Allied RELIABILITY

THE RELIABILITY JOURNEY THROUGH THE LENS OF TIRE MANUFACTURING

A PROACTIVE MAINTENANCE MINDSET

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INTRODUCTION

The continued evolution of digital technology (IoT, edge devices, sensors, AI, etc.) is transforming how industries within the manufacturing sector access data and gain insights into equipment performance. By identifying a potential failure before it occurs, companies can reduce maintenance costs, avoid unplanned downtime, minimize loss of production, and improve safety and environmental factors. To realize the full benefits of these technologies, a well-developed equipment maintenance strategy must be implemented—identifying the equipment failure modes, applying the right technologies for early failure mode detection, at the right frequency.

In these uncertain times—with persistent material and labor shortages, stricter environmental and health standards, and increasing demand for products—manufacturers need to also adopt an asset management strategy with proactive maintenance mindset as they identify barriers and gaps in their processes that may be preventing them from reaching business goals.

This eBook focuses on the current trends and challenges in the tire manufacturing industry specifically, and how the transition to modern methodologies along with a shift in mindset can significantly impact the way asset performance is monitored and continuously improved. It also demonstrates the critical components of reliability, as a whole, and the importance of **assessing** the existing reliability program maturity before adopting new technologies to drive success on your journey.

THE TIRE MANUFACTURING INDUSTRY

Tires make the world go round in our everyday lives, from personal to business to industrial use. Like many industries, the global tire manufacturing industry was heavily impacted by the COVID-19 pandemic. Due to COVID restrictions, more people working from home, and the rising cost of fuel, vehicle owners reduced their amount of driving—resulting in delayed visits for maintenance or tire replacement.

Coming out of the pandemic, car sales are now increasing with tires exponentially in higher demand. If we look at the longer term, worldwide tire production is expected to double by 2050, according to a spokesperson of Goodyear Tire. But it is not just about the numbers, per se, we are also seeing more sustainability awareness among tire manufacturers, as companies strive to reach carbon neutrality by 2050. A top priority of tire manufacturing management is to focus on zero-carbon technology, energy efficiency, and green energy. For example, in February 2021, Michelin Group announced it is working toward making its tires 100% sustainable by 2050.[1]

This is the ideal time for tire manufacturing companies to assess their legacy processes and determine a long-term plan that includes modernization and sustainability efforts, so they can meet the projected market growth while also mitigating potential risks, remaining competitive, and being good stewards of the planet.

Machinery health, qualified people, and environmental safety are all part of a sound business strategy in the new economy. Any opportunity to simplify and automate tire manufacturing processes will further optimize output and maximize revenue going forward. And in the constant quest for continuous improvement, it makes sense why these companies are looking to total asset performance management, to minimize equipment failures by de-risking and taking corrective actions that contribute to uninterrupted operations and extended life of manufacturing equipment.

[1] **Tire Industry Project closing in on key objectives, Rubber News article, 2018.**

TIRE MANUFACTURING PROCESSES

If you take a magnifying lens to tire manufacturing, you will see much more than meets the eye. It is a surprisingly long, arduous process made up of multiple components (e.g. beads, belt, ply, sidewall, sipe and groove, shoulder, and tread). Add to that the many different machines and multi-step processes required to create the final product, and the complexity is enormous.

It starts with mixing raw ingredients, followed by milling, forming, and assembly of a "green" tire. The green tire must then be cured and formed via a vulcanization process before undergoing the final finishing steps to produce a tire ready to mount on a vehicle. The below diagram depicts the end-to-end process flow.

