0.17 * u_5^{11} + 0.17 * l_5^{12} + 0.67 * m_5^{12} + 0.17 * u_5^{12} + 0.17 * l_5^{13} + 0.67 * m_5^{13} + 0.17 * u_5^{13}$$

$$13 * \tilde{\mu}_6 = 0.17 * l_6^1 + 0.67 * m_6^1 + 0.17 * u_6^1 + 0.17 * l_6^2 + 0.67 * m_6^2 + 0.17 * u_6^2 + 0.17 * l_6^3 + 0.67 * m_6^3 + 0.17 * u_6^3 + 0.17 * l_6^4 + 0.67 * m_6^4 + 0.17 * u_6^4 + 0.17 * l_6^5 + 0.67 * m_6^5 + 0.17 * u_6^5 + 0.17 * l_6^6 + 0.67 * m_6^6 + 0.17 * u_6^6 + 0.17 * l_6^7 + 0.67 * m_6^7 + 0.17 * u_6^7 + 0.17 * l_6^8 + 0.67 * m_6^8 + 0.17 * u_6^8 + 0.17 * l_6^9 + 0.67 * m_6^9 + 0.17 * u_6^9 + 0.17 * l_6^{10} + 0.67 * m_6^{10} + 0.17 * u_6^{10} + 0.17 * l_6^{11} + 0.67 * m_6^{11} + 0.17 * u_6^{11} + 0.17 * l_6^{12} + 0.67 * m_6^{12} + 0.17 * u_6^{12} + 0.17 * l_6^{13} + 0.67 * m_6^{13} + 0.17 * u_6^{13}$$

Input: enter the data in the Lingo 18.0 software

```
min=k1+k2+k3+k4+k5+k6+k7+k8+k9+k10+k11+k12+k13;

l12-(2.5*u11)<=k1*u11;
l12-(2.5*u11)>=-k1*u11;
m12*(3*m11)<=k1*m11;
m12*(3*m11)>=-k1*m11;
u12-(3.5*l11)<=k1*l11;
u12-(3.5*l11)>=-k1*l11;

l11-(1.5*u12)<=k1*u15;
l11-(1.5*u12)>=-k1*u15;
m11-(2*m15)<=k1*m15;
m11-(2*m15)>=-k1*m15;
u11-(2.5*l15)<=k1*l15;
u11-(2.5*l15)>=-k1*l15;

l12-(1*u12)<=k1*u12;
l12-(1*u12)>=-k1*u12;
m12-(1*m12)<=k1*m12;
m12-(1*m12)>=-k1*m12;
u12-(1*l12)<=k1*l12;
u12-(1*l12)>=-k1*l12;

l12-(3.5*u15)<=k1*u15;
l12-(3.5*u15)>=-k1*u15;
m12-(4*m15)<=k1*m15;
m12-(4*m15)>=-k1*m15;
u12-(4.5*l15)<=k1*l15;
u12-(4.5*l15)>=-k1*l15;

l16-(1.5*u15)<=k1*u15;
l16-(1.5*u15)>=-k1*u15;
m16-(2*m15)<=k1*m15;
m16-(2*m15)>=-k1*m15;
u16-(2.5*l15)<=k1*l15;
u16-(2.5*l15)>=-k1*l15;

l23-(1.5*u21)<=k2*u21;
l23-(1.5*u21)>=-k2*u21;
m23-(2*m12)<=k2*m21;
m23-(2*m12)>=-k2*m21;
u23-(2.5*l21)<=k2*l21;
u23-(2.5*l21)>=-k2*l21;

l21-(2.5*u21)<=k2*u26;
l21-(2.5*u21)>=-k2*u26;
m12-(3*m26)<=k2*m26;
m12-(3*m26)>=-k2*m26;
u21-(3.5*l26)<=k2*l26;
u21-(3.5*l26)>=-k2*l26;

l23-(1*u22)<=k2*u22;
l23-(1*u22)>=-k2*u22;
m23-(3*m22)<=k2*m22;
m23-(3*m22)>=-k2*m22;
u23-(3.5*l22)<=k2*l22;
u23-(3.5*l22)>=-k2*l22;
```

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```
l12-(1*u13)<=k1*u13;
l12-(1*u13)>=-k1*u13;
m12-(1*m13)<=k1*m13;
m12-(1*m13)>=-k1*m13;
u12-(1*l13)<=k1*l13;
u12-(1*l13)>=-k1*l13;

l13-(3.5*u15)<=k1*u15;
l13-(3.5*u15)>=-k1*u15;
m13-(4*m15)<=k1*m15;
m13-(4*m15)>=-k1*m15;
u13-(4.5*l15)<=k1*l15;
u13-(4.5*l15)>=-k1*l15;

l12-(1.5*u14)<=k1*u14;
l12-(1.5*u14)>=-k1*u14;
m12-(2*m14)<=k1*m14;
m12-(2*m14)>=-k1*m14;
u12-(2.5*l14)<=k1*l14;
u12-(2.5*l14)>=-k1*l14;

l14-(1.5*u15)<=k1*u15;
l14-(1.5*u15)>=-k1*u15;
m14-(2*m15)<=k1-m15;
m14-(2*m15)>=-k1-m15;
u14-(2.5*l15)<=k1*l15;
u14-(2.5*l15)>=-k1*l15;

l12-(2.5*u15)<=k1*u15;
l12-(2.5*u15)>=-k1*u15;
m12-(3*m15)<=k1*m15;
m12-(3*m15)>=-k1*m15;
u12-(3.5*l15)<=k1*l15;
u12-(3.5*l15)>=-k1*l15;

l15-(1*u15)<=k1*u15;
l15-(1*u15)>=-k1*u15;
m15-(1*m15)<=k1*m15;
m15-(1*m15)>=-k1*m15;
u15-(1*l15)<=k1*l15;
u15-(1*l15)>=-k1*l15;

l12-(2.5*u16)<=k1*u16;
l12-(2.5*u16)>=-k1*u16;
m12-(3*m16)<=k1*m16;
m12-(3*m16)>=-k1*m16;
u12-(3.5*l16)<=k1*l16;
u12-(3.5*l16)>=-k1*l16;
```

```
l22-(1.5*u26)<=k2*u26;
l22-(1.5*u26)>=-k2*u26;
m22-(2*m26)<=k2*m26;
m22-(2*m26)>=-k2*m26;
u22-(2.5*l26)<=k2*l26;
u22-(2.5*l26)>=-k2*l26;

l23-(1*u23)<=k2*u23;
l23-(1*u23)>=-k2*u23;
m23-(1*m23)<=k2*m23;
m23-(1*m23)>=-k2*m23;
u23-(1*l23)<=k2*l23;
u23-(1*l23)>=-k2*l23;

l23-(3.5*u26)<=k2*u26;
l23-(3.5*u26)>=-k2*u26;
m23-(3*m26)<=k2*m26;
m23-(3*m26)>=-k2*m26;
u23-(4.5*l26)<=k2*l26;
u23-(4.5*l26)>=-k2*l26;

l23-(2.5*u24)<=k2*u24;
l23-(2.5*u24)>=-k2*u24;
m23-(3*m24)<=k2*m24;
m23-(3*m24)>=-k2*m24;
u23-(3.5*l24)<=k2*l24;
u23-(3.5*l24)>=-k2*l24;

l24-(1.5*u26)<=k2*u26;
l24-(1.5*u26)>=-k2*u26;
m24-(2*m26)<=k2*m26;
m24-(2*m26)>=-k2*m26;
u24-(2.5*l26)<=k2*u26;
u24-(2.5*l26)>=-k2*u26;

l23-(1.5*u25)<=k2*u25;
l23-(1.5*u25)>=-k2*u25;
m23-(2*m25)<=k2*m25;
m23-(2*m25)>=-k2*m25;
u23-(2.5*l25)<=k2*l25;
u23-(2.5*l25)>=-k2*l25;

l25-(1.5*u26)<=k2*u26;
l25-(1.5*u26)>=-k2*u26;
m25-(2*m26)<=k2*m26;
m25-(2*m26)>=-k2*m26;
u25-(2.5*l26)<=k2*l26;
u25-(2.5*l26)>=-k2*l26;
```

```
l23-(3.5*u26)<=k2*u26;
l23-(3.5*u26)>=-k2*u26;
m23-(4*m26)<=k2*m26;
m23-(4*m26)>=-k2*m26;
u23-(4.5*l26)<=k2*l26;
u23-(4.5*l26)>=-k2*l26;

l26-(1*u26)<=k2*u26;
l26-(1*u26)>=-k2*u26;
m26-(1*m26)<=k2*m26;
m26-(1*m26)>=-k2*m26;
u26-(1*l26)<=k2*l26;
u26-(1*l26)>=-k2*l26;

l31-(1*u31)<=k3*u31;
l31-(1*u31)>=-k3*u31;
m31-(1*m31)<=k3*m31;
m31-(1*m31)>=-k3*m31;
u31-(1*l31)<=k3*l31;
u31-(1*l31)>=-k3*l31;

l31-(2.5*u34)<=k3*u34;
l31-(2.5*u34)>=-k3*u34;
m31-(3*m34)<=k3*m34;
m31-(3*m34)>=-k3*m34;
u31-(3.5*l34)<=k3*l34;
u31-(3.5*l34)>=-k3*l34;

l31-(1*u32)<=k3*u32;
l31-(1*u32)>=-k3*u32;
m31-(2*m32)<=k3*l32;
m31-(2*m32)>=-k3*l32;
u31-(2.5*l32)<=k3*l32;
u31-(2.5*l32)>=-k3*l32;

l32-(1*u34)<=k3*u34;
l32-(1*u34)>=-k3*u34;
m32-(1*m34)<=k3*m34;
```

```
l35-(0.67*u34)<=k3*u34;
l35-(0.67*u34)>=-k3*u34;
m35-(1*m34)<=k3*m34;
m35-(1*m34)>=-k3*m34;
u35-(1.5*l34)<=k3*l34;
u35-(1.5*l34)>=-k3*l34;

l31-(1*u36)<=k3*u36;
l31-(1*u36)>=-k3*u36;
m31-(1*m36)<=k3*m36;
m31-(1*m36)>=-k3*m36;
u31-(1*l36)<=k3*l36;
u31-(1*l36)>=-k3*l36;

l36-(1.5*u34)<=k3*u34;
l36-(1.5*u34)>=-k3*u34;
m36-(2*m34)<=k3*m34;
m36-(2*m34)>=-k3*m34;
u36-(2.5*l34)<=k3*l34;
u36-(2.5*l34)>=-k3*l34;

l41-(1*u41)<=k4*u41;
l41-(1*u41)>=-k4*u41;
m41-(1*m41)<=k4*m41;
m41-(1*m41)>=-k4*m41;
u41-(1*l41)<=k4*l41;
u41-(1*l41)>=-k4*l41;

l41-(3.5*u42)<=k4*u42;
l41-(3.5*u42)>=-k4*u42;
m41-(4*m42)<=k4*m42;
m41-(4*m42)>=-k4*m42;
u41-(4.5*l42)<=k4*l42;
u41-(4.5*l42)>=-k4*l42;

