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Ali Asghar. Rezazadeh[1], Houshang. Taghizadeh[1*], Majid. Bagherzadeh Khajeh[1]

1 Department of Management, Ta.C., Islamic Azad University, Tabriz,iran

Corresponding author email address:
taghizadeh@iau.ac.ir

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Roadmap for Production Growth in Iran's Auto Parts Manufacturing Industry

ABSTRACT

The aim of this study was to develop a roadmap for production growth in Iran's auto parts manufacturing industry. The present research adopted a qualitative approach and, in terms of purpose, was developmental in nature. The statistical population consisted of an expert panel including senior executives, managers, and specialists familiar with the research subject within the scope of the study. Data were collected through in-depth interviews and group analysis. The validity and credibility of the findings were examined and confirmed through external reviewers and triangulation. Reliability was also confirmed using Cohen's Kappa coefficient, with a value of 0.726. Qualitative data were analyzed using thematic analysis based on the data obtained from the interviews. The conceptual model consisted of 12 major dimensions and 146 indicators or evaluative concepts, which were derived through the integration and categorization of key points and guiding codes. Among the principal dimensions of the model were: production growth factors from the perspective of resources and infrastructure in the auto parts manufacturing industry, comprising 16 constructs and 35 indicators; production growth factors from the technological perspective in the auto parts manufacturing industry, comprising 8 constructs (2 primary and 6 secondary) and 19 indicators; and production growth factors from the perspective of trends and orientations in product development within the auto parts manufacturing industry, comprising 12 constructs and 34 indicators. The final findings led to the development of a strategic model in the form of a production growth roadmap with both longitudinal and functional dimensions, which can serve as a comprehensive guide for strategic orientation in the industry.

Keywords: Production Growth, Small and Medium-Sized Enterprises (SMEs), Auto Parts Manufacturing Industry, Crisis Improvement Process, Strategic Orientation.

Introduction

Production growth has become a strategic concern for industrial economies seeking resilience, competitiveness, employment generation, and technological upgrading. In manufacturing-based economies, production growth is not merely a matter of increasing output volume; rather, it involves improving productivity, strengthening supply chains, upgrading technologies, developing human capital, enhancing market responsiveness, and building institutional capacities that enable firms to compete in uncertain and dynamic environments. This issue is particularly important in industries that operate as intermediate links in larger industrial ecosystems, such as the auto parts manufacturing industry, because their performance directly affects the competitiveness, quality, cost structure, innovation capacity, and sustainability of downstream industries [1-4]. In Iran, the auto parts manufacturing industry has a critical role in supporting the automotive sector, reducing import dependence, generating employment, developing small and medium-sized enterprises, and strengthening domestic industrial capabilities. However, achieving sustained production growth in this industry requires a comprehensive roadmap that can integrate resources, infrastructure, technology, research and development, market needs, and strategic orientation within a coherent framework.

The concept of production growth in Iran has been discussed in relation to structural industrial challenges, macroeconomic constraints, investment barriers, and the need for coherent policy interventions. Production boom requires simultaneous attention to economic, managerial, technological, and institutional factors rather than reliance on isolated short-term measures. Previous studies on production boom in Iran have emphasized that industrial development depends on identifying the effective factors involved in production performance and designing appropriate community and policy mechanisms to support productive activities [5]. Similarly, the challenges, strategies, and requirements of production boom in Iran have been linked to regulatory reform, financial support, market stability, and improvement of the business environment [6]. In the industrial sector, production growth has also been associated with solving operational bottlenecks, reducing policy uncertainty, enhancing access to capital, and improving the competitiveness of domestic firms [7]. These perspectives indicate that production growth in the auto parts manufacturing industry must be examined as a multidimensional phenomenon shaped by firm-level capabilities, supply-chain relations, state policies, market conditions, and technological transitions.

The auto parts manufacturing industry is especially important because it links production systems, supplier networks, industrial design, logistics, quality control, and final automotive assembly. The effectiveness of this industry depends on the ability of firms to produce reliable, cost-effective, and technologically compatible components for domestic and international automotive markets. In Iran, this issue is intensified by the need to reduce dependence on imported parts, respond to domestic automotive demand, improve product quality, and develop export capacity. At the firm level, production growth is strongly affected by investment decisions, capital structure, and the ability of companies to use financial resources for expansion, modernization, and strategic development. Research on companies' success in achieving the objectives of capital increase shows that financial restructuring and capital expansion should be evaluated in terms of their real contribution to corporate performance and development objectives [8]. Therefore, in the auto parts manufacturing industry, attracting and directing capital must be aligned with technological upgrading, production capacity development, supply-chain improvement, and long-term competitiveness.

In addition to financial capacity, organizational restructuring and strategic renewal are important foundations for production growth. Industries facing crisis, inefficiency, or declining competitiveness often require restructuring processes that address managerial systems, operational processes, market positioning, and resource allocation. Corporate restructuring literature emphasizes that firms must redesign their strategies, structures, and operational arrangements when existing configurations no longer support growth, profitability, or survival [9]. In the context of Iran's auto parts manufacturing industry, restructuring is relevant not only at the level of individual firms but also at the level of inter-firm networks, supplier relationships, research and development systems, and regulatory arrangements. Strategic tools such as SWOT-based planning also demonstrate the importance of identifying strengths, weaknesses, opportunities, and threats when formulating growth and profitability strategies [10]. Accordingly, a production growth roadmap must provide a structured way to connect internal industrial capabilities with external opportunities and constraints.

A major dimension of production growth in manufacturing industries is the implementation of lean production, quality improvement, and efficiency-oriented tools. Lean production emphasizes waste reduction, continuous improvement, process optimization, and value creation for customers. A roadmap for implementing lean production tools can help organizations sequence improvement activities and align operational tools with strategic priorities [11]. In auto parts manufacturing, lean

tools are especially relevant because component production requires precision, standardization, cost control, and responsiveness to focal automotive manufacturers. Recent evidence from new energy vehicle component manufacturing also shows that Lean Six Sigma can improve assembly precision in small and medium-sized enterprises, highlighting the importance of structured quality improvement methods in component-based manufacturing systems [12]. Moreover, optimizing auto manufacturing through integrated efficiency indicators such as overall equipment effectiveness can enhance productivity, sustainability, and operational reliability [13]. These findings suggest that production growth in the auto parts sector should be linked not only to increased capacity but also to systematic improvement in process quality, equipment performance, waste reduction, and production precision.

Technological transformation has become another essential pillar of production growth, particularly due to the emergence of Industry 4.0, digital manufacturing, smart production systems, and data-driven supply-chain management. The integration of Industry 4.0 into localized manufacturing can support sustainability, industrial diversification, and national development strategies, as shown in the assessment of the Saudi automotive industry model under Saudi Vision 2030 [1]. For Iran's auto parts manufacturing industry, Industry 4.0 offers opportunities for digitalization of production, smart monitoring, predictive maintenance, real-time supply-chain coordination, and customization of parts according to customer needs. However, technological development requires not only investment in machinery and digital infrastructure but also the development of human capabilities, inter-organizational collaboration, and access to updated knowledge resources. The importance of organizational and cultural factors in success and failure during new work arrangements also shows that technological and organizational transformations cannot be separated from internal cultural readiness and managerial alignment [14]. Therefore, a production growth roadmap must include technological infrastructure, digital capabilities, human-resource development, and organizational adaptation as interconnected components.

