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Research Article

The Role and Challenges of Technical Program Management in Automotive Engineering

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A B S T R A C T

The automotive industry is going through a significant transformation due to advancements in technologies like connected cars (V2X technologies), artificial intelligence, autonomous driving and cloud technologies. Due to increasing complexity and functionalities, industry is moving to the concept of software defined vehicle. These changes provide both opportunities and numerous challenges to both OEM and Tier-1 suppliers. Especially, the role of technical program manager plays a crucial role for the success of the programs for both OEMs and Tier-1s in this rapidly transforming industry. This paper is mainly to present the role and challenges of the technical program managers during this transformation and some best practices to be followed.

Keywords: TPMs (Technical Program manager), Automotive, Connected Vehicles, Cyber security, Risk management.

1. Introduction

With the rise of connected and autonomous vehicles in the automotive industry, Software defined Vehicles (SDV) have become more common. Day-by-day the complexity of technical program manager's role is increasing with increase in complexity of vehicle integration with advanced technologies which include integration with cloud, artificial intelligence, connected and autonomous vehicles. This article briefly lists the role of the TPM at automotive Tier-1 supplier and the challenges that TPM go through day-to-day during the program execution.

It also lists some best practices to be followed to mitigate the challenges.

2. Role and responsibilities of TPM

2.1. Project planning and execution

- Coordinate and collaborate with cross-functional teams, including engineering, manufacturing, suppliers and quality assurance.

- Develop detailed project plans with work break down structure, including timelines, budgets and resource allocation.

- Ensure projects are completed on time, within scope and within budget and high quality.

2.2. Stakeholder management

- Primary point of contact between the OEM and supplier.

- Manage relationships with internal and external stakeholders to ensure alignment and resolve any issues or concerns raised by them promptly.

2.3. Risk management

- Manage risks by identify potential risks and develop mitigation strategies.

- Monitor project progress and adjust plans as necessary to address any emerging risks.

- Ensure compliance with industry standards and regulatory requirements.

2.4. Technical oversight

- Provide technical guidance and support to project teams.
- Ensure that all technical aspects of the project meet the required specifications and quality standards.
- Stay updated with the latest technological advancements and integrate them into project plans.

2.5. Resource management

- Allocate resources effectively and timely to ensure project success.
- Manage the project budget and ensure cost-efficiency.
- Oversee the procurement of necessary materials and components.

2.6. Quality assurance

- Implement quality control processes to ensure the highest standards are maintained.
- Conduct regular reviews and audits to identify areas for improvement.
- Ensure that all deliverables meet the OEM's quality requirements.

2.7. Leadership and communication

- Strong leadership skills to guide and motivate project teams.
- Excellent communication skills to convey complex technical information clearly and effectively.
- Ability to manage and resolve conflicts within the team and with stakeholders.

2.8. Technical expertise

- Deep understanding of automotive technologies and systems.
- Knowledge of industry standards and regulatory requirements.
- Proficiency in project management tools and methodologies.

2.9. Problem solving and analytical thinking

- Strong analytical skills to identify and address project challenges.
- Ability to think critically and make informed decisions quickly.
- Creative problem-solving skills to develop innovative solutions.

2.10. Organizational and time management

- Exceptional organizational skills to manage multiple projects simultaneously.
- Ability to prioritize tasks and manage time effectively.
- Attention to detail to ensure all aspects of the project are meticulously planned and executed.

2.11. Adaptability and flexibility

- Ability to adapt to changing project requirements and industry trends.
- Flexibility to work in a fast-paced and dynamic environment.
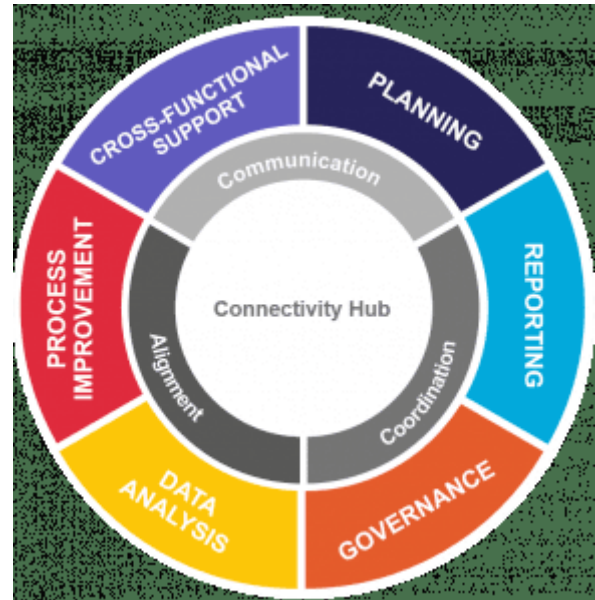- Willingness to continuously learn and improve.

