



## EVALUATION OF THE AUTOMOBILE CHIP CRISIS IN THE CONTEXT OF CRISIS MANAGEMENT

### KRİZ YÖNETİMİ BAĞLAMINDA OTOMOBİL ÇİP KRİZİNİN DEĞERLENDİRİLMESİ

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Received / Alınma: 12.07.2024

Accepted / Kabul: 24.10.2024

#### ABSTRACT

The automotive industry is a rapidly evolving sector that relies heavily on technological advancements. Chip technologies are essential for various automotive systems, including control mechanisms and infotainment systems. In this context, the chip crisis has exposed vulnerabilities in the supply chain and the industry's dependence on chip supplies. The primary issue of the crisis is the bottleneck facing automakers, which negatively impacts production processes and sales due to chip shortages. The purpose of this study is to analyze the chip crisis in the automotive industry and its implications for crisis management. The crisis arises from a shortage of chips in the supply chain, which has adverse effects on automakers. This research highlights the significance of this particular crisis by examining its impact on crisis management practices. It evaluates the causes, effects, and management strategies of the crisis from a crisis management perspective. The scale of this issue demonstrates that chip supply challenges affect not only the automotive industry but also other sectors. This study emphasizes the importance of supply chain and crisis management practices in the automotive industry by analyzing the causes, effects, and management strategies of the crisis. It concludes that companies, especially in the automotive sector, need to adopt more proactive approaches in response to such crises.

**Keywords:** Crisis Management, Automotive Chip Crisis, Proactive Crisis Management, Covid-19 Crisis, Business Success.

#### ÖZET

Otomotiv endüstrisi, hızla gelişen ve büyük ölçüde teknolojik ilerlemelere dayanan bir sektördür. Otomobillerin kontrol mekanizmaları ve bilgi-eğlence sistemleri gibi sistemlerinde çip teknolojileri hayati bir öneme sahiptir. Bu bağlamda; çip krizi, tedarik zincirindeki zayıflıkları ve sektörün çip tedarikine olan bağımlılığını gözler önüne sermektedir. Krizin temel sorunu, çip kıtlığının otomotiv üreticilerinde yarattığı darboğazdır; bu da üretim süreçlerini ve satışları olumsuz etkilemektedir. Bu çalışmanın amacı, otomotiv endüstrisindeki çip krizini ve bu krizin kriz yönetimi üzerindeki etkilerini analiz etmektir. Kriz, tedarik zincirindeki çip kıtlığından kaynaklanmakta ve otomobil üreticileri üzerinde olumsuz etkiler yaratmaktadır. Bu araştırma, kriz yönetimi uygulamalarının önemini vurgulayarak bu özel krizin etkilerini incelemektedir. İnceleme çalışması, krizin nedenlerini, etkilerini ve kriz yönetim stratejilerini kriz yönetimi perspektifinden değerlendirmektedir. Sorunun boyutu, çip tedarik sorunlarının yalnızca otomotiv endüstrisini değil, diğer endüstrileri de etkilediğini göstermektedir. Çalışma, otomotiv endüstrisindeki tedarik zinciri ve kriz yönetimi uygulamalarının önemini, krizin nedenleri, etkileri ve yönetim stratejilerini analiz ederek vurgulamaktadır. Çalışma sonucunda, özellikle otomotiv sektöründeki işletmelerin krizlere karşı daha proaktif hareket etmeleri gerektiği ortaya konulmuştur.

**Anahtar Kelimeler:** Kriz Yönetimi, Otomotiv Çip Krizi, Proaktif Kriz Yönetimi, Covid-19 Krizi, İş Başarısı.

## 1. INTRODUCTION

The automobile industry is a rapidly evolving sector where technological advancements are continuously shaping and transforming the landscape. These innovations have a profound impact on the performance, safety, and overall user experience of vehicles. Among the most critical elements driving these advancements are chips, which enable many core functions in modern automobiles. From engine control units to advanced driver-assistance systems (ADAS) and infotainment systems, chips play a pivotal role in the functionality and sophistication of today's vehicles.