The global automotive industry is also undergoing major transitions driven by electrification, new energy vehicles, environmental regulation, and changing consumer expectations. The development of new energy vehicles has become a central issue in industrial policy, supply-chain reconfiguration, and technological competition. Supplier selection for new energy vehicles increasingly requires demand-driven approaches that integrate customer requirements, quality function deployment, ontology-based knowledge systems, and case-based reasoning [15]. In China and the European Union, the creation of hydrogen markets reflects experimental approaches to shaping future clean-energy industrial ecosystems [16]. China's ecological civilization discourse and new energy vehicle strategy further show how automotive development is increasingly embedded in environmental politics, energy transition, and industrial transformation [17]. These international developments indicate that auto parts manufacturers must prepare for technological changes in vehicle architecture, energy systems, component design, and sustainability requirements. For Iran, a production growth roadmap should therefore consider not only current market demands but also future product development trends, including electric mobility, renewable energy-related technologies, digital components, and smart automotive systems.

Experiences from other countries also show that automotive sector development depends on industrial diversification, localization, foreign cooperation, and state–industry coordination. The development of vehicle assembly plants of Chinese automobile brands in Kazakhstan has been analyzed as a mechanism for multisectoral diversification and economic sustainability [3]. China's role in Kazakhstan's automotive sector further illustrates the complexity and complementarity of multi-vector state-to-state engagement and product diversification [4]. These cases show that automotive and auto parts

industries are shaped not only by market forces but also by geopolitical relations, industrial partnerships, and national diversification strategies. For Iran's auto parts manufacturing industry, similar lessons can be drawn regarding the need to develop domestic capabilities, strengthen regional market presence, enhance strategic partnerships, and reduce vulnerability to external shocks. A roadmap approach can help identify the current position of the industry, expected future goals, and pathways for moving from existing constraints toward competitive development.

Sustainability and circular economy practices are increasingly central to manufacturing strategy. The automotive industry faces growing pressure to reduce environmental impacts, improve resource efficiency, recycle materials, and adopt circular production models. Barriers to implementing circular economy practices in the automotive industry include technological, regulatory, financial, supply-chain, and cultural obstacles [18]. These barriers are highly relevant to auto parts manufacturing because component production involves raw material consumption, energy use, waste generation, product life-cycle considerations, and end-of-life recovery. In addition, stakeholder perceptions and actions in the Indonesian automotive industry's transition toward electric mobility show that transport electrification depends on coordinated action among government, industry, consumers, and supporting institutions [2]. Therefore, production growth in Iran's auto parts manufacturing industry should not be conceptualized merely as quantitative expansion but as sustainable growth that integrates environmental responsibility, resource efficiency, and future-oriented technological development.

Human resources and managerial communication are also essential for production growth. Manufacturing performance is influenced by the knowledge, skills, motivation, and participation of shopfloor employees as well as the ability of managers to receive, interpret, and act upon operational feedback. Research on voice flow from the shopfloor in Iran demonstrates that employee voice may flow either to managers or around managers, highlighting the importance of managerial openness, communication structures, and organizational trust in Iranian workplaces [19]. In auto parts manufacturing, where operational problems, quality issues, process inefficiencies, and technical improvements are often first identified by workers and supervisors, effective communication channels can significantly affect continuous improvement and innovation. Additionally, credibility-building through firms' communication practices, such as social media posts, reflects the growing importance of organizational reputation, stakeholder trust, and strategic communication in business environments [20]. Thus, the roadmap for production growth should include managerial, communicative, and human-resource dimensions alongside technological and financial factors.

Research, development, and industrial design constitute another important basis for competitiveness in the auto parts manufacturing industry. Development of industrial design companies and structural advertising models demonstrates the importance of design capability, market communication, and innovation-oriented institutional support in industrial development [21]. In auto parts manufacturing, R&D is not limited to laboratory innovation; it includes product design, process improvement, material selection, prototyping, testing, quality engineering, and adaptation to focal manufacturers' technical requirements. Effective R&D systems can help firms identify future trends, develop differentiated products, improve quality, reduce costs, and respond to new vehicle platforms. Furthermore, inventory control in closed-loop supply-chain management using multi-objective programming in Iran Khodro's cutting and press factory highlights the importance of quantitative decision models, reverse logistics, and supply-chain optimization in the Iranian automotive production ecosystem [22]. These insights show that production growth requires alignment between R&D, production planning, inventory control, supply-chain management, and product development.

Market structure and demand conditions are equally decisive in shaping production growth. Auto parts manufacturers must respond to domestic focal factories, spare-parts retail markets, export opportunities, regional competitors, and global quality standards. Market transparency, access to reliable demand information, price stability, and reduction of rent-seeking behavior are important conditions for industrial growth. At the same time, the emergence of foreign competitors, technological standards, and international supply chains requires domestic firms to improve cost competitiveness, product quality, and flexibility. The automotive transitions observed in China, Kazakhstan, Saudi Arabia, Indonesia, and other contexts show that competitive development depends on the interaction of industrial policy, supplier capabilities, market needs, and technological adaptation [1-4]. Therefore, a roadmap for Iran's auto parts manufacturing industry should identify both the existing position and expected future status of the industry in relation to market needs, technological requirements, production capabilities, and strategic goals.

Given the multidimensional nature of production growth, the roadmap approach is suitable because it enables the integration of strategic objectives, current capabilities, future needs, technological pathways, and implementation mechanisms. A roadmap can clarify what the industry seeks to achieve, where it currently stands, what resources and capabilities are required, and how the transition toward the desired future should occur. In the auto parts manufacturing industry, such a roadmap must cover workshop components, including resources, infrastructure, R&D, technology, product development trends, and market needs, as well as longitudinal or structural components, including current status, expected objectives, and pathways for achievement. By integrating insights from production boom studies, restructuring, lean production, Industry 4.0, sustainability, R&D, supply-chain management, and market-oriented product development, the roadmap can serve as a comprehensive guide for policymakers, managers, investors, and industrial stakeholders.

Therefore, the aim of this study is to design a roadmap for production growth in Iran's auto parts manufacturing industry by identifying and structuring the key factors, components, objectives, current conditions, and strategic pathways required for sustainable industrial development.

Methodology

The methodology of the present study, in terms of its philosophical foundation, involved a combination of interpretivist and positivist paradigms and had a fundamental–developmental orientation. Moreover, the research approach in the qualitative section was deductive, and the research also had a mixed nature through the use of both library-based information and field data. The research strategy was a survey strategy consistent with the thematic analysis approach applied to the interviews. The purpose of the research combined explanation and prediction, exploration, and description. The qualitative data were collected, categorized, and analyzed based on the thematic analysis approach through the collection, classification, and analysis of interview outputs. In addition, the present study was applied–developmental in terms of purpose and descriptive and causal in terms of research nature. Furthermore, in terms of data type, the present study was a sequential mixed-methods study. That is, qualitative data were first collected through interviews and then analyzed. After analyzing the qualitative data, quantitative data were collected and analyzed in two stages based on the results obtained from the qualitative phase. Therefore, the strategic foundation of the present research consisted of qualitative and quantitative sections using a mixed-methods approach. Mixed methods focus on the simultaneous collection, analysis, and integration of qualitative and quantitative data in a single study or a set of studies. In the present study, observation, review of documents

and records related to the research, and a field approach were used for data collection. The research instruments also included semi-structured interviews, researcher-made questionnaires, and research note cards.

In this study, theoretical sampling was used to conduct the interviews. This is the most common sampling method in thematic analysis based on field research (Charmaz, 2011, p. 433; Charmaz & Belgrave, 2002, p. 34), in such a way that decisions regarding what data should be collected next are determined by the emerging theory (Charmaz, 2014, p. 433). In addition, the sampling process continues until the theoretical sufficiency of the findings is achieved (Strauss & Corbin, 2016, p. 211). The sampling approach was also convenience sampling. This approach was used both for selecting interviewees and for selecting respondents to the research questionnaires from the statistical population. Therefore, based on the requirements of theoretical sampling, the sample members were selected using purposive and convenience sampling in the first stage and snowball sampling in the subsequent stage, and this process continued until theoretical saturation was reached. For selecting interviewees, a non-probability sampling method, specifically purposive judgmental sampling, was used. In selecting experts, an effort was made to ensure that all participants met the required selection criteria, including extensive experience, executive experience at senior levels, academic and research backgrounds relevant to the subject under study, higher education degrees, namely a master's degree or doctorate, and deep familiarity with advanced concepts in the field.