Figure 1: Program management responsibilities[1].

3. Challenges of Technical Program management

3.1. Complexity in global Project coordination

TPMs are responsible for driving and coordinating the cross functional teams which include Systems, Software, Hardware, mechanical and validation teams. These teams are typically spread across globally in different time zones, to leverage the expertise of each domain from certain regions. To coordinate these globally spread across teams requires exceptional organizational skills and the ability to manage diverse teams effectively. The complexity is further worsened with the need to integrate advanced technologies like artificial intelligence, cloud computing, 5G networks, connected and autonomous vehicles. Also, after COVID pandemic, most of the coordination happens over the virtual meetings (Teams, Webex) with negligible face to meetings, which increased further challenges for TPM to coordinate effectively.

3.2. Challenges with Integration of advanced technologies

With auto industry moving more towards the software define vehicle (SDV), TPMs must navigate the challenges of integrating different technologies. TPMs shall possess a good knowledge of software and hardware to drive successful integrations between the software and hardware teams. TPMs shall continuously keep up to date with advancements in technologies to successfully coordinate between domain teams and drive the issues to resolution. Especially, TPMs working in ECU development of Head unit, ADAS (Advance driver assistance systems), connectivity domains shall continuously learn and keep up with the fast-evolving industry trends in areas including cyber security, artificial intelligence, connectivity (V2X technologies) and cloud computing[2]. This helps TPMs to gain confidence and have good command and control over the program execution.

3.3. Managing supply chain disruptions

Since COVID pandemic, global supply chain issues have escalated. Industry had gone through major disruptions and could not build vehicles on time due to shortage of components. There was a need for Tier-1 to propose alternate components to address the shortages. Even the alternatives were identified, there was not enough time to test and qualify them as design

validation typically takes significant time of 3 to 4 months. So, TPMs need to ensure the alternative components are identified during early stage of the program and the design and validations are complete well before the completion of design freeze. It is very important for TPM to be well prepared and have strong strategies in place to withstand any disruptions in supply chain. Whether it's due to natural disasters, geopolitical changes or economic downturns, supply chain resilience is essential for success. Also, with evolving AI technologies, TPM shall consider embracing predictive analytics to turn supply chain disruptions into opportunities. Organizations shall consider leveraging IoT platforms to gain real time visibility into supply chain and proactively address disruptions[3] .

3.4. Collaboration with Customer

It is very important for TPM at Tier-1 supplier to maintain a regular communication with the Customer (OEM). TPM shall put himself in the shoes of the customer and work as a one team to enlighten the end consumer's experience. TPM shall constantly communicate the open issues, dependencies and action items to ensure timely closure of the open items so that supplier side team work seamlessly. TPM shall ensure the projects are delivered on time, within budget and scope. TPM is the key person and main interface between the Customer and supplier side domain teams who is primarily responsible for the success of the project. TPMs must also be skilled at managing change requests from the customer and addressing any issues that arise promptly.

3.5. Managing cross functional teams

TPM is primarily responsible for successful execution of the program by managing the golden triangle – cost, time and scope. Ideally, technical program manager has a dotted reporting from different teams but doesn't get to manage any individual directly. TPM shall timely escalate to ensure right team is staffed to address the project needs. Since the people doesn't directly report to the TPM, it is an art of the program manager to create an environment that fosters collaboration and innovation. It is very important for TPM to timely recognize and reward contributions and promote culture of diversity and inclusivity.

3.6. Environmental Sustainability and Regulatory compliance

Sustainable mobility has become a driving factor for the transformation in automotive industry. TPMs shall consider alternate implementations to reduce the impact on an environment. TPMs shall ensure projects comply with the sustainability goals, safety and regulatory requirements. Efforts to find environmentally friendly alternatives and reduce carbon emissions are essential.