l41-(3.5*u42)<=k4*u42;
l41-(3.5*u42)>=k4*u42;
m41-(4*m42)<=k4*m42;
```

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```
m32-(1*m34)>=-k3*m34;
u32-(1*l34)<=k3*l34;
u32-(1*l34)>=-k3*l34;

l31-(1.5*u33)<=k3*u33;
l31-(1.5*u33)>=-k3*u33;
m31-(1.5*m33)<=k3*m33;
m31-(1.5*m33)>=-k3*m33;
u31-(2.5*l33)<=k3*l33;
u31-(2.5*l33)>=-k3*l33;

l33-(1*u34)<=k3*u34;
l33-(1*u34)>=-k3*u34;
m33-(1*m34)<=k3*m34;
m33-(1*m34)>=-k3*m34;
u33-(1*l34)<=k3*l34;
u33-(1*l34)>=-k3*l34;

l31-(1.5*u34)<=k3*u34;
l31-(1.5*u34)>=-k3*u34;
m31-(2*m34)<=k3*m34;
m31-(2*m34)>=-k3*m34;
u31-(2.5*l34)<=k3*l34;
u31-(2.5*l34)>=-k3*l34;

l34-(1*u34)<=k3*u34;
l34-(1*u34)>=-k3*u34;
m34-(1*m34)<=k3*m34;
m34-(1*m34)>=-k3*m34;
u34-(1*l34)<=k3*l34;
u34-(1*l34)>=-k3*l34;

l31-(2.5*u35)<=k3*u35;
l31-(2.5*u35)>=-k3*u35;
m31-(3*m35)<=k3*m35;
m31-(3*m35)>=-k3*m35;
u31-(3.5*l35)<=k3*l35;
u31-(3.5*l35)>=-k3*l35;


l41-(2.5*u45)<=k4*u45;
l41-(2.5*u45)>=-k4*u45;
m41-(3*m45)<=k4*m45;
m41-(3*m45)>=-k4*m45;
u41-(3.5*l45)<=k4*l45;
u41-(3.5*l45)>=-k4*l45;


l45-(1.5*u42)<=k4*u42;
l45-(1.5*u42)>=-k4*u42;
m45-(2*m42)<=k4*m42;
m45-(2*m42)>=-k4*m42;
u45-(2.5*l42)<=k4*l42;
u45-(2.5*l42)>=-k4*l42;

l41-(1.5*u46)<=k4*u46;
l41-(1.5*u46)>=-k4*u46;
m41-(2*m46)<=k4*m46;
m41-(2*m46)>=-k4*m46;
u41-(2.5*l46)<=k4*l46;
u41-(2.5*l46)>=-k4*l46;

l46-(2.5*u42)<=k4*u42;
l46-(2.5*u42)>=-k4*u42;
m46-(3*m42)<=k4*m42;
m46-(3*m42)>=-k4*m42;
u46-(3.5*l42)<=k4*l42;
u46-(3.5*l42)>=-k4*l42;

l51-(1*u51)<=k5*u51;
l51-(1*u51)>=-k5*u51;
m51-(1*m51)<=k5*m51;
m51-(1*m51)>=-k5*m51;
u51-(1.5*l51)<=k5*l51;
u51-(1.5*l51)>=-k5*l51;

l51-(3.5*u56)<=k5*u56;
l51-(3.5*u56)>=-k5*u56;
m51-(4*m56)<=k5*m56;
m51-(4*m56)>=-k5*m56;
u51-(4.5*l56)<=k5*l56;
u51-(4.5*l56)>=-k5*l56;

l51-(1.5*u52)<=k5*u52;
l51-(1.5*u52)>=-k5*u52;
m51-(2*m52)<=k5*m52;
m51-(2*m52)>=-k5*m52;
u51-(2.5-l52)<=k5*l52;
```

```
m41-(4*m42)>=-k4*m42;
u41-(4.5*l42)<=k4*l42;
u41-(4.5*l42)>=-k4*l42;

l42-(1*u42)<=k4*u42;
l42-(1*u42)>=-k4*u42;
m42-(1*m42)<=k4*m42;
m42-(1*m42)>=-k4*m42;
u42-(1*l42)<=k4*l42;
u42-(1*l42)>=-k4*l42;

l41-(1.5*u43)<=k4*u43;
l41-(1.5*u43)>=-k4*u43;
m41-(2*m43)<=k4*m43;
m41-(2*m43)>=-k4*m43;
u41-(2.5*l43)<=k4*l43;
u41-(2.5*l43)>=-k4*l43;

l43-(2.5*u42)<=k4*u42;
l43-(2.5*u42)>=-k4*u42;
m43-(3*m42)<=k4*m42;
m43-(3*m42)>=-k4*m42;
u43-(3.5*l42)<=k4*l42;
u43-(3.5*l42)>=-k4*l42;

l41-(1.5*u44)<=k4*u44;
l41-(1.5*u44)>=-k4*u44;
m41-(2*m44)<=k4*m44;
m41-(2*m44)>=-k4*m44;
u41-(2.5*l44)<=k4*l44;
u41-(2.5*l44)>=-k4*l44;

l44-(2.5*u42)<=k4*u42;
l44-(2.5*u42)>=-k4*u42;
m44-(3*m42)<=k4*m42;
m44-(3*m42)>=-k4*m42;
u44-(3.5*l42)<=k4*l42;
u44-(3.5*l42)>=-k4*l42;


l54-(1.5*u56)<=k5*u56;
l54-(1.5*u56)>=-k5*u56;
m54-(2*m56)<=k5*m56;
m54-(2*m56)>=-k5*m56;
u54-(2.5*l56)<=k5*l56;
u54-(2.5*l56)>=-k5*l56;

l51-(2.5*u55)<=k5*u55;
l51-(2.5*u55)>=-k5*u55;
m51-(3*m55)<=k5*m55;
m51-(3*m55)>=-k5*m55;
u51-(3.5*l55)<=k5*l55;
u51-(3.5*l55)>=-k5*l55;

l55-(1.5*u56)<=k5*u56;
l55-(1.5*u56)>=-k5*u56;
m55-(2*m56)<=k5*m56;
m55-(2*m56)>=-k5*m56;
u55-(2.5*l56)<=k5*l56;
u55-(2.5*l56)>=-k5*l56;

l51-(3.5*u56)<=k5*u56;
l51-(3.5*u56)>=-k5*u56;
m51-(4*m56)<=k5*m56;
m51-(4*m56)>=-k5*m56;
u51-(4.5*l56)<=k5*l56;
u51-(4.5*l56)>=-k5*l56;

l56-(1*u56)<=k5*u56;
l56-(1*u56)>=-k5*u56;
m56-(1*m56)<=k5*m56;
m56-(1*m56)>=-k5*m56;
u56-(1*l56)<=k5*l56;
u56-(1*l56)>=-k5*l56;

l66-(1.5*u61)<=k6*u62;
l66-(1.5*u61)>=-k6*u62;
m66-(2*m61)<=k6*m61;
m66-(2*m61)>=-k6*m61;
u66-(2.5*l61)<=k6*l61;
u66-(2.5*l61)>=-k6*l61;

l61-(2.5*u63)<=k6*u63;
l61-(2.5*u63)>=-k6*u63;
m61-(3*m63)<=k6*m63;
m61-(3*m63)>=-k6*m63;
u61-(3.5*l63)<=k6*l63;
u61-(3.5*l63)>=-k6*l63;
```

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```
u51-(2.5-l52)>=-k5*l52;

l52-(1.5*u56)<=k5*u56;
l52-(1.5*u56)>=-k5*u56;
m52-(2*m56)<=k5*m56;
m52-(2*m56)>=-k5*m56;
u52-(2.5*l56)<=k5*u56;
u52-(2.5*l56)>=-k5*u56;

l51-(1.5*u53)<=k5*u53;
l51-(1.5*u53)>=-k5*u53;
m15-(2*m53)<=k5*m53;
m15-(2*m53)>=-k5*m53;
u51-(2.5*l53)<=k5*l53;
u51-(2.5*l53)>=-k5*l53;

l53-(1.5*u56)<=k5*u56;
l53-(1.5*u56)>=-k5*u56;
m53-(2*m56)<=k5*m56;
m53-(2*m56)>=-k5*m56;
u53-(2.5*l56)<=k5*l56;
u53-(2.5*l56)>=-k5*l56;

l51-(2.5*u54)<=k5*u54;
l51-(2.5*u54)>=-k5*u54;
m51-(3*m54)<=k5*m54;
m51-(3*m54)>=-k5*m54;
u51-(3.5*l54)<=k5*l54;
u51-(3.5*l54)>=-k5*l54;

l66-(1*u64)<=k6*u64;
l66-(1*u64)>=-k6*u64;
m66-(1*m64)<=k6*m64;
m66-(1*m64)>=-k6*m64;
u66-(1*l64)<=k6*l64;
u66-(1*l64)>=-k6*l64;

l64-(1.5*u63)<=k6*u63;
l64-(1.5*u63)>=-k6*u63;
m64-(2*m63)<=k6*m63;
m64-(2*m63)>=-k6*m63;
u64-(2.5*l63)<=k6*l63;
u64-(2.5*l63)>=-k6*l63;

l66-(1.5*u65)<=k6*u65;
l66-(1.5*u65)>=-k6*u65;
m66-(2*m65)<=k6*m65;
m66-(2*m65)>=-k6*m65;
u66-(2.5*l65)<=k6*l65;
u66-(2.5*l65)>=-k6*l65;

l65-(1.5*u63)<=k6*u63;
l65-(1.5*u63)>=-k6*u63;
m65-(2*m63)<=k6*m63;
m65-(2*m63)>=-k6*m63;
u65-(2.5*l63)<=k6*l63;
u65-(2.5*l63)>=-k6*l63;

l66-(1*u66)<=k6*u66;
l66-(1*u66)>=-k6*u66;
m66-(1*m66)<=k6*m66;
m66-(1*m66)>=-k6*m66;
u66-(1*l66)<=k6*l66;
u66-(1*l66)>=-k6*l66;

l66-(3.5*u63)<=k6*u63;
l66-(3.5*u63)>=-k6*u63;
m66-(4*m63)<=k6*m63;
m66-(4*m63)>=-k6*m63;
u66-(4.5*l63)<=k6*u63;
u66-(4.5*l63)>=-k6*u63;

l75-(1*u71)<=k7*u71;
l75-(1*u71)>=-k7*u71;
m75-(1*m71)<=k7*u71;
m75-(1*m71)>=-k7*u71;
u75-(1*l71)<=k7*l71;
u75-(1*l71)>=-k7*l71;

l71-(1.5*u76)<=k7*u76;
l71-(1.5*u76)>=-k7*u76;
m71-(2*m76)<=k7*m76;
m71-(2*m76)>=-k7*m76;
u71-(2.5*l76)<=k7*l76;
u71-(2.5*l76)>=-k7*l76;

l75-(0.67*u72)<=k7*u72;
l75-(0.67*u72)>=-k7*u72;