The participants in this study were selected from national experts and academics. In the first stage of sampling, theoretical sampling was used. Theoretical sampling is a type of purposive sampling that assists the researcher in creating or discovering a theory or concepts that have an established theoretical connection with the emerging theory. In theoretical sampling, events are sampled, not necessarily individuals; even when individuals are selected, the purpose is to explore events, namely events that represent various categories related to the phenomenon under investigation. The guides for theoretical sampling are the questions and comparisons that emerge during the analysis of interview content and lead to the discovery of appropriate categories, as well as their properties and dimensions. The data collection instrument at this stage of the study consisted of remote interviews, conducted by posing questions derived from the hypotheses and research questions through email and virtual platforms. This was done due to the very long distance between the researcher and some members of the focus group. The focus group members were selected purposively based on their scientific expertise, executive experience in the relevant field, higher university education, and the quality of their scientific and research backgrounds in the relevant area. The participants were asked about approaches related to production growth in Iran's auto parts manufacturing industry. Follow-up questions were posed to direct the discussions and reach categories related to the subject under investigation. A sample of the main interview questions is presented in the appendix, and the interviewees responded to these questions. Theoretical sampling continued until the categories reached theoretical saturation. Theoretical saturation is the stage at which no new data emerge in relation to a category, the category gains sufficient scope, and relationships among categories are established and confirmed. Coding was conducted simultaneously with data collection. In this study, theoretical saturation was achieved in the fourteenth interview. Nevertheless, the process continued until the eighteenth interview. In addition, outside the expert group, four additional individuals were selected as experts for reviewing and controlling the quality of various outputs of the qualitative research method in this study. While conducting the interviews, the researcher used their opinions in different parts of the process to examine the validity and reliability of the model.

To increase credibility and validity and to ensure the outputs of the first stage of the research, namely the accuracy of the findings from the researcher's perspective, triangulation and external reviewers were used. Cohen's kappa coefficient was used to assess the reliability of the designed models. Cohen's kappa coefficient is considered part of the sixth step in quality control of the findings of thematic content analysis and theme formation from the perspective of Sandelowski and Barroso (2007). Accordingly, after the model was finalized, an expert who was outside the normal process of theoretical model analysis and who was a researcher and expert in the research field and familiar with the qualitative analysis approach, without being informed of how the final integration of the codes and concepts had been conducted, and having access only to the open codes or guiding points extracted from the texts for a specific interview, categorized the codes into concepts. Then, the concepts presented by the researcher were compared with those presented by the expert, and the kappa coefficient was calculated based on the number of created concepts, similarities, and different concepts created. The results of the kappa coefficient calculation using SPSS at a 95% confidence level are presented in the following table.

Table 1

Examination of the Level of Coding Agreement Between the Researcher and the First Expert Regarding the Selected Interview

Measure	Value	Approximate Standard Error[a]	Approximate T[b]	Approximate Significance (Sig.)
Measure of agreement: Kappa	0.726	0.246	6.758	0.002

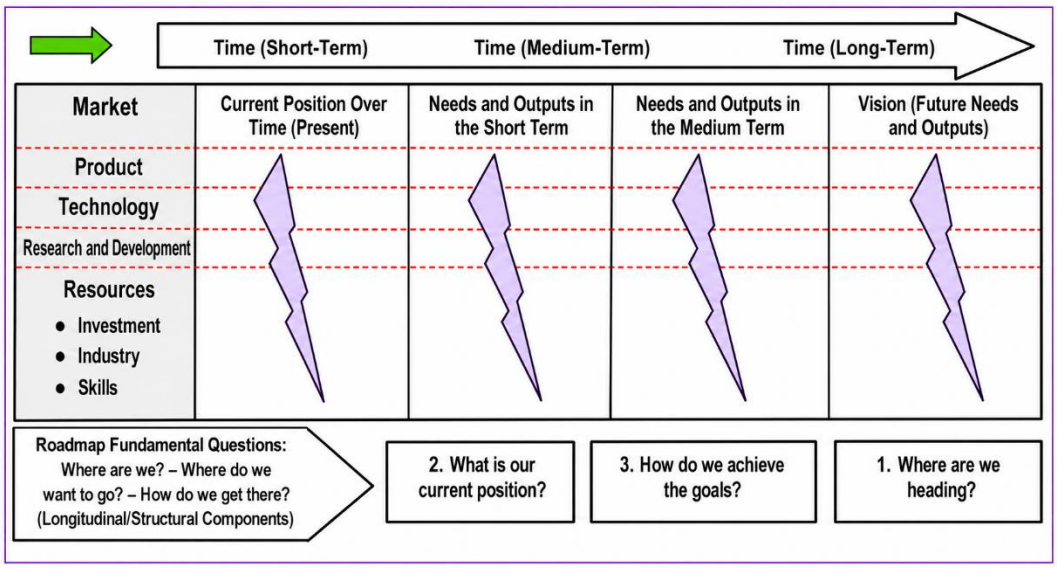
[a] Not assuming the null hypothesis. [b] Using the asymptotic standard error assuming the null hypothesis.

According to the above, the kappa coefficient calculated for the qualitative model was 0.726, which, given the numerical value of the kappa coefficient, indicates that the level of agreement or reliability of the model was appropriate.

The process of qualitative data collection was conducted in accordance with the thematic analysis approach, and modeling was performed using the roadmapping approach of Phaal et al. (2024). After summarizing the obtained information, the final themes were categorized, and the final classification was submitted to the focus group members for the final round. Finally, the roadmap model was conceptually formed according to Phaal et al. (2024). Figure 1 presents a general schematic of the roadmap formation model at the strategic level.

Figure 1

General schematic of the roadmap formation model at the strategic level



The general objective of this research is to design a roadmap for production growth in Iran's auto parts manufacturing industry. In accordance with the model of Phaal et al. (2024), the following specific objectives can be proposed:

A) Specific objectives related to the formation of the workshop components of the roadmap:

1. Determining production growth factors from the perspective of resource and infrastructure development in the auto parts manufacturing industry;
2. Determining production growth factors from the perspective of research and development in the auto parts manufacturing industry;
3. Determining production growth factors from the perspective of technological development in the auto parts manufacturing industry;
4. Determining production growth factors from the perspective of orientations in product development trends in the auto parts manufacturing industry;
5. Determining production growth factors in the auto parts manufacturing industry from the perspective of market conditions and needs;

B) Specific objectives related to the formation of the longitudinal or structural components of the roadmap:

6. Determining the expected objectives in the production growth roadmap for the auto parts manufacturing industry;
7. Determining the current position of the auto parts manufacturing industry relative to the expected objectives in the roadmap;
8. Identifying and determining methods or approaches for achieving and realizing the expected objectives in the production growth roadmap for the auto parts manufacturing industry.

Specific objectives related to evaluating and determining the validity and fit among different sections of the conceptual roadmap model:

9. Determining the criteria and indicators for evaluating the fit among the components and the overall model of the production growth roadmap in the auto parts manufacturing industry;
10. Determining the validity of the different components and the overall model explained in the form of the production growth roadmap in the auto parts manufacturing industry from the experts' perspective.