3.7. Cybersecurity challenges

With the rise in integration of connected and autonomous vehicles, cybersecurity has become a growing concern. It is very important for TPM to ensure cybersecurity requirements from OEM (Original Equipment Manufacturer) and supplier side corporate requirements are cascaded and addressed timely. TPM shall align with customer and corporate cybersecurity team and ensure security requirements are designed and implemented alongside the regular software development. Earlier, cybersecurity requirements were not given enough priority and these requirements were addressed during later stage of the software development lifecycle. But with significantly growing security risks, it's become corporate priority to have a strict enforcement of cybersecurity. Also, OEMs are making Over the air (OTA) as an essential feature which can help to deploy regular updates and patches to the vehicles. Without this function, it's a huge cost to OEM and supplier to recall and update if any issues are encountered in the field. Hence, TPMs shall give high attention to address cyber security requirements to protect both vehicles and users.

3.8. Cost management and innovation challenges

With rise in connected cars, integration of advanced technologies like Artificial Intelligence, Connected and autonomous features, cyber security and cloud computing need significant investment in research and development. Technical Program managers need to deal with uncertain costs associated with integration of evolving technologies and strike a balance between innovation and cost-efficiency, ensuring that the project remain financially viable.

In addition to the management of costs associated with integration of evolving technologies, TPM shall effectively manage the cost associated with Cost of poor quality (CoPQ).

3.9. Stringent Quality Assurance

The consequence of poor quality is very crucial in automotive industry. Product defects or recalls post SOP can have serious consequences for manufacturers and consumers. To ensure product quality, technical program managers must implement stringent quality assurance procedures and remain vigilant throughout the project life cycle.

3.10. Stakeholder complexity

The stakeholders in automotive industry are enormous which include consumers, manufacturers, suppliers, dealers, government and partners for technological integrations. Each has their own unique needs and expectations. Managing these relationships is a skill by itself. It requires excellent communication skills, diplomacy and the ability to balance different interests of the stakeholders.

3.11. Risk Management

It is very important for TPM to manage the risks due to complexity and interconnected of the industry. Ideally, Tier-1s have a well-defined risk management process integrated with their business governance to identify, assess, mitigate, monitor and manage risks supported by set of tools and dashboards.
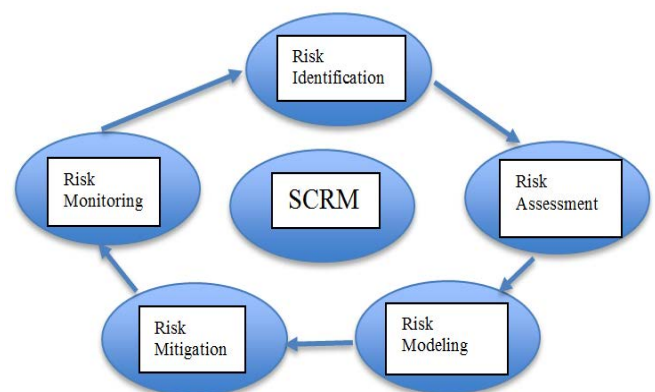

Figure 2: Risk Management Process.

Supply chain Risk Management (SCRM) has a strong

connection with the entire production chain performance across the world and the relationship between the stakeholders and partners. One study [4] did analysis to indicate how far SCRM has been used to manage the risk factors in Automotive industry's supply chain. The result of this analysis indicated that competitive orientation no longer relies on product/services, but on the ability to manage supply chain risks.

4. Conclusion

The role of a Technical Program Manager in automotive Tier-1 suppliers is multifaceted and incredibly demanding. It requires a blend of technical expertise, understanding complex industry dynamics, leadership and strategic thinking to navigate the complexities of the automotive industry. By effectively managing projects and fostering strong relationships with counterpart at OEM, TPMs play a crucial role in driving innovation and ensuring the successful delivery of high-quality automotive components and systems. With diligent planning and addressing complex issues early stage of the program, TPMs can successfully drive results in the continuously evolving industry.

5. References

1. https://www.migso-pcubed.com/case-studies/automotive-pmo-for-improved-connectivity/

2. Konstantin Shirokinskiy, Computer on Wheels: A new role for Tier 1 suppliers, Roland Berger, 2021.

3. Tatiana Gely. Mobility, Top Challenges Faced by Automotive Tier 1 Suppliers. Opentrends, 2023.

4. Yoga Irsyadillah N, Dadang S. A Literature Review of Supply Chain Risk Management In Automotive Industry, Sep 2020