l66-(1.5*u62)<=k6*u62;
l66-(1.5*u62)>=-k6*u62;
m66-(2*m62)<=k6*m62;
m66-(2*m62)>=-k6*m62;
u66-(2.5*l62)<=k6*l62;
u66-(2.5*l62)>=-k6*l62;

l62-(2.5*u63)<=k6*u63;
l62-(2.5*u63)>=-k6*u63;
m62-(3*m63)<=k6*m63;
m62-(3*m63)>=-k6*m63;
u62-(3.5*l63)<=k6*l63;
u62-(3.5*l63)>=-k6*l63;

l66-(2.5*u63)<=k6*u63;
l66-(2.5*u63)>=-k6*u63;
m66-(3*m63)<=k6*m63;
m66-(3*m63)>=-k6*m63;
u66-(3.5*l63)<=k6*l63;
u66-(3.5*l63)>=-k6*l63;

l63-(1*u63)<=k6*u63;
l63-(1*u63)>=-k6*u63;
m63-(1*m63)<=k6*m63;
m63-(1*m63)>=-k6*m63;
u63-(1*l63)<=k6*l63;
u63-(1*l63)>=-k6*l63;

l73-(1*u76)<=k7*u76;
l73-(1*u76)>=-k7*u76;
m73-(1*m76)<=k7*m76;
m73-(1*m76)>=-k7*m76;
u73-(1*l76)<=k7*l76;
u73-(1*l76)>=-k7*l76;

l75-(2.5*u74)<=k7*u74;
l75-(2.5*u74)>=-k7*u74;
m75-(3*m74)<=k7*m74;
m75-(3*m74)>=-k7*m74;
u75-(3.5*l74)<=k7*l74;
u75-(3.5*l74)>=-k7*l74;

l74-(1*u76)<=k7*u76;
l74-(1*u76)>=-k7*u76;
m74-(1*m76)<=k7*m76;
m74-(1*m76)>=-k7*m76;
u74-(1*l76)<=k7*l76;
u74-(1*l76)>=-k7*l76;

l75-(1*u75)<=k7*u75;
l75-(1*u75)>=-k7*u75;
m75-(1*m75)<=k7*m75;
m75-(1*m75)<=k7*m75;
u75-(1*l75)<=k7*l75;
u75-(1*l75)>=-k7*l75;

l75-(2.5*u76)<=k7*u76;
l75-(2.5*u76)>=-k7*u76;
m75-(3*m76)<=k7*m76;
m75-(3*m76)>=-k7*m76;
u75-(3.5*l76)<=k7*l76;
u75-(3.5*l76)>=-k7*l76;

l75-(2.5*u76)<=k7*u76;
l75-(2.5*u76)>=-k7*u76;
m75-(3*m76)<=k7*m76;
m75-(3*m76)>=-k7*m76;
u75-(3.5*l76)<=k7*l76;
u75-(3.5*l76)>=-k7*l76;

l76-(1*u76)<=k7*u76;
l76-(1*u76)>=-k7*u76;
m76-(1*m76)<=k7*m76;
m76-(1*m76)>=-k7*m76;
u76-(1*l76)<=k7*l76;
u76-(1*l76)>=-k7*l76;

l81-(1*u81)<=k8*u81;
l81-(1*u81)>=-k8*u81;
m81-(1*m81)<=k8*m81;
m81-(1*m81)>=-k8*m81;
u81-(1*l81)<=k8*l81;
u81-(1*l81)>=-k8*l81;

l81-(3.5*u85)<=k8*u85;
l81-(3.5*u85)>=-k8*u85;
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m75-(1*m72)<=k7*m72;
m75-(1*m72)>=-k7*m72;
u75-(1.5*l72)<=k7*l72;
u75-(1.5*l72)>=-k7*l72;

l72-(1.5*u76)<=k7*u76;
l72-(1.5*u76)>=-k7*u76;
m72-(2*m76)<=k7*m76;
m72-(2*m76)>=-k7*m76;
u72-(2.5*l76)<=k7*l76;
u72-(2.5*l76)>=-k7*l76;

l75-(1.5*u73)<=k7*u73;
l75-(1.5*u73)>=-k7*u73;
m75-(2*m73)<=k7*m73;
m75-(2*m73)>=-k7*m73;
u75-(2.5*l73)<=k7*l73;
u75-(2.5*l73)>=-k7*l73;

l81-(1.5*u83)<=k8*u83;
l81-(1.5*u83)>=-k8*u83;
m81-(2*m83)<=k8*m83;
m81-(2*m83)>=-k8*m83;
u81-(2.5*l83)<=k8*l83;
u81-(3.5*l83)>=-k8*l83;

l83-(2.5*u85)<=k8*u85;
l83-(2.5*u85)>=-k8*u85;
m83-(3*m85)<=k8*m85;
m83-(3*m85)>=-k8*m85;
u83-(3.5*l85)<=k8*l85;
u83-(3.5*l85)>=-k8*l85;

l81-(1.5*u84)<=k8*u84;
l81-(1.5*u84)>=k8*u84;
m81-(2*m84)<=k8*m84;
m81-(2*m84)>=-k8*m84;
u81-(2.5*l84)<=k8*l84;
u81-(2.5*l84)>=-k8*l84;

l84-(1.5*u85)<=k8*u85;
l84-(1.5*u85)>=-k8*u85;
m84-(2*m85)<=k8*m85;
m84-(2*m85)>=-k8*m85;
u84-(2.5*l85)<=k8*m85;
u84-(2.5*l85)>=-k8*m85;

l81-(3.5*u85)<=k8*u85;
l81-(3.5*u85)>=-k8*u85;
m81-(4*m85)<=k8*m85;
m81-(4*m85)>=-k8*m85;
u81-(4.5*l85)<=k8*l85;
u81-(4.5*l85)>=-k8*l85;

l85-(1*u85)<=k8*u85;
l85-(1*u85)>=-k8*u85;
m85-(1*m85)<=k8*m85;
m85-(1*m85)>=-k8*m85;
u85-(1*l85)<=k8*l85;
u85-(1*l85)>=-k8*l85;

l81-(1.5*u86)<=k8*m86;
l81-(1.5*u86)>=-k8*m86;
m81-(2*m86)<=k8*m86;
m81-(2*m86)>=-k8*m86;
u81-(2.5*l86)<=k8*l86;
u81-(2.5*l86)>=-k8*l86;

l86-(2.5*u85)<=k8*u85;
l86-(2.5*u85)>=-k8*u85;
m86-(3*m86)<=k8*m85;
m86-(3*m86)>=-k8*m85;
u86-(3.5*l85)<=k8*l85;
u86-(3.5*l85)>=-k8*l85;

l93-(1.5*u91)<=k9*u91;
l93-(1.5*u91)>=-k9*u91;
m93-(2*m91)<=k9*m91;
m93-(2*m91)>=-k9*m91;
u93-(2.5*l91)<=k9*l91;
u93-(2.5*l91)>=-k9*l91;

l91-(1.5*u94)<=k9*u94;
l91-(1.5*u94)>=-k9*u94;
m91-(2*m94)<=k9*m94;
m91-(2*m94)>=-k9*m94;
u91-(2.5*l94)<=k9*l94;
u91-(2.5*l94)>=-k9*l94;

m81-(4*m85)<=k8*m85;
m81-(4*m85)>=-k8*m85;
u81-(4.5*l85)<=k8*l85;
u81-(4.5*l85)>=-k8*l85;

l81-(2.5*u82)<=k8*u82;
l81-(2.5*u82)>=-k8*u82;
m81-(3*m82)<=k8*m82;
m81-(3*m82)>=-k8*m82;
u81-(3.5*l82)<=k8*l82;
u81-(3.5*l82)>=-k8*l82;

l82-(1.5*u85)<=k8*u85;
l82-(1.5*u85)>=-k8*u85;
m82-(2*m85)<=k8*m85;
m82-(2*m85)>=-k8*m85;
u82-(2.5*l85)<=k8*l85;
u82-(2.5*l85)>=-k8*l85;

l92-(1.5*u94)<=k9*u94;
l92-(1.5*u94)>=-k9*u94;
m92-(2*m94)<=k9*m94;
m92-(2*m94)>=-k9*m94;
u92-(2.5*l94)<=k9*l94;
u92-(2.5*l94)>=-k9*l94;

l93-(1*u93)<=k9*u93;
l93-(1*u93)>=-k9*u93;
m93-(1*m93)<=k9*m93;
m93-(1*m93)>=-k9*m93;
u93-(1*l93)<=k9*l93;
u93-(1*l93)>=-k9*l93;

l93-(2.5*u94)<=k9*u94;
l93-(2.5*u94)>=-k9*u94;
m93-(3*m94)<=k9*m94;
m93-(3*m94)>=-k9*m94;
u93-(3.5*l94)<=k9*l94;
u93-(3.5*l94)>=-k9*l94;

l93-(1.5-u94)<=k9*u94;
l93-(1.5-u94)>=-k9*u94;
m93-(2*m94)<=k9*m94;
m93-(2*m94)>=-k9*m94;
u93-(2.5*l94)<=k9*l94;
u93-(2.5*l94)>=-k9*l94;

l94-(1*u94)<=k9*u94;
l94-(1*u94)>=-k9*u94;
m94-(1*m94)<=k9*m94;
m94-(1*m94)>=-k9*m94;
u94-(1*l94)<=k9*l94;
u94-(1*l94)>=-k9*l94;

l93-(2.5*u95)<=k9*u95;
l93-(2.5*u95)>=-k9*u95;
m93-(3*m95)<=k9*m95;
m93-(3*m95)>=-k9*m95;
u93-(3.5*l95)<=k9*l95;
u93-(3.5*l95)>=-k9*l95;

l95-(0.67*u94)<=k9*u94;
l95-(0.67*u94)>=-k9*u94;
m95-(1*m94)<=k9*m94;
m95-(1*m94)>=-k9*m94;
u95-(1.5*l94)<=k9*l94;
u95-(1.5*l94)>=-k9*l94;

l93-(1.5*u96)<=k9*u96;
l93-(1.5*u96)>=-k9*u96;
m93-(2*m96)<=k9*m96;
m93-(2*m96)>=-k9*m96;
u93-(2.5*l96)<=k9*l96;
u93-(2.5*l96)>=-k9*l96;

l96-(1.5*u94)<=k9*u94;
l96-(1.5*u94)>=-k9*u94;
m96-(2*m94)<=k9*m94;
m96-(2*m94)>=-k9*m94;
u96-(2.5*l94)<=k9*l94;
u96-(2.5*l94)>=-k9*l94;

l101-(1*u101)<=k10*u101;
l101-(1*u101)>=-k10*u101;
m101-(1*m101)<=k10*m101;
m101-(1*m101)>=-k10*m101;
u101-(1*l101)<=k10*l101;
u101-(1*l101)>=-k10*l101;
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l93-(1.5*u92)<=k9*u92;
l93-(1.5*u92)>=-k9*u92;
m93-(2*m92)<=k9*m92;
m93-(2*m92)>=-k9*m92;
u93-(2.5*l92)<=k9*l92;
u93-(2.5*l92)>=-k9*l92;