Findings and Results

The findings related to the workshop components of the roadmap, in line with achieving the objectives, indicated the development of a conceptual model consisting of 12 main dimensions and 146 indicators or evaluative concepts, which were summarized and obtained through the integration and categorization of guiding points or codes. Among the main dimensions of the model were production growth factors from the perspective of resources and infrastructure in the auto parts manufacturing industry, consisting of 16 constructs and 35 indicators; production growth factors from the technological perspective in the auto parts manufacturing industry, consisting of 8 constructs, including 2 main and 6 subconstructs, and 19 indicators; and production growth factors from the perspective of trends and orientations in product development in the auto parts manufacturing industry, consisting of 12 constructs and 34 indicators. Table 2 presents the conceptual model of production growth factors from the perspective of workshop components.

Table 2

Conceptual Model of Production Growth Factors from the Perspective of Workshop Components

Integrating Theme	Global Themes	Organizing Themes	Basic Themes
Production growth factors from the perspective of resource and infrastructure development in the auto parts manufacturing industry	Systematic development of investment in the auto parts manufacturing industry	Systematizing capital attraction	Attracting capital with the aim of strategic development of the auto parts manufacturing industry and its supply chains
			Paying attention to long-term benefits versus short-term benefits in the industry investment process
			Ensuring private-sector investment security in the auto parts manufacturing industry by governing institutions
		Targeted direction of large-scale capital in the industry	Conducting cost–benefit analysis to estimate strengths and weaknesses in the industry's investment portfolio
			Targeted supervision of financing entrepreneurial activities toward enhancing production growth in the auto parts manufacturing industry
			Investing in strengthening and directing material and information flows in auto parts manufacturing supply chains
			Appropriate location selection for new investment from the perspective of enhancing competitive advantages in the auto parts manufacturing industry
	Development and updating of brainware resources	Enhancing the capabilities of existing brainware	Specialized and professional empowerment of human resources active in the auto parts manufacturing industry
			Holding training courses to update the knowledge of the auto parts manufacturing workforce
			Strengthening the relationship between industry and academic environments to empower the brainware resources of the auto parts manufacturing industry
		Attracting the required brainware for competitiveness and development of the auto parts manufacturing industry	Updating the infrastructure for attracting human resources in the auto parts manufacturing industry
			Creating a form of standardization and coordination in the process of recruiting capable human resources in the auto parts manufacturing industry
	Development and updating of hardware resources	Manufacturing and production infrastructure	Updating the production systems, including processes and operations, of firms active in the auto parts manufacturing industry
			Developing and updating access to modern machinery and equipment for active auto parts manufacturing firms
		Updating hardware resources in technological development	Investing in emerging technologies in the auto parts manufacturing industry to align with Industry 4.0 requirements
			Upgrading equipment and machinery to increase quality and production speed in the auto parts manufacturing industry
			Developing and updating technological infrastructure in the auto parts manufacturing industry
		Communication, monitoring, and control infrastructure	Strengthening and developing information-flow infrastructure in auto parts manufacturing supply chains in accordance with Industry 4.0 requirements
			Improving output monitoring processes through the development of tracking and analysis systems for auto parts manufacturers' products in focal factories and final products, namely automobiles
			Improving the performance of monitoring systems in auto parts manufacturers' supply chains
			Enhancing monitoring and control systems in supply chains in accordance with Industry 4.0 requirements
	Factors related to industrial environmental conditions	Changes in legal infrastructure related to the industry in accordance with production growth objectives	Strengthening legal infrastructure that encourages consumption of domestic products
			Government support programs and regulatory policies in the development of resources and infrastructure
		Legislation to enhance the attractiveness of private-sector investment in the auto parts manufacturing industry	Legislation aimed at eliminating black-market rent-seeking in favor of dealers and intermediaries in the auto parts manufacturing industry and attempting to allow auto parts manufacturers to benefit from intermediation profits

			Legislation aimed at eliminating intermediation rents and transferring profit based on the cost price of auto parts manufacturing products to producers
			Removing problems, complexities, and barriers facing new investors in obtaining permits when establishing an industrial auto parts manufacturing unit
		Social resources related to production growth	Public encouragement to prefer the use of domestic materials and products related to the automotive industry and affiliated industries over foreign equivalents
			Strengthening and directing social capital toward preference for domestically manufactured goods
			Increasing the social popularity of domestic products
Growth and development in planning and research and development (R&D) in the auto parts manufacturing industry	Collaborative research and development	Collaboration with scientific and academic institutions in the research and development process	Collaborative research and development with universities and scientific institutions
			Attracting innovation factors through partnership in access to credible and up-to-date knowledge resources in the company's field of activity
		Promoting collaboration with other components in the chain	Collaborative research and development within supply chains among downstream auto parts manufacturers
			Collaborative research and development within supply chains among upstream auto parts manufacturers
			Collaborative research and development between auto parts manufacturers and focal factories
		Focus on sustainable collaborative development	Research and development with consideration of reducing the environmental impacts of production
			Research and development with consideration of using renewable and recycled raw materials
			Research and development with consideration of producing durable and recyclable products
	Future-oriented research and development	Future-oriented research and development with medium-term objectives	Foresight through research and development to improve medium-term competitiveness
			Research and development aimed at product adjustment for expanding target markets
			Research and development to identify endogenous forces and other existing and accessible capacities
			Research and development aimed at creating an innovation portfolio
		Future-oriented research and development with long-term objectives	Identifying and forecasting future trends and developing emerging technologies in the auto parts manufacturing industry
			Research and development aimed at identifying and forecasting future trends and developing emerging technologies
			Foresight in research and development of technologies related to renewable energy or artificial intelligence in auto parts manufacturing
	Applied and profitability-oriented research and development	Development of key technologies	Focusing on developing technologies that are critical to the company's long-term competitiveness
			Research and development focused on creating sustainable competitive advantage
		Attracting financial support for research and development aimed at profitability	Government financial support in the early stages of research and development with the aim of strategic partnership in outputs
			Private-sector support for research and development projects in line with patent rights and growth of intellectual capital in the industry
	Goal-oriented research and development	Growth and development of R&D	Establishing and developing research and development centers
			Developing centers aimed at enhancing innovation and introducing new products and services
			Developing centers aimed at improving product quality
			Developing centers aimed at advancing manufacturing and production technologies
		Targeted financing of R&D	Achieving balance between R&D expenditures and their outputs
			Aligning research and development costs with target market needs

		Targeted development of R&D tools	Emphasizing the improvement of human-resource quality based on research and development objectives
			Recruiting efficient and creative personnel based on research and development objectives
			Retaining key human capital from the perspective of R&D objectives in the industry
			Existence of a selection process based on various indicators, including cost, performance, quality, and other factors, for R&D processes in the company
		Improving the planning system and production planning	Alignment of research and development programs with the technological status and existing processes in the auto parts manufacturing industry
			Planning to create and develop new processes for improving product production
			Conducting field and statistical analyses based on identifying customers and the target market
			Planning research and development using a customer-survey system
Trends and orientations in product development in the auto parts manufacturing industry	Market orientation in product development	Targeted identification of markets related to products	Identifying market gaps for auto parts manufacturers in target markets and developing products based on them
			Developing products based on precise analysis of customer needs by target market
		Flexibility of product development based on market needs	Ability to adjust and modify product development processes based on customer feedback
			Ability to adjust and modify product development processes based on market changes
			Possibility of customizing auto parts manufacturing products based on the specific needs of customers, namely focal factories
	Cost–benefit orientation in selecting the product development trend	Cost–benefit orientation based on sustainability objectives	Selecting the product development portfolio of auto parts manufacturing based on reducing environmental risks in the production process
			Determining the product development trend in auto parts manufacturing based on reducing environmental risks during consumption and throughout the product life cycle
		Cost–benefit orientation based on market risk management	Identifying risks related to producing parts in the target market and making production decisions accordingly
			Determining product development strategies based on risk-reduction objectives
		Cost–benefit orientation based on benefits	Identifying and analyzing potential and actual benefits before initiating auto parts product development trends
			Examining direct and indirect benefits in new product development, such as increased sales, market share, customer satisfaction, and branding
	Competition-oriented product development	Targeting production and operations infrastructure	Competitive targeting in the development of production infrastructure, factory operations, machinery, and equipment with the aim of producing high-quality products from the perspective of international markets
			Reconfiguring production infrastructure, equipment, and factory operations with the aim of producing products at competitive prices compared with competitors in international markets
		Competition orientation through Industry 4.0 tools in product development	Digitalizing production processes to improve quality, reduce production time, and produce customized products
			Digitalizing new product design processes to improve quality and increase the level of parts customization
			Developing products in response to market demand in the auto parts manufacturing industry
			Developing products in accordance with new changes and trends in the automotive, electronics, and other industries
		Intelligent competition orientation related to the product	More modern and functional designs for products to improve performance
			Creating more modern and functional designs for products that help improve performance and ease of use
			Integrating advanced technologies, such as the Internet of Things (IoT), into products to increase functionality and access to data without human intervention
			Flexibility and customization: the ability to produce diverse and customized products based on customer needs, which can lead to increased customer satisfaction and loyalty