In recent years, the industry has been grappling with a major disruption known as the automobile chip crisis. Rooted primarily in supply chain challenges, this crisis has deeply affected automakers and their suppliers, revealing critical vulnerabilities in the sector's supply chain dependencies. The underlying cause of the crisis is a severe shortage in chip supply. As automobiles become increasingly reliant on technology, the demand for chips has surged. With chips controlling numerous vital functions—from vehicle control systems to connectivity features—this shortage has created a bottleneck in production, significantly disrupting manufacturing processes and sales across the industry.

The automobile chip crisis has highlighted the industry's heavy reliance on a steady chip supply and exposed the fragility of its global supply chains. Automakers worldwide have faced production halts and delays in vehicle deliveries, resulting in significant financial losses and the erosion of customer trust. In addition, the disruption in chip supply has rendered the automotive sector more vulnerable to other external and global events. For instance, the COVID-19 pandemic intensified the crisis, as lockdowns and logistical challenges further strained chip production and distribution.

This study explores the automobile chip crisis through a crisis management lens, offering insights into how the industry can learn from this crisis and develop more resilient strategies moving forward. To this end, a comprehensive review will analyze the causes, effects, and associated management strategies. Drawing on academic literature, industry reports, and media sources, this analysis provides a well-rounded perspective. By highlighting the widespread impact of the chip crisis and the importance of proactive crisis management practices, this study underscores the need for automakers and their stakeholders to adopt more robust and adaptive strategies.

In the subsequent sections of this study, the root causes and consequences of the automobile chip crisis will be examined in greater depth, and various crisis management strategies will be evaluated. Additionally, the study will discuss potential solutions to mitigate the crisis and prevent similar disruptions in the future. Special attention will be given to the extent to which such crises may reoccur and the preventive measures the industry can adopt to minimize their impact.

Ultimately, the automobile chip crisis is not just a temporary disruption; it is a significant turning point that could reshape the future of the automotive industry. This crisis underscores the urgent need for automakers to prioritize crisis management, supply chain resilience, and the exploration of alternative solutions. Collaboration between industry players, the adoption of innovative strategies, and the development of contingency plans will be essential in navigating future challenges. This study aims to raise awareness among industry stakeholders about the

importance of effective crisis management and to provide a foundation for developing strategies that ensure the sector is better prepared for similar crises in the future.

The contribution of this research lies in its ability to offer actionable insights and guidance to automotive industry stakeholders, fostering greater awareness and preparedness in the realm of crisis management.

## 2. METHOD

This study adopts a literature review approach to examine the automobile chip crisis and its implications for crisis management. The review method was employed to compile, analyze, and synthesize relevant research articles, books, and other academic resources that contribute to the understanding of this topic. Data collection was conducted through academic search engines, scientific databases, and online archives of reputable academic journals. The search process involved the use of combinations of keywords such as "automobile chip crisis," "supply chain management," and "crisis management" to identify the most pertinent literature in the field.

The data selection process was guided by a set of inclusion criteria to ensure the relevance and quality of the sources reviewed. Priority was given to recent, peer-reviewed academic publications focusing on the automobile chip crisis and crisis management strategies. Furthermore, factors such as the quality and reliability of the sources, the impact factor of the journals, the number of citations, and the expertise of the authors were carefully considered during the selection process. This approach ensured that the most credible and up-to-date resources were included in the review.

After identifying the relevant literature the selected data were analyzed and synthesized by examining similarities, differences, and key findings across the sources. Particular attention was given to common themes, recurring challenges, and innovative strategies related to crisis management in the automotive industry. The insights derived from the literature were then evaluated and interpreted within the broader framework of strategic crisis management, focusing on how lessons from the chip crisis can inform future industry practices.

In terms of data analysis, a thematic approach was employed to categorize and interpret the findings. This method allowed for a detailed examination of the various dimensions of the chip crisis, including its causes, impacts, and the management responses of automakers and supply chain partners. The results were synthesized to offer a comprehensive understanding of the crisis and to highlight key strategies that can enhance the resilience of the automotive industry.