l101-(1.5*u102)<=k10*u102;
l101-(1.5*u102)>=-k10*u102;
m101-(2*m102)<=k10*l102;
m101-(2*m102)>=-k10*l102;
u101-(2.5*l102)<=k10*l102;
u101-(2.5*l102)>=-k10*l102;

l102-(1.5*u105)<=k10*u105;
l102-(1.5*u105)>=-k10*u105;
m102-(2*m105)<=k10*m105;
m102-(2*m105)>=-k10*m105;
u102-(2.5*l105)<=k10*l105;
u102-(2.5*l105)>=-k10*l105;

l101-(1.5*u103)<=k10*u103;
l101-(1.5*u103)>=-k10*u103;
m101-(2*m103)<=k10*m103;
m101-(2*m103)>=-k10*m103;
u101-(2.5*l103)<=k10*l103;
u101-(2.5*l103)>=-k10*l103;

l103-(1.5*u105)<=k10*u105;
l103-(1.5*u105)>=-k10*u105;
m103-(2*m105)<=k10*m105;
m103-(2*m105)>=-k10*m105;
u103-(2.5*l105)<=k10*l105;
u103-(2.5*l105)>=-k10*l105;

l101-(1.5*u104)<=k10*u104;
l101-(1.5*u104)>=-k10*u104;
m101-(2*m104)<=k10*m104;
m101-(2*m104)>=-k10*m104;
u101-(2.5*l104)<=k10*l104;
u101-(2.5*l104)>=-k10*l104;

l104-(2.5*u105)<=k10*u105;
l104-(2.5*u105)>=-k10*u105;
m104-(3*m105)<=k10*m105;
m104-(3*m105)>=-k10*m105;
u104-(3.5*l105)<=k10*l105;
u104-(3.5*l105)>=-k10*l105;

l101-(2.5*u105)<=k10*u105;
l101-(2.5*u105)>=-k10*u105;
m101-(3*m105)<=k10*m105;
m101-(3*m105)>=-k10*m105;
u101-(3.5*l105)<=k10*l105;
u101-(3.5*l105)>=-k10*l105;

l105-(1*u105)<=k10*u105;
l105-(1*u105)>=-k10*u105;
m105-(1*m105)<=k10*m105;
m105-(1*m105)>=-k10*m105;
u105-(1*l105)<=k10*l105;
u105-(1*l105)>=-k10*l105;

l101-(1.5*u106)<=k10*u106;
l101-(1.5*u106)>=-k10*u106;
m101-(2*m106)<=k10*m106;
m101-(2*m106)>=-k10*m106;
u101-(2.5*l106)<=k10*l106;
u101-(2.5*l106)>=-k10*l106;

l106-(1.5*u105)<=k10*u105;
l106-(1.5*u105)>=-k10*u105;
m106-(2*m105)<=k10*m105;
m106-(2*m105)>=-k10*m105;
u106-(2.5*l105)<=k10*l105;
u106-(2.5*l105)>=-k10*l105;

l113-(2.5*u111)<=k11*u111;
l113-(2.5*u111)>=-k11*u111;
m113-(3*m111)<=k11*u111;
m113-(3*m111)>=-k11*u111;
u113-(3.5*l111)<=k11*l111;
u113-(3.5*l111)>=-k11*l111;
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l101-(2.5*u105)<=k10*u105;
l101-(2.5*u105)>=-k10*u105;
m101-(3*m105)<=k10*m105;
m101-(3*m105)>=-k10*m105;
u101-(3.5*l105)<=k10*l105;
u101-(3.5*l105)>=-k10*l105;


l111-(1.5*u114)<=k11*u114;
l111-(1.5*u114)>=-k11*u114;
m111-(2*m114)<=k11*m114;
m111-(2*m114)>=-k11*m114;
u111-(2.5*l114)<=k11*l114;
u111-(2.5*l114)>=-k11*l114;

l113-(2.5*u112)<=k11*u112;
l113-(2.5*u112)>=-k11*u112;
m113-(3*m112)<=k11*l112;
m113-(3*m112)>=-k11*l112;
u113-(3.5*l112)<=k11*l112;
u113-(3.5*l112)>=-k11*l112;

l112-(1.5*u114)<=k11*u114;
l112-(1.5*u114)>=-k11*u114;
m112-(2*m114)<=k11*m114;
m112-(2*m114)>=-k11*m114;
u112-(2.5*l114)<=k11*l114;
u112-(2.5*l114)>=-k11*l114;

l113-(1*u113)<=k11*u113;
l113-(1*u113)>=-k11*u113;
m113-(1*m113)<=k11*m113;
m113-(1*m113)>=-k11*m113;
u113-(1*l113)<=k11*l113;
u113-(1*l113)>=-k11*l113;

l113-(3.5*u114)<=k11*u114;
l113-(3.5*u114)>=-k11*u114;
m113-(4*m114)<=k11*m114;
m113-(4*m114)>=-k11*m114;
u113-(4.5*l114)<=k11*l114;
u113-(4.5*l114)>=-k11*l114;

l113-(3.5*u114)<=k11*u114;
l113-(3.5*u114)>=-k11*u114;
m113-(4*m114)<=k11*m114;
m113-(4*m114)>=-k11*m114;
u113-(4.5*l114)<=k11*l114;
u113-(4.5*l114)>=-k11*l114;

l114-(1*u114)<=k11*u114;
l114-(1*u114)>=-k11*u114;
m114-(1*m114)<=k11*m114;
m114-(1*m114)>=-k11*m114;
u114-(1*l114)<=k11*l114;
u114-(1*l114)>=-k11*l114;

l113-(2.5*u115)<=k11*u115;
l113-(2.5*u115)>=-k11*u115;
m113-(3*m115)<=k11*m115;
m113-(3*m115)>=-k11*m115;
u113-(3.5*l115)<=k11*l115;
u113-(3.5*l115)>=-k11*l115;

l115-(1.5*u114)<=k11*u114;
l115-(1.5*u114)>=-k11*u114;
m115-(2*m114)<=k11*m114;
m115-(2*m114)>=-k11*m114;
u115-(2.5*l114)<=k11*l11;
u115-(2.5*l114)>=-k11*l11;

l113-(1.5*u116)<=k11*u116;
l113-(1.5*u116)>=-k11*u116;
m113-(2*m116)<=k11*m116;
m113-(2*m116)>=-k11*m116;
u113-(2.5*l116)<=k11*l116;
u113-(2.5*l116)>=-k11*l116;

l116-(2.5*u114)<=k11*u114;
l116-(2.5*u114)>=-k11*u114;
m116-(3*m114)<=k11*m114;
m116-(3*m114)>=-k11*m114;
u116-(3.5*l114)<=k11*l114;
u116-(3.5*l114)>=-k11*l114;
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l123-(1*u112)<=k12*u112;
l123-(1*u112)>=-k12*u112;
m123-(1*m121)<=k12*m121;
m123-(1*m121)>=-k12*m121;
u123-(1*l121)<=k12*l121;
u123-(1*l121)>=-k12*l121;

l121-(2.5*u126)<=k12*u126;
l121-(2.5*u126)>=-k12*u126;
m121-(3*m126)<=k12*m126;
m121-(3*m126)>=-k12*m126;
u121-(3.5*l126)<=k12*l126;
u121-(3.5*l126)>=-k12*l126;

l123-(1.5*u122)<=k12*u122;
l123-(1.5*u122)>=-k12*u122;
m123-(2*m122)<=k12*m122;
m123-(2*m122)>=-k12*m122;
u123-(2.5*l122)<=k12*l122;
u123-(2.5*l122)>=-k12*l122;

l122-(1.5*u126)<=k12*u126;
l122-(1.5*u126)>=-k12*u126;
m122-(2*m126)<=k12*m126;
m122-(2*m126)>=-k12*m126;
u122-(2.5*l126)<=k12*l126;
u122-(2.5*l126)>=-k12*l126;

l123-(1*u123)<=k12*u123;
l123-(1*u123)>=-k12*u123;
m123-(1*m123)<=k12*m123;
m123-(1*m123)>=-k12*m123;
u123-(1*l123)<=k12*l123;
u123-(1*l123)>=-k12*l123;

l123-(1*u126)<=k12*u126;
l123-(1*u126)>=-k12*u126;
m123-(1*m126)<=k12*m126;
m123-(1*m126)>=-k12*m126;
u123-(1*l126)<=k12*l126;
u123-(1*l126)>=-k12*l126;

l123-(1.5*u124)<=k12*u124;
l123-(1.5*u124)>=-k12*u124;
m123-(2*u124)<=k12*u124;
m123-(2*u124)>=-k12*u124;
u123-(2.5*u123)<=k12*u123;
u123-(2.5*u123)>=-k12*u123;

l124-(1*u126)<=k12*u126;
l124-(1*u126)>=-k12*u126;
m124-(1*m126)<=k12*u126;
m124-(1*m126)>=-k12*u126;
u124-(1-l126)<=k12-l126;
u124-(1-l126)>=-k12-l126;

l123-(3.5*u125)<=k12*u125;
l123-(3.5*u125)>=-k12*u125;
m123-(4*m125)<=k12*m125;
m123-(4*m125)>=-k12*m125;
u123-(4.5*l125)<=k12*l125;
u123-(4.5*l125)>=-k12*l125;

l125-(2.5*u126)<=k12*u126;
l125-(2.5*u126)>=-k12*u126;
m125-(3*m126)<=k12*m126;
m125-(3*m126)>=-k12*m126;
u125-(3.5*l126)<=k12*l126;
u125-(3.5*l126)>=-k12*l126;

l123-(1*u126)<=k12*u126;
l123-(1*u126)>=-k12*u126;
m123-(1*m126)<=k12*m126;
m123-(1*m126)>=-k12*m126;
u123-(1*l126)<=k12*l126;
u123-(1*l126)>=-k12*l126;

l136-(1*u136)<=k13*u136;
l136-(1*u136)>=-k13*u136;
m136-(1*m136)<=k13*m136;
m136-(1*m136)>=-k13*m136;
u136-(1*l136)<=k13*l136;
u136-(1*l136)>=-k13*l136;

l126-(1*u126)<=k12*u126;
l126-(1*u126)>=-k12*u126;
m126-(1*m126)<=k12*u126;
m126-(1*m126)>=-k12*u126;
u126-(1*l126)<=k12*l126;
u126-(1*l126)>=-k12*l126;

l136-(2.5*u131)<=k13*u131;
l136-(2.5*u131)>=-k13*u131;
m136-(3*m131)<=k13*m131;
m136-(3*m131)>=-k13*m131;
u136-(3.5*l131)<=k13*m131;
u136-(3.5*l131)>=-k13*m131;

l131-(1.5*u134)<=k13*u134;
l131-(1.5*u134)>=-k13*u134;
m131-(2*m134)<=k13*m134;
m131-(2*m134)>=-k13*m134;
u131-(2.5*l134)<=k13*l134;
u131-(2.5*l134)>=-k13*l134;

l136-(2.5*u132)<=k13*u132;
l136-(2.5*u132)>=-k13*u132;
m136-(3*m132)<=k13*m13;
m136-(3*m132)>=-k13*m13;
u136-(3.5*l132)<=k13*l132;
u136-(3.5*l132)>=-k13*l132;