		Product development based on a differentiation strategy	Targeting uniqueness and distinctiveness of products
			Orienting product development toward differentiation from foreign equivalents
			Emphasizing the creation of differentiated products through various innovations
		Development based on the requirements of focal factories	Developing products based on platform classification, namely classes of vehicles produced by the focal factory that have similar basic structures
			Flexibility and customization: the ability to produce diverse and customized products based on customer needs, which can lead to increased customer satisfaction and loyalty
	Innovation orientation in product development	Enhancing innovation in product development trends	Innovation in product design
			Innovation in the manufacturing and production process of products
			Innovation-oriented product development
			Presenting product innovation based on firms' specialized strengths
		Orientation toward innovation	Targeted innovations for developing new technologies and creative ideas
			Efforts to generate targeted innovations to enhance competitiveness
Production growth factors from the perspective of market conditions and needs in the auto parts manufacturing industry	Market conditions	Openness and transparency in the market	Information asymmetry between focal factories and auto parts manufacturers in upstream chain market processes, particularly regarding parts design and production documentation
			Possibility of using real-time information flows to determine market conditions in terms of supply and demand across the layers of the auto parts manufacturing supply chain
			Information transparency of focal factories in downstream chain marketing processes, particularly regarding information flows related to spare-parts inventory and after-sales services
			Absence of monopolistic flows and rent-seeking groups in the market and movement toward competitive markets
			Existence of mechanisms for easy access by auto parts manufacturers to the information required for conducting field analyses based on identifying customers and their needs in target markets
		Macroeconomic processes affecting the market	Impact of macroeconomic trends on price stability or instability across different time periods in target markets
			Impact of macro-political and economic trends on access to raw materials and machinery required for production, marketing, and product development orientations
			Establishment of relative market stability and absence of frequent changes in exchange rates and prices
		Domestic market conditions and regional or local competitors	General condition of the country's auto parts manufacturing industry compared with competitors and their capabilities in domestic and regional markets
			Condition and capability of the country's auto parts manufacturing industry in responding to changes in the tastes and needs of domestic and regional customers
			Functional capabilities of systems for identifying strengths and addressing weaknesses of auto parts manufacturing firms in the country compared with their regional competitors
			Price and quality of products produced by domestic auto parts manufacturing firms compared with the price and quality of similar imported products
			Fluctuations in supply, demand, and needs of domestic and regional or local auto parts markets
			Degree of orientation of the automotive market, domestic and regional, toward activity and cooperation with key customers and signing long-term contracts with large and well-known companies compared with local and domestic companies
		Foreign market conditions and leading industrial competitors	Status of production, supply, and marketing technology in the country's auto parts manufacturing industry compared with leading competitors and their capabilities in new and international markets

			Status of the country's auto parts manufacturing products in terms of competitiveness with first-tier foreign equivalents from the perspective of price and final cost
			Status of the country's auto parts manufacturing products in terms of competitiveness with first-tier foreign equivalents from the perspective of product quality
			Functional capabilities of systems for identifying and strengthening strengths and addressing weaknesses of auto parts manufacturing firms in the country compared with world-class leading competitors
			Ability of the country's auto parts manufacturing firms to respond to changes in the tastes and needs of foreign customers
			Final cost of products exported by domestic auto parts manufacturing firms compared with the price and quality of similar products in international markets
	Market needs	Domestic market needs	Status of the needs and demands of domestic customers, including domestic focal factories and auto-parts retailers, regarding produced products
			Level of efforts related to improving and enhancing production to improve product status in new and export markets
			Ability to regulate and target production capacity for sales in the domestic market in accordance with market needs
			Fluctuations in supply, demand, and needs in the domestic auto parts market
			Macroeconomic developments, including growth rate, unemployment rate, and customers' purchasing power, and their impact on domestic market demand and needs
		Needs of foreign markets or new markets	Demand of foreign customers, including foreign focal factories and auto-parts retailers, in the effective operational domain of the country's auto parts manufacturing industry
			Ability to regulate and target auto parts manufacturers' production capacities in accordance with sales objectives and the needs of new markets or competitive markets outside the country
			Level of competition and rate of emergence of new competitors in foreign and international markets of the auto parts manufacturing industry and their impact on determining desirable price and quality in the market
Production growth factors from the perspective of technological development in the auto parts manufacturing industry	Development of technological infrastructure in the industry	Attracting and using capital in the development of technological infrastructure	Investing in research projects to discover and develop new technologies to improve quality and reduce costs
			Possibility of attracting private-sector capital for commercializing emerging technologies in the auto parts manufacturing industry
			Easy access by auto parts manufacturing firms to the capital required to finance technology development projects
		Creating interactive infrastructure for technological development	Establishing innovation networks and interaction among companies, universities, and research centers
			Interactive infrastructure to facilitate access to technological resources
			Interactive infrastructure for access to strategic materials and advanced technologies
		Diversity in investment sources for technological development	Ensuring access to capital resources for financing technological and innovative projects by the government
			Ensuring access to capital resources for financing technological and innovative projects by private investors
	Development of technological capabilities	Development of individual capabilities of human resources active in the industry	Using an individualistic perspective in consolidating expertise to shape the workforce and increase the rate of skilled and trained workers for creating and implementing new technologies
			Possibility of providing specialized supplementary training for human resources based on interests and individual development
		Development of collective technological capabilities of human resources active in the industry	Requiring human resources to obtain valid specialized and professional certifications within the framework of job qualification requirements in various fields of auto parts manufacturing
			Using the Technology Development Package (TDE) to create alignment between technology and innovation, improve

		quality, and increase efficiency in small and large auto parts manufacturing companies
		Expanding the Technology Development Package (TDE) in small and large auto parts manufacturing companies to create alignment between technology and innovation, improve quality, and increase efficiency
		Integrating advanced technologies, such as the Internet of Things (IoT), into products to increase functionality and access to data without human intervention
	Enhancing organizational capital through effective cooperation with research and academic institutions	Cooperation with research institutions and universities to improve specialization in attracting and applying up-to-date technologies
		Establishing cooperation with scientific centers to develop emerging technologies and transfer knowledge to the auto parts manufacturing industry
		Providing specialized training courses for employees to familiarize them with new technologies and update their skills

The findings related to determining the expected objectives in the production growth roadmap for the auto parts manufacturing industry and the current position were formed within 5 integrating themes and 11 organizing themes, in a conceptual framework consisting of 47 basic themes. Table 3 presents the findings related to the longitudinal or structural components of the roadmap.