**Ethical Considerations:** This study did not involve experiments, surveys, or data collection from human participants and therefore did not require ethics committee approval. The authors affirm adherence to all ethical guidelines and standards throughout the study's development including transparency, accuracy in reporting, and respect for intellectual property.

## 3. CRISIS MANAGEMENT

Crises are typically defined as unexpected and disruptive events that can pose significant threats to an organization's business continuity and overall stability. Effective crisis management strategies are essential for minimizing the impact of these events, safeguarding the organization's reputation, and ensuring a swift recovery (Coombs, 2019; Fearn-Banks, 2019). In this section, we will define the concept of crisis management, outline its key processes, and explore strategies for managing crises effectively.

Crisis management refers to a set of strategies and processes that enable organizations to efficiently address unexpected events or critical situations. Crises can arise from a wide range of sources, such as natural disasters, pandemics, product failures, financial scandals, or reputational damage. The goal of crisis management is to minimize the negative effects of such events and facilitate a rapid recovery. This process typically involves three main phases: pre-crisis, during the crisis, and post-crisis (Coombs, 2019).

**Pre-crisis phase:** In this stage, organizations focus on risk identification, crisis scenario planning, and preparation. Risk analyses are conducted to determine potential crisis triggers, and organizations develop contingency plans and crisis communication strategies. This proactive planning is crucial for ensuring a quick and coordinated response when a crisis occurs (Coombs, 2019).

**Crisis phase:** During the crisis organizations must act swiftly to contain the situation, minimize damage, and protect stakeholders. Effective crisis communication is critical at this stage, as it helps manage public perception and maintain trust. Organizations should implement predetermined strategies, communicate transparently, and make timely decisions to reduce the impact of the crisis (Fearn-Banks, 2019).

**Post-crisis phase:** After the immediate threat has been addressed, organizations enter the recovery phase, where they learn from the crisis and take steps to improve resilience. This phase involves analyzing the crisis, identifying weaknesses in response strategies, and implementing measures to strengthen crisis preparedness for the future (Pearson & Clair, 1998).

For effective crisis management, several key strategies must be considered:

**Thorough Planning and Preparation:** Organizations should develop comprehensive crisis management and communication plans well in advance. These plans should be regularly updated and tested through scenario-based exercises to ensure they remain effective in addressing emerging risks (Coombs, 2019).

**Building a Competent Crisis Management Team:** The crisis management team should consist of individuals with expertise in decision-making, communication, and coordination. Members should receive regular training on their roles and responsibilities and participate in simulation exercises to enhance their readiness for potential crises (Fearn-Banks, 2019).

**Effective Communication Strategies:** Clear and transparent communication during a crisis is vital. Organizations must provide accurate and timely information to all stakeholders, including employees, customers, partners, and the public. Promptly addressing stakeholder concerns helps maintain trust and protect the organization's reputation (Pearson & Clair, 1998).

**Media Management:** Media outlets play a significant role in shaping public perception during a crisis. Organizations need to manage media relations effectively, ensuring that only accurate and consistent information is disseminated. A strong media strategy is crucial for protecting the organization's reputation and mitigating potential misinformation (Fearn-Banks, 2019).

**Learning from the Crisis:** After the crisis has passed, organizations should conduct a comprehensive review of their crisis response efforts. This process involves identifying any shortcomings, analyzing what went wrong, and applying lessons learned to improve crisis preparedness for the future. Continuous learning and adaptation are key to building long-term resilience (Pearson & Clair, 1998).

Crisis management is an indispensable aspect of organizational strategy, designed to help organizations navigate unexpected challenges while ensuring business continuity. Key components such as proactive planning, team coordination, effective communication, and learning from past experiences all contribute to a robust crisis management framework. These strategies not only protect an organization's reputation but also enhance its capacity for recovery and future resilience (Canöz & Öndoğan, 2015).