l132-(1.5*u134)<=k13*u13;
l132-(1.5*u134)>=-k13*u13;
m132-(2*m134)<=k13*m134;
m132-(2*m134)>=-k13*m134;
u132-(2.5*l134)<=k13*l134;
u132-(2.5*l134)>=-k13*l134;

l136-(1.5*u133)<=k13*l133;
l136-(1.5*u133)>=-k13*l133;
m136-(2*m133)<=k13*m133;
m136-(2*m133)>=-k13*m133;
u136-(2.5*l133)<=k13*l133;
u136-(2.5*l133)>=-k13*l133;

l133-(1.5*u134)<=k13*u134;
l133-(1.5*u134)>=-k13*u134;
m133-(2*m134)<=k13*m134;
m133-(2*m134)>=-k13*m134;
u133-(2.5*l134)<=k13*l134;
u133-(2.5*l134)>=-k13*l134;

l136-(3.5*u134)<=k13*u134;
l136-(3.5*u134)>=-k13*u134;
m136-(4*m134)<=k13*u134;
m136-(4*m134)>=-k13*u134;
u136-(4.5*l134)<=k13*l134;
u136-(4.5*l134)>=-k13*l134;

l134-(1*u134)<=k13*u134;
l134-(1*u134)>=-k13*u134;
m134-(1*m134)<=k13*m134;
m134-(1*m134)>=-k13*m134;
u134-(1*l134)<=k13*l134;
u134-(1*l134)>=-k13*l134;

l136-(2.5*u135)<=k13*u135;
l136-(2.5*u135)>=-k13*u135;
m136-(3*m135)<=k13*m135;
m136-(3*m135)>=-k13*m135;
u136-(3.5*l135)<=k13*l135;
u136-(3.5*l135)>=-k13*l135;

l135-(1.5*u134)<=k13*u134;
l135-(1.5*u134)>=-k13*u134;
m135-(2*m134)<=k13*m134;
m135-(2*m134)>=-k13*m134;
u135-(2.5*l134)<=k13*l134;
u135-(2.5*l134)>=-k13*l134;

l136-(3.5*u134)<=k13*u134;
l136-(3.5*u134)>=-k13*u134;
m136-(4*m134)<=k13*m134;
m136-(4*m134)>=-k13*m134;
u136-(4.5*l134)<=k13*l134;
u136-(4.5*l134)>=-k13*l134;

0.17*l11+0.67*m11+0.17*u11+0.17*l12+0.67*m12+0.17*u12+0.17*l13+0.67*m13+0.17*u13+0.17*l14+0.67*m14+0.17*u14
+0.17*l15+0.67*m15+0.17*u15+0.17*l16+0.67*m16+0.17*u16=1;
```

```
0.17*l21+0.67*m21+0.17*u21+0.17*l22+0.67*m22+0.17*u22+0.17*l23+0.67*m23+0.17*u23+0.17*l24+0.67*m24+0.17*u24
+0.17*l25+0.67*m25+0.17*u25+0.17*l26+0.67*m26+0.17*u26=1;

0.17*l31+0.67*m31+0.17*u31+0.17*l32+0.67*m32+0.17*u32+0.17*l33+0.67*m33+0.17*u33+0.17*l34+0.67*m34+0.17*u34
+0.17*l35+0.67*m35+0.17*u35+0.17*l36+0.67*m36+0.17*u36=1;

0.17*l41+0.67*m41+0.17*u41+0.17*l42+0.67*m42+0.17*u42+0.17*l43+0.67*m43+0.17*u43+0.17*l44+0.67*m44+0.17*u44
+0.17*l45+0.67*m45+0.17*u45+0.17*l46+0.67*m46+0.17*u46=1;

0.17*l51+0.67*m51+0.17*u51+0.17*l52+0.67*m52+0.17*u52+0.17*l53+0.67*m53+0.17*u53+0.17*l54+0.67*m54+0.17*u54
+0.17*l55+0.67*m55+0.17*u55+0.17*l56+0.67*m56+0.17*u56=1;

0.17*l61+0.67*m61+0.17*u61+0.17*l62+0.67*m62+0.17*u62+0.17*l63+0.67*m63+0.17*u63+0.17*l64+0.67*m64+0.17*u64
+0.17*l65+0.67*m65+0.17*u65+0.17*l66+0.67*m66+0.17*u66=1;

0.17*l71+0.67*m71+0.17*u71+0.17*l72+0.67*m72+0.17*u72+0.17*l73+0.67*m73+0.17*u73+0.17*l74+0.67*m74+0.17*u74
+0.17*l75+0.67*m75+0.17*u75+0.17*l76+0.67*m76+0.17*u76=1;

0.17*l81+0.67*m81+0.17*u81+0.17*l82+0.67*m82+0.17*u82+0.17*l83+0.67*m83+0.17*u83+0.17*l84+0.67*m84+0.17*u84
+0.17*l85+0.67*m85+0.17*u85+0.17*l86+0.67*m86+0.17*u86=1;

0.17*l91+0.67*m91+0.17*u91+0.17*l92+0.67*m92+0.17*u92+0.17*l93+0.67*m93+0.17*u93+0.17*l94+0.67*m94+0.17*u94
+0.17*l95+0.67*m95+0.17*u95+0.17*l96+0.67*m96+0.17*u96=1;

0.17*l101+0.67*m101+0.17*u101+0.17*l102+0.67*m102+0.17*u102+0.17*l103+0.67*m103+0.17*u103+0.17*l104+0.67*m1
04+0.17*u104+0.17*l105+0.67*m105+0.17*u105+0.17*l106+0.67*m106+0.17*u106=1;

0.17*l111+0.67*m111+0.17*u111+0.17*l112+0.67*m112+0.17*u112+0.17*l113+0.67*m113+0.17*u113+0.17*l114+0.67*m1
14+0.17*u114+0.17*l115+0.67*m115+0.17*u115+0.17*l116+0.67*m116+0.17*u116=1;

0.17*l121+0.67*m121+0.17*u121+0.17*l122+0.67*m122+0.17*u122+0.17*l123+0.67*m123+0.17*u123+0.17*l124+0.67*m1
24+0.17*u124+0.17*l125+0.67*m125+0.17*u125+0.17*l126+0.67*m126+0.17*u126=1;

0.17*l131+0.67*m131+0.17*u131+0.17*l132+0.67*m132+0.17*u132+0.17*l133+0.67*m133+0.17*u133+0.17*l134+0.67*m1
34+0.17*u134+0.17*l135+0.67*m135+0.17*u135+0.17*l136+0.67*m136+0.17*u136=1;


 l11<=m11;m11<=u11;                                  l74<=m74;m74<=u74;
 l12<=m12;m12<=u12;                                  l75<=m75;m75<=u75;
 l13<=m13;m13<=u13;                                  l76<=m76;m76<=u76;
 l14<=m14;m14<=u14;
 l15<=m15;m15<=u15;                                  l81<=m81;m81<=u81;
 l16<=m16;m16<=u16;                                  l82<=m82;m82<=u82;
                                                     l83<=m83;m83<=u83;
 l21<=m21;m21<=u21;                                  l84<=m84;m84<=u84;
 l22<=m22;m22<=u22;                                  l85<=m85;m85<=u85;
 l23<=m23;m23<=u21;                                  l86<=m86;m86<=u86;
 l24<=m24;m24<=u24;
 l25<=m25;m25<=u25;                                  l91<=m91;m91<=u91;
 l26<=m26;m26<=u26;                                  l92<=m92;m92<=u92;
                                                     l93<=m93;m93<=u93;
 l31<=m31;m31<=u31;                                  l94<=m94;m94<=u94;
 l32<=m32;m32<=u32;                                  l95<=m95;m95<=u95;
 l33<=m33;m33<=u33;                                  l96<=m96;m96<=u96;
 l34<=m34;m34<=u34;
 l35<=m35;m35<=u35;                                  l101<=m101;m101<=u101;
 l36<=m36;m36<=u36;                                  l102<=m102;m102<=u102;
                                                     l103<=m103;m103<=u103;
 l41<=m41;m41<=u41;                                  l104<=m104;m104<=u104;
 l42<=m42;m42<=u42;                                  l105<=m105;m105<=u105;
 l43<=m43;m43<=u43;                                  l106<=m106;m106<=u106;
 l44<=m44;m44<=u44;
 l45<=m45;m45<=u45;                                  l111<=m111;m111<=u111;
 l46<=m46;m46<=u46;                                  l112<=m112;m112<=u112;
                                                     l113<=m113;m113<=u113;
 l51<=m51;m51<=u51;                                  l114<=m114;m114<=u114;
 l52<=m52;m52<=u52;                                  l115<=m115;m115<=u115;
 l53<=m53;m53<=u53;                                  l116<=m116;m116<=u116;
 l54<=m54;m54<=u54;
 l55<=m55;m55<=u55;                                  l121<=m121;m121<=u121;
 l56<=m56;m56<=u56;                                  l122<=m122;m122<=u122;
                                                     l123<=m123;m123<=u123;
 l61<=m61;m61<=u61;                                  l124<=m124;m124<=u124;
 l62<=m62;m62<=u62;                                  l125<=m125;m125<=u125;
 l63<=m63;m63<=u63;                                  l126<=m126;m126<=u126;
 l64<=m64;m64<=u64;
 l65<=m65;m65<=u65;                                  l131<=m131;m131<=u131;
 l66<=m66;m66<=u66;                                  l132<=m132;m132<=u132;
                                                     l133<=m133;m133<=u133;
 l71<=m71;m71<=u71;                                  l134<=m134;m134<=u134;
 l72<=m72;m72<=u72;                                  l135<=m135;m135<=u135;
 l73<=m73;m73<=u73;                                  l136<=m136;m136<=u136;

l11>0;l21>0;l31>0;l41>0;l51>0;l61>0;l71>0;l81>0;l91>0;l101>0;l111>0;l121>0;l131>0;

l12>0;l22>0;l32>0;l42>0;l52>0;l62>0;l72>0;l82>0;l92>0;l102>0;l112>0;l122>0;l132>0;
```

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```
l13>0;l23>0;l33>0;l43>0;l53>0;l63>0;l73>0;l83>0;l93>0;l103>0;l113>0;l123>0;l133>0;
l14>0;l24>0;l34>0;l44>0;l54>0;l64>0;l74>0;l84>0;l94>0;l104>0;l114>0;l124>0;l134>0;
l15>0;l25>0;l35>0;l45>0;l55>0;l65>0;l75>0;l85>0;l95>0;l105>0;l115>0;l125>0;l135>0;
l16>0;l26>0;l36>0;l46>0;l56>0;l66>0;l76>0;l86>0;l96>0;l106>0;l116>0;l126>0;l136>0;

k1>=0;k2>=0;k3>=0;k4>=0;k5>=0;k6>=0;k7>=0;k8>=0;k9>=0;k10>=0;k11>=0;k12>=0;k13>=0;

end
```