Table 3

Findings Related to the Longitudinal or Structural Components of the Roadmap

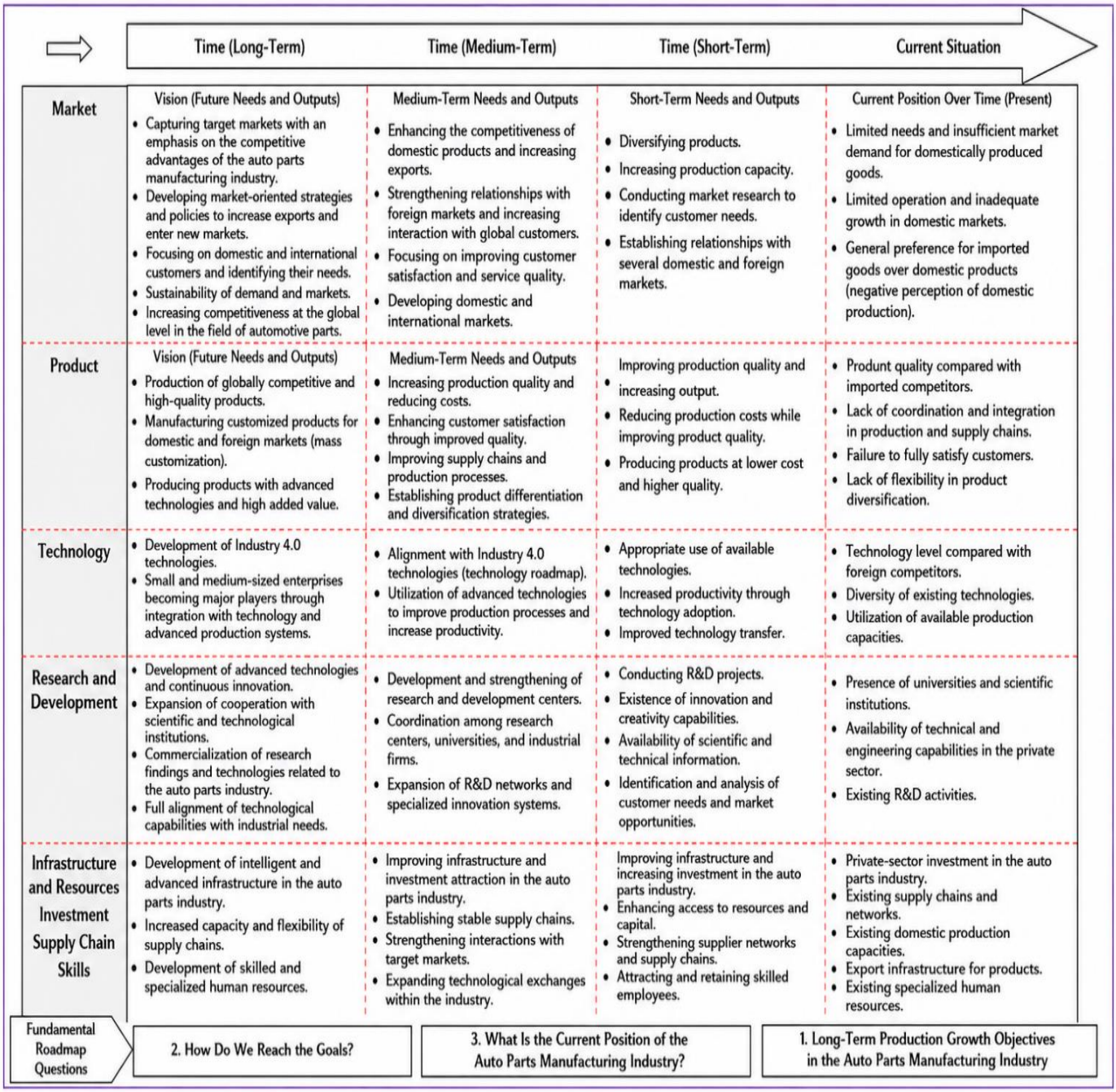
Integrating Theme	Organizing Themes	Basic Themes
Enhancing the competitiveness of the auto parts manufacturing industry	General enhancement of relative competitive advantages	Producing auto parts manufacturing products that can compete with existing competitors in international markets
		Producing all required parts related to domestically produced vehicles, namely complete self-sufficiency
		Appropriate location selection from the perspective of enhancing competitive advantages
		Precise selection of produced parts based on the needs of up-to-date vehicles worldwide
		For new investment in the auto parts manufacturing industry
		Establishing systems for identifying strengths and addressing firms' weaknesses
		Creating and developing monitoring and control systems surrounding the industry
	Protection of companies' intellectual assets	Removing barriers to the commercialization of intellectual property and strictly complying with judicial laws related to the auto parts manufacturing industry
		Protecting intellectual property rights by using active and specialized monitoring teams in the auto parts manufacturing business environment
		Using precise information-classification systems to preserve the intellectual assets of auto parts manufacturing companies
		Training and raising employees' awareness regarding the preservation of intellectual assets of auto parts manufacturing companies
		Providing adequate protection for data related to sensitive intellectual property of auto parts manufacturing companies
Increasing the level of employment generation using the capacities of the auto parts manufacturing industry	Using the existing capacities of the auto parts manufacturing industry for sustainable employment generation	Granting financial benefits and incentives to firms in the auto parts manufacturing industry for sustainable recruitment and employment of domestic human resources
		Establishing laws and regulations supporting producers in the auto parts manufacturing industry with the aim of controlling imports of goods that have domestic equivalents
	Enhancing private-sector participation	Encouraging private investment in the auto parts manufacturing industry with the aim of sustainable employment generation, improving quality of life, and increasing social welfare
		Facilitating value-creation processes in the auto parts manufacturing industry through enhanced cooperation between the public and private sectors
		Creating favorable conditions for private-sector economic activities in the auto parts manufacturing industry

	Creating new capacities and facilities for sustainable employment in the auto parts manufacturing industry	Ease and openness in the process of creating new businesses in the auto parts manufacturing industry
		Financial incentives for sustainable employment and establishment of new units in the auto parts manufacturing industry
		Tax exemptions for creating and maintaining long-term employment generation in the auto parts manufacturing industry
		Increasing the attractiveness of new investment in production and employment generation in the auto parts manufacturing industry
		Creating new job opportunities by attracting private-sector capital for industries related to auto parts manufacturing
Sustainability at different levels	Enhancing economic sustainability	Achieving sustainable economic growth in the automotive sector
		Stability of procedures in the export process of products with the aim of enhancing economic sustainability
		Impact on stabilizing the inflation rate in supplying people's basic needs in the field of automotive parts
		Strengthening the country's economic foundation by increasing production and reducing economic fluctuations
		Creating price stability and meeting society's needs
		Eliminating intermediation rents and providing society and producers with access to a transparent and competitive market in the auto parts manufacturing industry
	Environmental sustainability	Developing sustainable production and reducing negative impacts on the environment
		Supporting green technologies and using renewable resources
	Socio-political sustainability	Reducing dependence on imports, especially imports related to the automotive industry
		Developing and improving domestic production processes to meet market needs and reduce dependence on foreign goods in the field of auto parts manufacturing
		Encouraging and promoting the use of domestic materials and products related to the automotive industry and affiliated industries
		Enhancing public welfare and satisfaction, especially regarding access to high-quality domestically produced automotive products for the general public
	Sustainable upgrading and improvement of basic infrastructure related to the auto parts manufacturing industry	Attracting investment to upgrade and improve transportation infrastructure and affiliated industries
		Attracting investment to upgrade and improve information technology infrastructure related to the industry
		Sustainability in access to energy, primary resources, and target markets related to the automotive and auto parts manufacturing industries
Enhancing research, development, and technology	Research, development, and innovation	Encouraging research and development in various industries to improve and enhance the quality of auto parts manufacturing products
		Supporting startups and innovative businesses in the field of auto parts manufacturing and other industries related to automobile production
	Technological enhancement	Developing and upgrading technological infrastructure in the field of auto parts manufacturing
		Improving access to strategic materials and advanced technologies
		General development of technological capabilities at the level of the auto parts manufacturing industry
Promoting exports and reducing dependence	Generating income from exports of automotive parts	Promoting exports and supporting producers in entering international markets
		Facilitating the export process and reducing trade barriers
	Reducing dependence on imports of automotive parts	Developing domestic production to meet market needs and reduce dependence on foreign goods
		Reducing dependence on imports and promoting the use of domestic materials and products

Finally, as a summary, the following figure presents the production growth roadmap, with an emphasis on longitudinal or structural components, namely the current status and expected status, as the final finding.