Notable frameworks in crisis management include Coombs' (2014) continuous cycle for crisis communication planning and response, which emphasizes the importance of proactive preparation. Fink (2013) highlights the critical role of thorough planning and underscores the need for readiness in the face of potential crises. Additionally, Seeger (2006) explores best practices in crisis communication, informed by expert panels, while Ulmer, Sellnow, and Seeger (2017) argue that crises, when managed effectively, can be transformed into opportunities for growth and improvement.

#### **4. AUTOMOBILE CHIP CRISIS DUE TO COVID-19 PANDEMIC IN THE CONTEXT OF STRATEGIC CRISIS MANAGEMENT**

Chips, also known as computer chips, microchips, integrated circuits, semiconductor chips, can be defined as the "brain" of electronic devices. Most chips are produced from silicon, a semiconductor material. In addition to silicon, materials such as germanium and gallium arsenide can also be used in chip production. The electrical conduction properties of conductors can be controlled using different methods (for example, by electric current, voltage, light effect) In this way, they can act as an insulator when needed or as a conductor when required (Sarigül, 2023).

OICA (2023) provides statistical data on automobile production worldwide. These data show that the increase in automobile production and the increase in demand may trigger shortages in chip supply. The McKinsey & Company report by Kolmanovsky, V., Macia, F., & Steiger, D. (2023) analyzes the effects of the auto chip crisis on the auto industry. It covers the causes of chip supply shortages, how it affected automakers, and how the crisis came about. The study addresses challenges in chip supply, growth in demand, and limitations of automobile manufacturing.

The chip issue is very important for automobiles because chips are the basic components used to perform many important functions of automobiles. Here are some points that highlight the importance of chips in automobiles:

**Control and Management:** Chips in automobiles provide the vehicle's control and management systems. The operation of engine control, braking system, suspension, steering and other important systems takes place through chips. These chips enable the vehicle to operate safely and effectively (Kaya, 2023).

**In-Vehicle Infotainment:** Chips used in-automobile infotainment systems operate displays, navigation systems, audio systems and other features. These chips enable drivers and passengers to spend more comfortable and enjoyable time in the vehicle (Göl, 2019).

**Security Systems:** The security systems in automobiles function via chips. ABS (Anti-lock braking System), ESP (Electronic Stability Program), airbags, collision avoidance systems are activated by chips and reduce potential hazards in the vehicle.

**Automation and Driver Assistance Systems:** Chips are also of great importance for the autonomous vehicles of the future. Autonomous driving systems and driver assistance systems operate through chips. Chips integrated with radars, cameras and sensors allow the vehicle to move safely by sensing its surroundings.

**Data Processing and Analysis:** Chips in automobiles process and analyze data from the vehicle's systems. Chips are used in areas such as fuel efficiency, performance monitoring, fault detection. In this way, the performance of vehicles, maintenance requirements and other important data can be managed more effectively.

Considering all these factors, chips have become an essential component for automobiles. The vehicle's performance, safety, comfort and technological features are largely supported by chips. Therefore, chip procurement and management are crucial in the automobile industry.

This crisis represents a major bottleneck in the supply of microchips and semiconductor components for automakers. Today's automobiles are equipped with a range of advanced electronic systems and control units. These systems are used to optimize the engine performance of vehicles, reduce emissions, increase safety features and improve the driving experience. These electronic components work through microchips and semiconductors (Agile, 2022).

However, from the end of 2020, there is an automobile chip crisis around the world. The COVID-19 pandemic is one of the main causes of this crisis. The pandemic has impacted global supply chains and restricted chip production and supply. At the same time, the closure of factories and interruptions in production due to the epidemic deepened the chip crisis (Sarigül, 2023)

Another reason for this crisis is the increasing demand. After the epidemic, many people turned to private vehicles, leading to an increase in demand for automobiles. In addition, the increase in the popularity of electric vehicles has also increased the demand for the chip. Electric vehicles need more chips because they need more control units for electric motors, battery management and other features.