Output: Results obtained from Lingo 18.0 software

```
Local optimal solution found.
  Objective value:                              14.89152
  Infeasibilities:                          0.3451555E-07
  Total solver iterations:                             78
  Elapsed runtime seconds:                           0.33

  Model Class:                                         QP

  Total variables:                    247
  Nonlinear variables:                234
  Integer variables:                    0

  Total constraints:                 1197
  Nonlinear constraints:              932

  Total nonzeros:                    3446
  Nonlinear nonzeros:                 934
```

Variable	Value	Reduced Cost
K1	1.700000	0.000000
K2	2.100000	0.000000
K3	0.5000000	0.000000
K4	0.4074054	0.000000
K5	2.753439	0.000000
K6	0.6333331	0.3414809E-07
K7	0.3747226	0.000000
K8	1.666667	0.000000
K9	1.623239	0.000000
K10	0.5505103	0.000000
K11	0.4074054	0.000000
K12	1.820551	0.000000

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K13	0.3542487	0.000000
L12	0.2503070	0.000000
U11	0.1778032	0.000000
M12	0.2503070	0.000000
M11	0.1778032	0.000000
U12	0.2503070	0.000000
L11	0.1390594	0.000000
U15	0.1390594	0.000000
M15	0.1088291	0.000000
L15	0.8924182E-01	0.000000
U13	0.2503070	0.000000
M13	0.2503070	0.000000
L13	0.2503070	0.000000
U14	0.7822092E-01	0.000000
M14	0.6765053E-01	0.000000
L14	0.6226467E-01	0.000000
U16	0.1390594	0.000000
M16	0.1390594	0.000000
L16	0.1390594	0.000000
L23	0.1614884	0.000000
U21	0.1614884	0.000000
M23	0.1614884	0.000000
M21	0.1614884	0.000000
U23	0.1733240	0.000000
L21	0.1614884	0.000000
U26	0.1153488	0.000000
M26	0.8102543E-01	0.000000
L26	0.7221832E-01	0.000000
U22	0.1238028	0.000000
M22	0.1238028	0.000000
L22	0.1238028	0.000000
U24	0.1238028	0.000000
M24	0.1238028	0.000000
L24	0.1238028	0.000000
U25	0.3322043	0.000000
M25	0.3322043	0.000000
L25	0.3322043	0.000000
L31	0.2330704	0.000000
U31	0.3107605	0.000000
M31	0.2589671	0.000000
U34	0.1165352	0.000000
M34	0.1035868	0.000000
L34	0.1035868	0.000000
U32	0.1553802	0.000000

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M32	0.1553802	0.000000
L32	0.1058003	0.000000
U33	0.1379255	0.000000
M33	0.1379255	0.000000
L33	0.1379255	0.000000
U35	0.1035868	0.000000
M35	0.1035868	0.000000
L35	0.1035868	0.000000
U36	0.2324593	0.000000
M36	0.2324593	0.000000
L36	0.2324593	0.000000
L41	0.2613135	0.000000
U41	0.2928489	0.000000
M41	0.2928489	0.000000
U42	0.6687649E-01	0.000000
M42	0.6657506E-01	0.000000
L42	0.5967490E-01	0.000000
U43	0.1845503	0.000000
M43	0.1838817	0.000000
L43	0.1399454	0.000000
U44	0.1845503	0.000000
M44	0.1838817	0.000000
L44	0.1399454	0.000000
U45	0.1248754	0.000000
M45	0.1060342	0.000000
L45	0.9469361E-01	0.000000
U46	0.1845503	0.000000
M46	0.1838817	0.000000
L46	0.1399454	0.000000
L51	0.1092712	0.000000
U51	0.1632624	0.000000
M51	0.1632624	0.000000
U56	0.1463661	0.000000
M56	0.1309703	0.000000
L56	0.8781964E-01	0.000000
U52	0.6225591	0.000000
M52	0.6225591	0.000000
L52	0.6225591	0.000000
U53	0.3107725E-01	0.000000
M53	0.3107725E-01	0.000000
L53	0.3107725E-01	0.000000
U54	0.2837649E-01	0.000000
M54	0.2837649E-01	0.000000
L54	0.2610762E-01	0.000000

U55	0.2837649E-01	0.000000
M55	0.2837649E-01	0.000000
L55	0.2610762E-01	0.000000
L66	0.2124032	0.9374202E-07
U61	0.2450806	0.000000
U62	0.2450806	-0.4062155E-07
M66	0.2362045	0.000000
M61	0.1728325	-0.4062155E-07
U66	0.2362045	0.1003222E-06
L61	0.1265381	-0.4062155E-07
U63	0.6778827E-01	0.4154430E-07
M63	0.6778827E-01	0.000000
L63	0.6203045E-01	-0.4062155E-07
M62	0.1728325	0.000000
L62	0.1265381	0.000000
U64	0.1943621	-0.4062155E-07
M64	0.1785091	0.000000
L64	0.1446150	0.000000
U65	0.1943621	-0.4062155E-07
M65	0.1728325	0.000000
L65	0.8223521E-01	-0.4062155E-07
L75	0.2262315	0.000000
U71	0.1995605	0.000000
M75	0.2743403	0.000000
M71	0.1995605	0.000000
U75	0.2743403	0.000000
L71	0.1995605	0.000000
U76	0.1064480	0.000000
M76	0.9403976E-01	0.000000
L76	0.8778109E-01	0.000000
U72	0.2165470	0.000000
M72	0.2062554	0.000000
L72	0.1995605	0.000000
U73	0.1206747	0.000000
M73	0.1206747	0.000000
L73	0.1206747	0.000000
U74	0.1044995	0.000000
M74	0.1044995	0.000000
L74	0.8778109E-01	0.000000
L81	0.2842580	0.000000
U81	0.2842580	0.000000
M81	0.2842580	0.000000
U85	0.1218248	0.000000
M85	0.1218248	0.000000

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L85	0.1003263	0.000000
U82	0.2131935	0.000000
M82	0.2131935	0.000000
L82	0.1550498	0.000000
U83	0.1839316	0.000000
M83	0.1839316	0.000000
L83	0.1550498	0.000000
U84	0.8976567E-01	0.000000
M84	0.8976567E-01	0.000000
L84	0.8976567E-01	0.000000
U86	0.1839316	0.000000
M86	0.1015207	0.000000
L86	0.1015207	0.000000
L93	0.3757548	0.000000
U91	0.1432408	0.000000
M93	0.3757548	0.000000
M91	0.1037069	0.000000
U93	0.3757548	0.000000
L91	0.9113100E-01	0.000000
U94	0.4285714	0.000000
M94	0.1633749	0.000000
L94	0.1633749	0.000000
U92	0.1432408	0.000000
M92	0.1037069	0.000000
L92	0.9113100E-01	0.000000
U95	0.9113100E-01	0.000000
M95	0.8127524E-01	0.000000
L95	0.7334323E-01	0.000000
U96	0.1432408	0.000000
M96	0.1037069	0.000000
L96	0.9113100E-01	0.000000
L101	0.2213475	0.000000
U101	0.2757681	0.000000
M101	0.2417270	0.000000
U105	0.7256082E-01	0.000000
M105	0.6808232E-01	0.000000
L105	0.6808232E-01	0.000000
U102	0.2076858	0.000000
M102	0.1598001	0.000000
L102	0.1414566	0.000000
U103	0.2076858	0.000000
M103	0.1667670	0.000000
L103	0.1414566	0.000000
U104	0.2331226	0.000000

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M104	0.1667670	0.000000
L104	0.1414566	0.000000
U106	0.2076858	0.000000
M106	0.1667670	0.000000
L106	0.1414566	0.000000
L113	0.3076598	0.000000
U111	0.1470231	0.000000
M113	0.3307704	0.000000
M111	0.1302228	0.000000
U113	0.3447883	0.000000
L111	0.1114884	0.000000
U114	0.7873762E-01	0.000000
M114	0.7873762E-01	0.000000
L114	0.7025877E-01	0.000000
U112	0.1470231	0.000000
M112	0.1253971	0.000000
L112	0.1114884	0.000000
U115	0.1275828	0.000000
M115	0.1275828	0.000000
L115	0.1114884	0.000000
U116	0.2172819	0.000000
M116	0.2076928	0.000000
L116	0.1647659	0.000000
L123	0.2190719	0.000000
M123	0.2190719	0.000000
M121	0.2827385	0.000000
U123	0.2190719	0.000000
L121	0.2827385	0.000000
U126	0.7766991E-01	0.000000
M126	0.7766991E-01	0.000000
U121	0.2827385	0.000000
L126	0.7766991E-01	0.000000
U122	0.2531909	0.000000
M122	0.2531909	0.000000
L122	0.2531909	0.000000
U124	0.6872122E-01	0.000000
L124	0.000000	0.000000
M124	0.6872122E-01	0.000000
U125	0.1304427	0.000000
M125	0.9731606E-01	0.000000
L125	0.8176004E-01	0.000000
L136	0.3383486	0.000000
U131	0.1576831	0.000000
M136	0.3402896	0.000000

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M131	0.1286174	0.000000
U136	0.3402896	0.000000
L131	0.1102435	0.000000
U134	0.8824623E-01	0.000000
M134	0.7815117E-01	0.000000
L134	0.7348617E-01	0.000000
U132	0.1576831	0.000000
M132	0.1287832	0.000000
L132	0.1081744	0.000000
U133	0.1881128	0.000000
L133	0.1585876	0.000000
M133	0.1839873	0.000000
U135	0.1576831	0.000000
M135	0.1286174	0.000000
L135	0.1081744	0.000000

Solving the nonlinear problem by applying LINGO 18.0, the value of each variable is shown in table 4.22.