Figure 2

Production growth roadmap with emphasis on longitudinal or structural components: current status and expected status



The following table presents the criteria and indicators for evaluating the fit among the components of the production growth roadmap model in the auto parts manufacturing industry.

Table 4

Output of Findings Related to Examining the Criteria and Indicators for Evaluating the Fit Among the Components of the Production Growth Roadmap Model in the Auto Parts Manufacturing Industry

Dimension	Criterion / Indicator	Empirical Mean	t Statistic	Significance Level	Result
Process adequacy	Adequacy of the process in achieving the final classification for guided codes in forming different sections of the roadmap	4.7501	19.671	0.000	Confirmed
	Adequacy of the overall structure and component process in forming data for the workshop section of the roadmap	4.233	12.821	0.000	Confirmed
	Adequacy of the overall structure and component process in forming data for the longitudinal or structural section of the roadmap	4.543	13.996	0.000	Confirmed
	Adequacy of activities in preparing the report and describing raw data for modeling different sections of the roadmap	4.264	13.464	0.000	Confirmed
Content richness	Richness of the final content related to the overall workshop components of the roadmap	3.742	11.456	0.000	Confirmed
	Richness of the final content related to the overall structure and nature of the longitudinal or structural components of the roadmap	4.545	12.365	0.000	Confirmed
	Researcher's accuracy in creating content and presenting the written report related to the steps of forming outputs in the roadmap modeling process	4.535	14.361	0.000	Confirmed
Analytical quality	Presentation of interpretive findings along with analysis of some complex and ambiguous data in the theoretical roadmap model	4.172	12.574	0.000	Confirmed
	Consistency among outputs, analyses, and data, namely consistency between guided codes and open codes	4.524	19.430	0.000	Confirmed
	Presentation of convincing and organized analyses of data, namely extraction of appropriate guided codes from open codes	4.643	12.821	0.000	Confirmed
	Establishment of an appropriate balance between analyses and data extracted from qualitative approaches	4.241	11.321	0.000	Confirmed
	Quality of analysis and extraction of the qualitative model findings report	4.7501	19.671	0.000	Confirmed

What is the status of the different components and the overall model explained in the form of the production growth roadmap in the auto parts manufacturing industry from the experts' perspective in terms of validity?

What is the validity status of the model explained in the form of the production growth roadmap in the auto parts manufacturing industry from the experts' perspective?

Table 5

Validity of the Production Growth Roadmap in the Auto Parts Manufacturing Industry from the Experts' Perspective

Main Validation Sections	Criterion	Empirical Mean	t Statistic	Significance Level	Result
Process validity	Adequacy in the final classification of guided codes in the roadmap	4.322	12.651	0.000	Confirmed
	Adequacy of the component process in the workshop section of the roadmap	4.7501	19.671	0.000	Confirmed
	Adequacy of the component process in the structural section of the roadmap	4.233	12.821	0.000	Confirmed
	Adequacy of the reporting and data description process	4.543	13.996	0.000	Confirmed
Content validity	Richness of the content related to the overall workshop components of the roadmap	4.264	13.464	0.000	Confirmed
	Richness of the content related to the overall structure and nature of the longitudinal or structural components of the roadmap	3.742	11.456	0.000	Confirmed
	Researcher's accuracy in creating content and presenting the written report related to the steps of forming outputs in the roadmap modeling process	4.545	12.365	0.000	Confirmed
Qualitative–analytical validity	Presentation of interpretive findings along with analysis of some complex and ambiguous data in the theoretical roadmap model	4.535	14.361	0.000	Confirmed
	Consistency among outputs, analyses, and data, namely consistency between guided codes and open codes	4.172	12.574	0.000	Confirmed
	Presentation of convincing and organized analyses of data, namely extraction of appropriate guided codes from open codes	4.524	19.430	0.000	Confirmed
	Establishment of an appropriate balance between analyses and data extracted from qualitative approaches	4.643	12.821	0.000	Confirmed
	Quality of analysis and extraction of the qualitative model findings report	4.241	11.321	0.000	Confirmed

According to the research model, production growth factors from the perspective of trends and orientations in product development in the auto parts manufacturing industry within the model include 12 constructs and 34 indicators, which were validated using confirmatory factor analysis.

Discussion and Conclusion

The findings of the present study led to the development of a comprehensive roadmap for production growth in Iran's auto parts manufacturing industry. The proposed roadmap was structured around two complementary dimensions: workshop components and longitudinal (structural) components. The workshop dimension identified the key drivers of production growth, including resource and infrastructure development, research and development, technological development, product development trends, and market conditions and needs. The longitudinal dimension focused on expected goals, current industrial conditions, and pathways for achieving the desired future state. The findings further demonstrated that production growth in the auto parts manufacturing industry is not driven by a single factor but rather emerges from the interaction among investment systems, technological capabilities, innovation processes, market responsiveness, supply-chain efficiency, and supportive institutional frameworks. Moreover, the validation results indicated strong process adequacy, content richness, analytical quality, and overall credibility of the proposed roadmap model, suggesting that the identified components provide a coherent representation of the factors influencing production growth in the industry.

One of the most important findings of this study was the central role of resources and infrastructure in promoting production growth. The results revealed that systematic investment, development of human capital, modernization of hardware resources, and strengthening of communication and monitoring infrastructures constitute the foundational requirements for sustainable growth in the auto parts manufacturing sector. This finding is consistent with previous studies emphasizing that production growth requires coordinated investment strategies, supportive infrastructure, and effective allocation of resources across industrial systems [5, 6]. The prominence of investment-related factors in the present model also aligns with evidence suggesting that firms that successfully utilize capital increases and financial resources are more capable of achieving long-term development objectives and strengthening their competitive position [8]. From a strategic perspective, investment should not merely increase production capacity but should also enhance technological readiness, operational flexibility, and supply-chain integration. Therefore, the identified emphasis on infrastructure and resource development reflects a broader understanding that production growth is fundamentally dependent on the quality and sustainability of the industrial foundation upon which firms operate.

Another significant finding concerned the importance of research and development as a strategic mechanism for industrial advancement. The proposed roadmap highlighted collaborative, future-oriented, profitability-driven, and goal-oriented research and development activities as essential contributors to production growth. These findings support the argument that innovation and knowledge generation are increasingly critical determinants of competitiveness in manufacturing industries. Previous studies have shown that industrial growth and technological advancement depend heavily on the existence of effective research and development systems, innovation networks, and partnerships with scientific institutions [21]. Likewise, the importance of collaboration among universities, firms, and research centers identified in the present study is consistent with findings emphasizing the role of knowledge exchange and technological cooperation in enhancing industrial

performance [1]. The emphasis on future-oriented research and development also reflects international trends in the automotive industry, where firms increasingly invest in emerging technologies, sustainable mobility solutions, and advanced manufacturing processes to remain competitive in rapidly changing markets [16, 17]. Consequently, the findings suggest that production growth in Iran's auto parts manufacturing industry depends not only on current operational efficiency but also on the industry's ability to anticipate future technological and market developments.