The chip crisis has greatly affected automakers. Many automakers have had to stop or reduce their production lines. Others have suspended production of certain models due to limited stock of chips. This negatively affected automobile sales and industry revenues (Wu &etc., 2021).

The automobile chip crisis has had a wide-ranging impact, extending to sectors beyond the auto industry. For example, manufacturers of cell phones, computers and electronic devices also face challenges in supplying chips.

To solve the automobile chip crisis, automakers are diversifying their supply chains and seeking alternative solutions. In addition, some countries are taking policy measures to encourage chip production and R&D. However, it may take some time before this crisis is fully resolved and supply normalized (Pitgem, 2023).

This crisis had significant effects on the automobile industry and related sectors. However, improvements are expected over time as the pressure on chip supply and manufacturing eases. The automobile chip crisis can be considered as an important challenge in terms of crisis management. Here are some factors for automakers to consider while managing this crisis:

**Diversify the Supply Chain:** During the crisis, automakers should try to diversify their supply chain to alleviate the bottleneck in chip supply. Collaborating with various suppliers and seeking alternative solutions can help automakers manage the crisis more effectively.



**Communication and Transparency:** Communication is very important in a crisis. Automakers must clearly explain the situation to consumers, dealers and other stakeholders and be in constant communication. Transparency increases trust and understanding.

**Prioritization:** In situations where chip stock is limited, automakers may prioritize certain models or market segments. Focusing on the production of the most popular or highly profitable models can enable them to use resources efficiently.

**Researching Alternative Solutions:** Automakers must seek alternative solutions to mitigate the chip crisis. For example, some manufacturers may consider collaborating with different industries for chip supply or optimizing existing chips. It may also be beneficial to make improvements in supply chain management and inventory control.

**Long-Term Planning:** Automakers should make long-term planning so that similar crises do not happen again. This helps them develop more reliable and sustainable supply chain strategies minimizing uncertainties in chip procurement (Bahar, 2007).

Automobile manufacturers should apply principles such as crisis management, effective leadership, quick decision making, flexibility and cooperation while managing the automobile chip crisis and try to react quickly to minimize the effects of the crisis (Şenel, 2006).

The auto chip crisis was an unexpected event and difficult to foresee for many automakers. Therefore, it cannot be said that a fully proactive crisis management was implemented before the crisis. However, some precautions could have been taken:

**Supply Chain Diversification:** Automakers could reduce dependency on various suppliers by diversifying their supply chain. Working with multiple suppliers reduces reliance on a single supplier and provides greater flexibility in crisis situations.

**Searching for Alternative Chip Sources:** Automakers could have searched for alternative chip sources in case of a potential bottleneck in chip supply. Engaging with different manufacturers and evaluating alternative chip suppliers could have provided a better position in a time of crisis.

**Inventory Management and Communication:** Automakers could have been more careful about supply chain management and inventory control. Regularly assessing their stock levels and creating additional stocks in case of increased demand would have allowed them to be better prepared during the crisis. Also, being in constant communication with supply chain stakeholders keeps them informed about potential crises and helps them react more quickly.

Of course, a real-time crisis management plan and more proactive measures could be taken. However, an unexpected and globally impactful event such as the automobile chip crisis, can be difficult to predict accurately. Therefore, automakers and other industries will learn lessons to be better prepared to minimize the possible effects of similar crises in the future.

It is possible for the automobile industry to expect similar crises after the chip crisis. The chip crisis was unexpected for the auto industry and has been a major challenge for many automakers. However, challenges and shortages associated with chip supply may continue, leading to similar crises in the future. Here are some factors that support this expectation:

**Increasing Electronicization:** Automobiles are being equipped with more and more electronic systems and components. Especially with the spread of electric vehicles, the demand for chips will increase. This could create potential bottlenecks and bottlenecks in chip supply.

**Global Supply Chain Dependence:** Automakers worldwide depend on chip manufacturing and supply chains. Any disruption in the supply chain can affect chip supply. Events such as global political, economic or natural disasters can affect the supply chain and lead to similar crises.