Table 4.24 Obtained Value of Variables Using LINGO 18.0

K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13
1.7	2.1	0.5	0.4074	2.7534	0.6333	0.3747	1.6667	1.6232	0.5505	0.4074	1.8206	0.3542

L11	0.139	M11	0.178	U11	0.178
L12	0.250	M12	0.250	U12	0.250
L13	0.250	M13	0.250	U13	0.250
L14	0.062	M14	0.068	U14	0.078
L15	0.089	M15	0.109	U15	0.139
L16	0.139	M16	0.139	U16	0.139
L21	0.161	M21	0.161	U21	0.161
L22	0.124	M22	0.124	U22	0.124
L23	0.161	M23	0.161	U23	0.173
L24	0.124	M24	0.124	U24	0.124
L25	0.332	M25	0.332	U25	0.332
L26	0.072	M26	0.081	U26	0.115
L31	0.233	M31	0.259	U31	0.311
L32	0.106	M32	0.155	U32	0.155
L33	0.138	M33	0.138	U33	0.138
L34	0.104	M34	0.104	U34	0.117
L35	0.104	M35	0.104	U35	0.104
L36	0.232	M36	0.232	U36	0.232

L74	0.088	M74	0.104	U74	0.104
L75	0.226	M75	0.274	U75	0.274
L76	0.088	M76	0.094	U76	0.106
L81	0.284	M81	0.284	U81	0.284
L82	0.155	M82	0.213	U82	0.213
L83	0.155	M83	0.184	U83	0.184
L84	0.090	M84	0.090	U84	0.090
L85	0.100	M85	0.122	U85	0.122
L86	0.102	M86	0.102	U86	0.184
L91	0.091	M91	0.104	U91	0.143
L92	0.091	M92	0.104	U92	0.104
L93	0.376	M93	0.376	U93	0.376
L94	0.163	M94	0.163	U94	0.429
L95	0.073	M95	0.081	U95	0.081
L96	0.091	M96	0.104	U96	0.143
L101	0.221	M101	0.242	U101	0.276
L102	0.141	M102	0.160	U102	0.208
L103	0.141	M103	0.167	U103	0.208
L104	0.141	M104	0.167	U104	0.233
L105	0.068	M105	0.068	U105	0.073

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L41	0.261	M41	0.293	U41	0.293
L42	0.060	M42	0.067	U42	0.067
L43	0.140	M43	0.184	U43	0.185
L44	0.140	M44	0.184	U44	0.185
L45	0.095	M45	0.106	U45	0.125
L46	0.140	M46	0.184	U46	0.185
L51	0.109	M51	0.163	U51	0.163
L52	0.623	M52	0.623	U52	0.623
L53	0.031	M53	0.031	U53	0.031
L54	0.026	M54	0.028	U54	0.028
L55	0.026	M55	0.028	U55	0.028
L56	0.088	M56	0.131	U56	0.146
L61	0.127	M61	0.173	U61	0.245
L62	0.127	M62	0.173	U62	0.245
L63	0.062	M63	0.068	U63	0.068
L64	0.145	M64	0.179	U64	0.194
L65	0.082	M65	0.173	U65	0.194
L66	0.212	M66	0.236	U66	0.236
L71	0.200	M71	0.200	U71	0.200
L72	0.200	M72	0.206	U72	0.217
L73	0.121	M73	0.121	U73	0.121

L106	0.141	M106	0.167	U106	0.208
L111	0.111	M111	0.130	U111	0.147
L112	0.111	M112	0.125	U112	0.147
L113	0.308	M113	0.331	U113	0.345
L114	0.070	M114	0.079	U114	0.079
L115	0.111	M115	0.128	U115	0.128
L116	0.165	M116	0.208	U116	0.217
L121	0.283	M121	0.283	U121	0.283
L122	0.253	M122	0.253	U122	0.253
L123	0.219	M123	0.219	U123	0.219
L124	0.000	M124	0.069	U124	0.069
L125	0.082	M125	0.097	U125	0.130
L126	0.253	M126	0.078	U126	0.078
L131	0.110	M131	0.129	U131	0.158
L132	0.188	M132	0.129	U132	0.158
L133	0.159	M133	0.184	U133	0.188
L134	0.073	M134	0.078	U134	0.088
L135	0.108	M135	0.129	U135	0.158
L136	0.338	M136	0.340	U136	0.340

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Fuzzy Values of Strategic Planning Models

Table 4.33 Fuzzy values of Bryson Model Assessment Based on the Criteria

Criteria	Formality	Clarity	Measurability	Objectivity	Coverage	Consistency	$\sum_j \tilde{x}_{lj}^i$
Manager 1	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(2,3.2,4.4)
Manager 2	(0.7,0.9,1)	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(2.6,3.8,4.8)
Manager 3	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(2,3.2,4.4)
Manager 4	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.2,3.4,4.6)
Manager 5	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.7,0.9,1)	(3,4.2,5.2)
Manager 6	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(1.8,3,4.2)
Manager 7	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.3)
Manager 8	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(1.8,3,4.2)
Manager 9	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(2.6,3.8,4.9)
Manager 10	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 11	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3.2,4.4,5.5)
Manager 12	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.4,3.6,4.8)
Manager 13	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.0,3.2,4.4)

Table 4.34 Fuzzy values of Wright Model Assessment Based on the Criteria

Criteria	Formality	Clarity	Measurability	Objectivity	Coverage	Consistency	$\sum_j \tilde{x}_{lj}^i$
Manager 1	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.0,3.2,4.4)
Manager 2	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.5,0.7,0.9)	(2.6,3.8,4.9)
Manager 3	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0,0.1,0.3)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(1.7,2.8,4)
Manager 4	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(1.4,2.6,3.8)

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Manager 5	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.0,3.2,4.4)
Manager 6	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(1.8,3.0,4.2)
Manager 7	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0,0.1,0.3)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(1.3,2.4,3.6)
Manager 8	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0,0.1,0.3)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(1.9,3.0,4.2)
Manager 9	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(1.2,2.4,3.6)
Manager 10	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.6,1.8,3)
Manager 11	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.4,3.6,4.8)
Manager 12	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 13	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.4,3.6,4.8)

Table 4.35 Fuzzy values of Wheelen Model Assessment Based on the Criteria

Criteria	**Formality**	**Clarity**	**Measurability**	**Objectivity**	**Coverage**	**Consistency**	$\sum_{j} \tilde{x}_{ij}^{i}$
Manager 1	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.2,3.4,4.6)
Manager 2	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.7,0.9,1)	(0.5,0.7,0.9)	(2,3.2,4.3)
Manager 3	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(2.4,3.6,4.8)
Manager 4	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(1.8,3,4.2)
Manager 5	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.4,3.6,4.7)
Manager 6	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(3.2,4.4,5.4)
Manager 7	(0.3,0.5,0.7)	(0.7,0.9,1)	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(3.2,4.4,5.3)
Manager 8	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(2,3.2,4.4)
Manager 9	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(1.8,3,4.2)
Manager 10	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.4)
Manager 11	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(2.8,4.0,5.2)
Manager 12	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 13	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)	(2.8,4,5.1)

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Table 4.36 Fuzzy values of Hill and Jones Model Assessment Based on the Criteria

Criteria	Formality	Clarity	Measurability	Objectivity	Coverage	Consistency	$\sum_j \tilde{x}_{lj}^i$
Manager 1	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.8,4,5.2)
Manager 2	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(1.8,3,4.2)
Manager 3	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.4,3.6,4.8)
Manager 4	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(2,3.2,4.4)
Manager 5	(0.7,0.9,1)	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3.2,4.4,5.4)
Manager 6	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(3,4.2,5.3)
Manager 7	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(3.8,5,5.8)
Manager 8	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.3)
Manager 9	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 10	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(1.8,3,4.2)
Manager 11	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 12	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(2.8,4,5.1)
Manager 13	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.4,3.6,4.8)

Table 4.37 Fuzzy values of Bowman and Asch Model Assessment Based on the Criteria

Criteria	Formality	Clarity	Measurability	Objectivity	Coverage	Consistency	$\sum_j \tilde{x}_{lj}^i$
Manager 1	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 2	(0.3,0.5,0.7)	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3.2,4.4,5.4)
Manager 3	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(2.2,3.4,4.6)
Manager 4	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(1.6,2.8,4)
Manager 5	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0,0.1,0.3)	(0.1,0.3,0.5)	(2.1,3.2,4.3)
Manager 6	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(3.8,5,5.8)

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Manager 7	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)	(2.8,4,5.1)
Manager 8	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(2.4,3.6,4.7)
Manager 9	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(1.4,2.6,3.8)
Manager 10	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(1.4,2.6,3.8)
Manager 11	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.7,0.9,1)	(3,4.2,5.3)
Manager 12	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(2.6,3.8,5)
Manager 13	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.6,3.8,5)

Table 4.38 Fuzzy values of David Model Assessment Based on the Criteria

Criteria	**Formality**	**Clarity**	**Measurability**	**Objectivity**	**Coverage**	**Consistency**	$\sum_{j} \tilde{x}_{lj}^{i}$
Manager 1	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.4)
Manager 2	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3.4,4.6,5.6)
Manager 3	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.4)
Manager 4	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2,3.2,4.4)
Manager 5	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(2,3.2,4.4)
Manager 6	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.7,0.9,1)	(3.2,4.4,5.4)
Manager 7	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.7,0.9,1)	(2.8,4,5.1)
Manager 8	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.7,0.9,1)	(0.3,0.5,0.7)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(2.6,3.8,4.8)
Manager 9	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.4)
Manager 10	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(0.1,0.3,0.5)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.2,3.4,4.6)
Manager 11	(0.7,0.9,1)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(3,4.2,5.3)
Manager 12	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.1,0.3,0.5)	(2.4,3.6,4.8)
Manager 13	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.5,0.7,0.9)	(2.8,4,5.2)

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Normalized Fuzzy Value of Strategic Planning Models

Table 4. 39 Normalized fuzzy values of Bryson model

Criteria	**Formality**			**Clarity**			**Measurability**			**Objectivity**			**Coverage**			**Consistency**		
μ	0.202			0.201			0.186			0.114			0.135			0.165		
	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}
Manager 1	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 2	0.09	0.15	0.26	0.13	0.20	0.29	0.13	0.20	0.29	0.09	0.15	0.26	0.09	0.15	0.26	0.09	0.15	0.26
Manager 3	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 4	0.07	0.16	0.35	0.02	0.09	0.25	0.07	0.16	0.35	0.07	0.16	0.35	0.11	0.22	0.45	0.11	0.22	0.45
Manager 5	0.11	0.22	0.45	0.07	0.16	0.35	0.07	0.16	0.35	0.11	0.22	0.45	0.02	0.09	0.25	0.07	0.16	0.35
Manager 6	0.09	0.16	0.28	0.09	0.16	0.28	0.06	0.11	0.22	0.09	0.16	0.28	0.13	0.20	0.31	0.13	0.20	0.31
Manager 7	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25	0.06	0.13	0.25	0.10	0.18	0.32	0.14	0.23	0.36
Manager 8	0.15	0.24	0.38	0.10	0.18	0.35	0.15	0.24	0.38	0.06	0.13	0.27	0.02	0.08	0.19	0.06	0.13	0.27
Manager 9	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 10	0.11	0.21	0.41	0.11	0.21	0.41	0.02	0.09	0.23	0.02	0.09	0.23	0.11	0.21	0.41	0.11	0.21	0.41
Manager 11	0.13	0.21	0.33	0.09	0.17	0.30	0.09	0.17	0.30	0.06	0.12	0.23	0.09	0.17	0.30	0.09	0.17	0.30
Manager 12	0.10	0.19	0.38	0.10	0.19	0.38	0.10	0.19	0.38	0.06	0.14	0.29	0.10	0.19	0.38	0.02	0.08	0.21
Manager 13	0.10	0.18	0.32	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25	0.10	0.18	0.32	0.10	0.18	0.32

Table 4.40 Normalized Fuzzy Values of Wright Model

Criteria	**Formality**			**Clarity**			**Measurability**			**Objectivity**			**Coverage**			**Consistency**		
μ	0.202			0.201			0.186			0.114			0.135			0.165		
	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}
Manager 1	0.11	0.22	0.45	0.02	0.09	0.25	0.07	0.16	0.35	0.07	0.16	0.35	0.11	0.22	0.45	0.07	0.16	0.35
Manager 2	0.06	0.13	0.27	0.1	0.18	0.35	0.02	0.08	0.19	0.1	0.18	0.35	0.14	0.24	0.38	0.10	0.18	0.35
Manager 3	0.08	0.18	0.41	0.03	0.11	0.29	0.13	0.25	0.53	0	0.04	0.18	0.08	0.18	0.41	0.13	0.25	0.53
Manager 4	0.08	0.19	0.5	0.08	0.19	0.5	0.03	0.12	0.36	0.08	0.19	0.5	0.08	0.19	0.5	0.03	0.12	0.36
Manager 5	0.11	0.22	0.45	0.07	0.16	0.35	0.02	0.09	0.25	0.07	0.16	0.35	0.11	0.22	0.45	0.07	0.16	0.35
Manager 6	0.12	0.23	0.5	0.12	0.23	0.5	0.02	0.1	0.28	0.02	0.1	0.28	0.07	0.17	0.39	0.07	0.17	0.39