The results further revealed that technological development constitutes a major pillar of production growth. The roadmap emphasized technological infrastructure, technological capabilities, digital transformation, and advanced manufacturing technologies as critical factors shaping future industrial performance. This finding is strongly supported by recent research on Industry 4.0 and smart manufacturing systems. The integration of advanced technologies into production processes has been shown to improve operational efficiency, product quality, flexibility, and sustainability [1]. Similarly, studies examining automotive industry transformation indicate that technological modernization is essential for maintaining competitiveness in increasingly sophisticated global markets [2, 3]. The emphasis on technological capability development among employees and organizations in the present study also aligns with findings highlighting the importance of human capital in supporting successful technological adoption and innovation. Technology alone cannot generate production growth unless organizations possess the necessary knowledge, skills, and managerial capacities to utilize technological resources effectively. Therefore, the roadmap appropriately combines technological infrastructure development with capability-building initiatives.

The identified role of product development trends represents another noteworthy contribution of the study. The findings demonstrated that market-oriented product development, cost–benefit considerations, competition-driven innovation, differentiation strategies, and innovation-oriented design significantly influence production growth. These results correspond closely with contemporary perspectives on strategic product development, which emphasize customer responsiveness, market intelligence, and innovation as central drivers of industrial success. Research on supplier selection and product development in new energy vehicle industries similarly highlights the increasing importance of aligning production decisions with evolving customer demands and technological requirements [15]. Furthermore, the focus on innovation-oriented product development supports evidence suggesting that firms capable of continuously improving products and introducing differentiated solutions achieve superior competitive performance and long-term sustainability [12]. The emphasis on flexibility and customization identified in the present study is particularly relevant because modern automotive markets increasingly require manufacturers to adapt quickly to changing customer preferences, technological standards, and environmental regulations.

Market conditions and market needs also emerged as critical determinants of production growth. The roadmap identified market transparency, information accessibility, macroeconomic stability, domestic and international competition, and evolving customer demands as important contextual factors influencing industrial performance. These findings are consistent with previous studies emphasizing the role of market structures, policy environments, and economic stability in supporting industrial development [6, 7]. The significance of market transparency identified in this study may be explained by the need for accurate information regarding customer requirements, supplier capabilities, and competitive conditions. In highly interconnected industries such as automotive manufacturing, information asymmetry can create inefficiencies that hinder innovation and reduce responsiveness. Furthermore, the findings support recent international evidence suggesting that automotive firms must continuously monitor global technological and market developments to remain competitive in

increasingly integrated supply chains [3, 4]. Consequently, effective market intelligence systems appear to be essential components of any strategy aimed at promoting sustainable production growth.

An important aspect of the proposed roadmap concerns the expected outcomes associated with production growth. The longitudinal component identified competitiveness enhancement, employment generation, sustainability, technological advancement, export promotion, and reduced import dependency as major strategic objectives. These objectives correspond closely with broader national development priorities and international experiences in industrial policy. The emphasis on competitiveness reflects the necessity of enabling domestic firms to compete effectively against foreign producers in both domestic and international markets. Similar conclusions have been reported in studies examining automotive sector development and industrial diversification strategies in emerging economies [3, 4]. The focus on employment generation is equally important because the auto parts manufacturing industry possesses substantial capacity to create direct and indirect employment opportunities throughout the supply chain. Moreover, the identified emphasis on sustainability is highly consistent with contemporary industrial development frameworks that advocate balancing economic growth with environmental responsibility and social welfare [13, 18].

The findings related to sustainability deserve particular attention. The roadmap incorporated economic, environmental, and socio-political dimensions of sustainability, indicating that production growth should not be viewed solely through an economic lens. This perspective aligns with growing international recognition that manufacturing industries must integrate environmental considerations into production systems, supply chains, and product development activities. Research on circular economy implementation in the automotive industry demonstrates that sustainable production practices can simultaneously improve efficiency, reduce waste, and enhance long-term competitiveness [18]. Likewise, studies examining automotive electrification and sustainable industrial transformation emphasize the importance of aligning technological innovation with environmental objectives [2, 17]. Therefore, the integration of sustainability principles within the proposed roadmap represents a significant strength, as it positions production growth within a broader framework of responsible industrial development.

Another noteworthy finding concerns the importance of organizational and managerial factors. The emphasis on knowledge development, communication systems, collaboration, and institutional coordination suggests that production growth depends not only on technological and financial resources but also on effective management practices. This finding corresponds with evidence indicating that employee participation, organizational communication, and managerial responsiveness contribute significantly to innovation and continuous improvement in industrial environments [19]. Similarly, studies examining organizational adaptation and strategic transformation highlight the importance of cultural readiness and internal alignment in supporting industrial change [14]. The results therefore reinforce the argument that successful production growth requires coordinated action across multiple organizational levels, ranging from operational personnel to senior management and policy makers.

The validation results further strengthen confidence in the proposed roadmap. The high levels of agreement observed during the qualitative validation process and the positive evaluations provided by experts indicate that the model possesses satisfactory reliability, content richness, and analytical consistency. These outcomes suggest that the roadmap effectively captures the complexity of production growth in the auto parts manufacturing industry and provides a comprehensive framework for strategic planning. Furthermore, the strong validation results demonstrate that the integration of thematic

analysis with roadmap methodology can provide valuable insights for industrial policy development and strategic decision-making.

Overall, the findings indicate that production growth in Iran's auto parts manufacturing industry requires a systemic approach that simultaneously addresses investment, infrastructure, research and development, technological advancement, market orientation, sustainability, organizational capability, and strategic governance. The proposed roadmap illustrates that these factors are interconnected and mutually reinforcing. Consequently, fragmented interventions are unlikely to generate sustainable industrial growth. Instead, policymakers and industry leaders must pursue integrated strategies that align technological, organizational, financial, and market-related initiatives within a coherent developmental framework. Such an approach can enhance competitiveness, strengthen domestic production capabilities, support innovation, reduce import dependency, and position the industry for long-term sustainable growth.

One limitation of the present study is its reliance on expert opinions and qualitative data collection methods, which may reflect subjective interpretations of industrial conditions and future development pathways. Although extensive efforts were made to ensure credibility and reliability through theoretical saturation, expert validation, triangulation, and inter-coder agreement assessment, the findings remain dependent on the perspectives of selected experts. In addition, the study focused specifically on the Iranian auto parts manufacturing industry, which may limit the generalizability of the findings to other industrial sectors or national contexts. The dynamic nature of technological change, market conditions, and industrial policies also means that some roadmap components may require periodic revision as environmental conditions evolve.

Future studies may extend the present research by quantitatively testing the relationships among the roadmap components identified in this study. Structural equation modeling, system dynamics modeling, and multi-criteria decision-making approaches could be used to evaluate the relative importance of different factors and identify causal pathways influencing production growth. Comparative studies involving different manufacturing sectors or different countries may also provide valuable insights into the contextual factors shaping production growth strategies. Furthermore, future research could examine the implementation effectiveness of roadmap-based interventions and evaluate their impact on productivity, innovation performance, export capability, and organizational sustainability over time.

Industrial policymakers should utilize the proposed roadmap as a strategic framework for coordinating investment, technology development, research and development, and industrial support policies. Managers of auto parts manufacturing firms should prioritize capability development, technological modernization, market intelligence systems, and innovation-oriented product development to strengthen competitiveness and resilience. Industry associations and governmental agencies may also establish collaborative platforms that facilitate knowledge sharing, technology transfer, and coordination among manufacturers, universities, research centers, and investors. Particular attention should be given to sustainability initiatives, digital transformation programs, workforce development, and export-oriented strategies to ensure that production growth contributes not only to economic expansion but also to long-term industrial competitiveness and national development.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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