**Demand Fluctuations:** Automobile demand can fluctuate depending on economic and market conditions. If demand suddenly increases, problems with the supply of chips may arise. Similarly, if demand falls, overproduction and oversupply can occur among chip manufacturers.

**Technological Developments:** The automobile industry is constantly working on new technologies and innovations. This may lead to the emergence of new chip types and features. The development and adoption of new chip technologies can lead to changes and challenges in chip supply.

Considering these factors, there is a possibility that the auto industry will face crises like the chip crisis in the future. However, automakers and suppliers can be better prepared to deal with such crises and minimize their impact, drawing on experience and learning. Measures such as chip supply diversification, strategic stock management and cooperation can mitigate the effects of future crises.

The automobile industry has tried to draw lessons from the chip crisis. The crisis has shown how dependent on automakers and suppliers they are for the supply of chips. Therefore, after the chip crisis, many companies have taken strategic steps to deal with similar problems in the future. Here are some areas where lessons were learned:

**Diversification of the Supply Chain:** Many automakers are trying to reduce the dependency on a single supplier by diversifying their supply chain. Working with different chip suppliers and exploring alternative chip sources aims to provide greater flexibility in future crises.

**Inventory Management and Communication:** Automakers have become more mindful of supply chain management and inventory control. It aims to regularly evaluate stock levels, provide flexibility in demand increases and strengthen communication channels, and manage them more effectively during the crisis.

**Optimization of Chip Technologies:** Automobile manufacturers are working on optimizing chip technologies and using them more efficiently. Chip design innovations and optimizations aim to better adapt to supply issues while improving the performance of existing chips.

**Collaboration and Partnership:** There is a tendency to develop stronger cooperation and partnership between automakers and chip suppliers. Strategic partnerships can increase reliability in chip supply and make it easier to deal with future crises.

However, it may take time for the lessons learned from the auto industry's chip crisis to be fully implemented and to yield results. Chip supply and technological advances are a rapidly advancing field, and it may not be possible to completely prevent crises. However, the sector is constantly trying to take measures to be more resilient to crises and to minimize their effects.

Some possible consequences of the automobile chip crisis could be:

**Production Disruptions:** Automakers have experienced disruptions in their production lines due to shortages in chip supply. This has led to delays and reductions in vehicle production.

**Decreased Demand:** Customer demand decreased due to restrictions in automobile production and delivery delays. This resulted in decreases in automobile sales and loss of potential customers.



**Price Increases:** Chip shortages exacerbated the supply shortage in automobile production, resulting in increases in automobile prices. The decrease in demand and the decrease in supply has caused automobile prices to rise.

**Supply Chain Vulnerability:** Problems in chip supply in the automobile industry have revealed that the industry's supply chain is fragile. This highlighted the sensitivity and risks of the sector in future similar crises.

**Alternative Solutions:** Automobile manufacturers sought alternative solutions to overcome the difficulties in chip supply. This may include steps such as working with different suppliers, increasing chip stocks or diversifying chip supply.

The automobile chip crisis is a major problem with serious implications for the automobile industry. This study aimed to evaluate the automobile chip crisis from a crisis management perspective. Implementing crisis management strategies, taking proactive measures and learning post-crisis lessons can make the automobile industry resilient to such crises.

The automobile chip crisis has led to delays in automobile production and delivery due to shortages in chip supply. This has led to reductions in customer demand and loss of potential customers. In addition, increases in automobile prices were observed, revealing fragilities in the automobile supply chain.

In terms of crisis management, the importance of being proactively prepared for such crises in the automobile industry should be emphasized. Improving supply chain management processes, diversifying chip sources, and exploring alternative solutions can help mitigate the effects of similar crises.

Lessons from this crisis could help make the auto industry more resilient to similar challenges in the future. Better planning, assessment of supply chain risks, and collaboration on chip procurement can enable automakers to be better prepared for such crises.