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Manager 7	0.08	0.21	0.54	0.03	0.13	0.38	0	0.04	0.23	0.08	0.21	0.54	0.08	0.21	0.54	0.08	0.21	0.54
Manager 8	0.12	0.23	0.47	0.12	0.23	0.47	0.07	0.17	0.37	0	0.03	0.16	0.07	0.17	0.37	0.07	0.17	0.37
Manager 9	0.03	0.13	0.42	0.03	0.13	0.42	0.03	0.13	0.42	0.08	0.21	0.58	0.08	0.21	0.58	0.08	0.21	0.58
Manager 10	0.03	0.17	0.83	0.03	0.17	0.83	0.03	0.17	0.83	0.03	0.17	0.83	0.03	0.17	0.83	0.03	0.17	0.83
Manager 11	0.06	0.14	0.29	0.1	0.19	0.38	0.06	0.14	0.29	0.1	0.19	0.38	0.1	0.19	0.38	0.06	0.14	0.29
Manager 12	0.06	0.13	0.27	0.1	0.18	0.35	0.1	0.18	0.35	0.06	0.13	0.27	0.1	0.18	0.35	0.10	0.18	0.35
Manager 13	0.06	0.14	0.29	0.02	0.08	0.21	0.1	0.19	0.38	0.1	0.19	0.38	0.1	0.19	0.38	0.10	0.19	0.38

Table 4.41 Normalized Fuzzy Values of Wheelen Model

Criteria	**Formality**			**Clarity**			**Measurability**			**Objectivity**			**Coverage**			**Consistency**		
μ	0.202			0.201			0.186			0.114			0.135			0.165		
	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}
Manager 1	0.11	0.21	0.41	0.07	0.15	0.32	0.07	0.15	0.32	0.07	0.15	0.32	0.11	0.21	0.41	0.07	0.15	0.32
Manager 2	0.07	0.16	0.35	0.02	0.09	0.25	0.02	0.09	0.25	0.07	0.16	0.35	0.16	0.28	0.50	0.12	0.22	0.45
Manager 3	0.10	0.19	0.38	0.06	0.14	0.29	0.06	0.14	0.29	0.10	0.19	0.38	0.06	0.14	0.29	0.10	0.19	0.38
Manager 4	0.07	0.17	0.39	0.02	0.10	0.28	0.02	0.10	0.28	0.07	0.17	0.39	0.12	0.23	0.50	0.12	0.23	0.50
Manager 5	0.15	0.25	0.42	0.06	0.14	0.29	0.02	0.08	0.21	0.06	0.14	0.29	0.11	0.19	0.38	0.11	0.19	0.38
Manager 6	0.06	0.11	0.22	0.09	0.16	0.28	0.09	0.16	0.28	0.09	0.16	0.28	0.13	0.20	0.31	0.13	0.20	0.31
Manager 7	0.06	0.11	0.22	0.13	0.20	0.31	0.13	0.20	0.31	0.13	0.20	0.31	0.09	0.16	0.28	0.06	0.11	0.22
Manager 8	0.07	0.16	0.35	0.07	0.16	0.35	0.11	0.22	0.45	0.07	0.16	0.35	0.11	0.22	0.45	0.02	0.09	0.25
Manager 9	0.02	0.10	0.28	0.02	0.10	0.28	0.02	0.10	0.28	0.12	0.23	0.50	0.12	0.23	0.50	0.12	0.23	0.50
Manager 10	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 11	0.10	0.18	0.32	0.10	0.18	0.32	0.10	0.18	0.32	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25
Manager 12	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35
Manager 13	0.10	0.18	0.32	0.06	0.13	0.25	0.06	0.13	0.25	0.10	0.18	0.32	0.10	0.18	0.32	0.14	0.23	0.36

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Table 4.42 Normalized Fuzzy Values of Hill and Jones Model

Criteria	**Formality**			**Clarity**			**Measurability**			**Objectivity**			**Coverage**			**Consistency**		
μ	0.202			0.201			0.186			0.114			0.135			0.165		
	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}
Manager 1	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25	0.10	0.18	0.32	0.10	0.18	0.32	0.10	0.18	0.32
Manager 2	0.07	0.17	0.39	0.07	0.17	0.39	0.12	0.23	0.50	0.02	0.10	0.28	0.02	0.10	0.28	0.12	0.23	0.50
Manager 3	0.10	0.19	0.38	0.06	0.14	0.29	0.06	0.14	0.29	0.06	0.14	0.29	0.10	0.19	0.38	0.10	0.19	0.38
Manager 4	0.11	0.22	0.45	0.07	0.16	0.35	0.02	0.09	0.25	0.11	0.22	0.45	0.07	0.16	0.35	0.07	0.16	0.35
Manager 5	0.13	0.20	0.31	0.13	0.20	0.31	0.06	0.11	0.22	0.09	0.16	0.28	0.09	0.16	0.28	0.09	0.16	0.28
Manager 6	0.09	0.17	0.30	0.13	0.21	0.33	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.06	0.12	0.23
Manager 7	0.12	0.18	0.26	0.12	0.18	0.26	0.09	0.14	0.24	0.12	0.18	0.26	0.12	0.18	0.26	0.09	0.14	0.24
Manager 8	0.13	0.21	0.33	0.09	0.17	0.30	0.09	0.17	0.30	0.06	0.12	0.23	0.09	0.17	0.30	0.09	0.17	0.30
Manager 9	0.10	0.18	0.35	0.06	0.13	0.27	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35	0.10	0.18	0.35
Manager 10	0.02	0.10	0.28	0.12	0.23	0.50	0.02	0.10	0.28	0.02	0.10	0.28	0.12	0.23	0.50	0.12	0.23	0.50
Manager 11	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35
Manager 12	0.14	0.23	0.36	0.06	0.13	0.25	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25	0.10	0.18	0.32
Manager 13	0.10	0.19	0.38	0.06	0.14	0.29	0.06	0.14	0.29	0.06	0.14	0.29	0.10	0.19	0.38	0.10	0.19	0.38

Table 4.43 Normalized Fuzzy Values of Bowman and Asch Model

Criteria	**Formality**			**Clarity**			**Measurability**			**Objectivity**			**Coverage**			**Consistency**		
μ	0.202			0.201			0.186			0.114			0.135			0.165		
	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}
Manager 1	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35
Manager 2	0.06	0.11	0.22	0.13	0.20	0.31	0.13	0.20	0.31	0.09	0.16	0.28	0.09	0.16	0.28	0.09	0.16	0.28
Manager 3	0.11	0.21	0.41	0.07	0.15	0.32	0.07	0.15	0.32	0.07	0.15	0.32	0.07	0.15	0.32	0.11	0.21	0.41
Manager 4	0.08	0.18	0.44	0.03	0.11	0.31	0.08	0.18	0.44	0.03	0.11	0.31	0.08	0.18	0.44	0.13	0.25	0.56
Manager 5	0.16	0.28	0.48	0.12	0.22	0.43	0.07	0.16	0.33	0.12	0.22	0.43	0.00	0.03	0.14	0.02	0.09	0.24
Manager 6	0.09	0.14	0.24	0.12	0.18	0.26	0.12	0.18	0.26	0.09	0.14	0.24	0.12	0.18	0.26	0.12	0.18	0.26

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Manager 7	0.10	0.18	0.32	0.06	0.13	0.25	0.06	0.13	0.25	0.10	0.18	0.32	0.10	0.18	0.32	0.14	0.23	0.36
Manager 8	0.11	0.19	0.38	0.11	0.19	0.38	0.15	0.25	0.42	0.06	0.14	0.29	0.06	0.14	0.29	0.02	0.08	0.21
Manager 9	0.03	0.12	0.36	0.03	0.12	0.36	0.03	0.12	0.36	0.08	0.19	0.50	0.08	0.19	0.50	0.13	0.27	0.64
Manager 10	0.03	0.12	0.36	0.03	0.12	0.36	0.03	0.12	0.36	0.03	0.12	0.36	0.13	0.27	0.64	0.13	0.27	0.64
Manager 11	0.06	0.12	0.23	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.13	0.21	0.33
Manager 12	0.10	0.18	0.35	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35
Manager 13	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35	0.06	0.13	0.27	0.10	0.18	0.35	0.10	0.18	0.35

Table 4.44 Normalized Fuzzy Values of David Model

Criteria	**Formality**			**Clarity**			**Measurability**			**Objectivity**			**Coverage**			**Consistency**		
μ	0.202			0.201			0.186			0.114			0.135			0.165		
	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}	a_{ij}^{i}	b_{ij}^{i}	c_{ij}^{i}
Manager 1	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 2	0.09	0.15	0.26	0.13	0.20	0.29	0.13	0.20	0.29	0.09	0.15	0.26	0.09	0.15	0.26	0.09	0.15	0.26
Manager 3	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 4	0.07	0.16	0.35	0.02	0.09	0.25	0.07	0.16	0.35	0.07	0.16	0.35	0.11	0.22	0.45	0.11	0.22	0.45
Manager 5	0.11	0.22	0.45	0.07	0.16	0.35	0.07	0.16	0.35	0.11	0.22	0.45	0.02	0.09	0.25	0.07	0.16	0.35
Manager 6	0.09	0.16	0.28	0.09	0.16	0.28	0.06	0.11	0.22	0.09	0.16	0.28	0.13	0.20	0.31	0.13	0.20	0.31
Manager 7	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25	0.06	0.13	0.25	0.10	0.18	0.32	0.14	0.23	0.36
Manager 8	0.15	0.24	0.38	0.10	0.18	0.35	0.15	0.24	0.38	0.06	0.13	0.27	0.02	0.08	0.19	0.06	0.13	0.27
Manager 9	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30	0.09	0.17	0.30
Manager 10	0.11	0.21	0.41	0.11	0.21	0.41	0.02	0.09	0.23	0.02	0.09	0.23	0.11	0.21	0.41	0.11	0.21	0.41
Manager 11	0.13	0.21	0.33	0.09	0.17	0.30	0.09	0.17	0.30	0.06	0.12	0.23	0.09	0.17	0.30	0.09	0.17	0.30
Manager 12	0.10	0.19	0.38	0.10	0.19	0.38	0.10	0.19	0.38	0.06	0.14	0.29	0.10	0.19	0.38	0.02	0.08	0.21
Manager 13	0.10	0.18	0.32	0.10	0.18	0.32	0.10	0.18	0.32	0.06	0.13	0.25	0.10	0.18	0.32	0.10	0.18	0.32