The automobile chip crisis has been a major challenge for the auto industry. However, effective implementation of crisis management strategies and lessons learned from the crisis can make the automobile industry more resilient to such crises. By focusing on supply chain management, reliability in chip supply, and alternative solutions, the industry's capacity to deal with similar crises in the future can be increased.

## **5. CONCLUSION AND EVALUATION**

In this study, it is aimed to analyze the automobile chip crisis from the perspective of crisis management. Crisis management is an important approach to effectively respond to such crises encountered in the automobile industry. In addition, the importance of proactive measures to be taken before the crisis was emphasized through the example of the automobile chip crisis.

The automobile chip crisis caused delays in automobile production and delivery due to chip supply shortages and supply-demand imbalances. This situation led to decreases in customer demand and increases in automobile prices. It has also been observed that vulnerabilities in automobile supply chain management have emerged.

In the study, it was also emphasized that proactive crisis management should be applied before the automobile chip crisis. In the automobile industry, it has been stated that the reliability of chip supply and the search for alternative solutions are important. It has also been suggested to improve supply chain management processes, conduct risk analysis and ensure cooperation.

The results of the study show that the lessons learned from the automobile chip crisis are important for building a resilient industry against similar crises in the future. The automobile industry should be better prepared for supply chain management and reliability in chip supply and work on alternative solutions. In this way, the effects of similar crises can be minimized, and the sustainability of automobile production can be ensured.

The following recommendations can be made for the automobile industry, drawing on the experience of the chip crisis:

**Diversification of the Supply Chain:** The chip crisis has exposed the risks of automakers being overly dependent on a single supplier or a specific region. Therefore, automakers and their suppliers should consider diversifying their supply chains and turning to alternative suppliers. Seeking chip procurement from different regions, different suppliers, and even different industries will diffuse risks and minimize supply disruptions.

**Communication and Collaboration:** Effective communication and cooperation between automobile manufacturers, their suppliers and other stakeholders is of great importance. In times of crisis, providing regular and transparent communication makes it easier to deal with problems quickly and work together in search of solutions. In addition, creating joint emergency plans against crisis situations and regularly conducting scenario studies will strengthen cooperation for crisis management.

**Inventory Management and Demand Forecasting:** The chip crisis requires automakers and suppliers to be more precise in their inventory management and demand forecasting. More effective inventory management strategies should be developed and models and data used in demand forecasting should be improved. More flexible production and supply planning should be made, considering demand fluctuations and uncertainties in chip supply.

**R & D and Innovation:** The chip crisis has demonstrated technological dependence and constraints in the automobile industry. Therefore, automakers should aim to develop their own chip design and manufacturing capabilities and increase their independence. By investing more in R&D and innovation studies, alternative technologies and solutions can be found, and the industry can be better prepared for future crises.

**Evaluation of Crisis Scenarios:** Automobile manufacturers should identify potential crisis scenarios and prepare for them by conducting risk analyzes. Predetermined crisis scenarios will enable contingency plans to be developed and crisis management teams to work on these scenarios. In addition, lessons and experiences from past crises will enable to intervene more effectively in future crises.

These recommendations can help the auto industry learn from its chip crisis experiences and better prepare for similar crises in the future. However, each automaker or supplier should assess its specific situation and needs and integrate applicable recommendations into its own strategies.

The automobile chip crisis has been a major challenge for the auto industry. However, it is possible for the sector to become more resilient to such crises by applying crisis management principles and taking proactive measures. Future studies may offer more in-depth analysis and solutions in the automotive industry's supply chain management, chip procurement and crisis management strategies.

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**Conflict of Interest Statement:** There is no conflict of interest between any individual, institution, or organization that could be involved in this study.

**Support and Acknowledgments:** No financial support was received from any institution or organization for this study. We thank the editors of Dicle Academy Journal for their interest and effort and the reviewers for their contributions.

**Ethics Committee Approval:** The study topic does not require ethics committee approval. The authors declare that all ethical guidelines were followed during all stages of the preparation of this study.

**Contribution Ratio:** The authors contributed equally to this study.