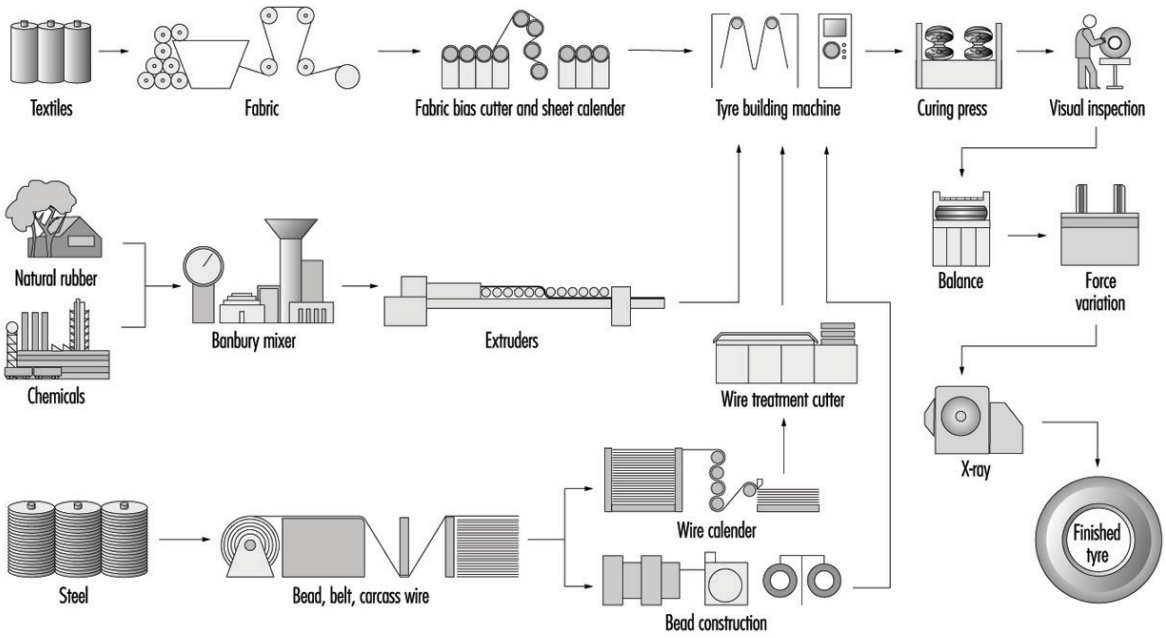


Figure 1: Process flow chart of tire manufacturing steps

SOURCE: Tyre Manufacturing (iloencyclopaedia.org)

All industrial manufacturing processes need their equipment to be reliable to produce a high output consistently and efficiently and still maintain strict environmental, health, safety, and product quality standards—with minimal downtime. Tire manufacturing is challenged to keep everything up and running despite *tens of thousands* of inherent failure modes across a very wide process asset base. The first step in the reliability improvement journey begins with a clear understanding of all those equipment failure modes and the development of a maintenance strategy to not only detect failures, but to proactively address them before they cause bigger problems.

Mapping your processes from a failure mode perspective helps define potential points of failure in your processes, as shown in the failure mode tree below.

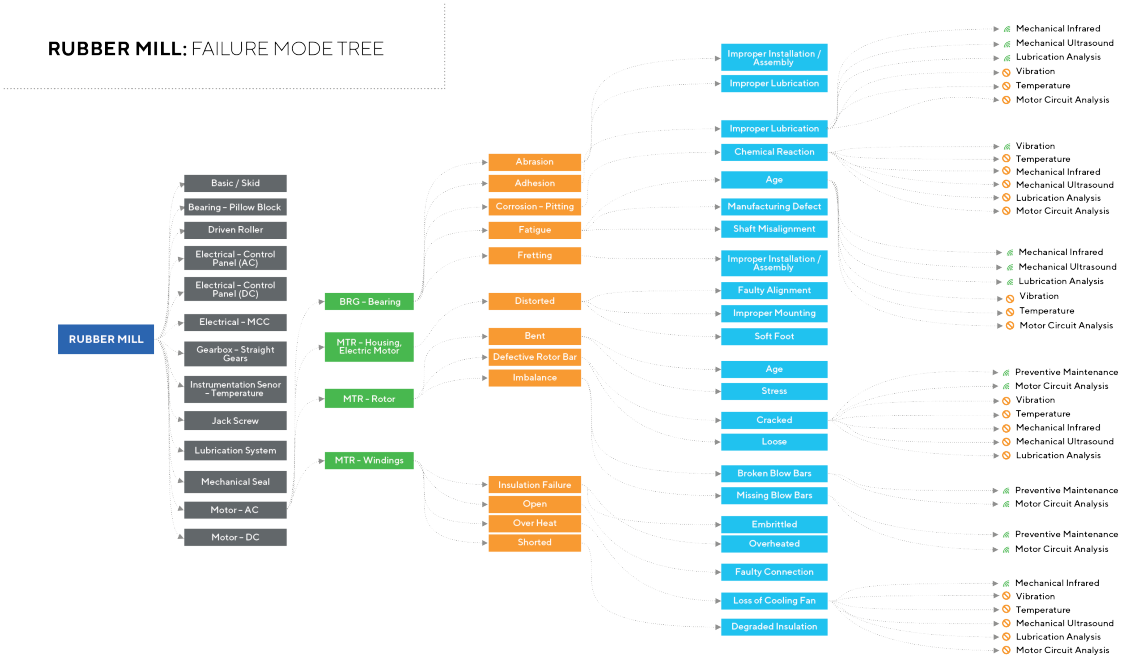


Figure 2: Example of a failure mode tree

MANAGING ASSET PERFORMANCE

Reliability Maturity Assessment

What is the reliability maturity level of your company? This question is key to ask up front, as it sheds light on restraining factors that may be standing in the way of reliability improvements. It is also an important consideration in an asset-intensive industry like tire manufacturing, where a multi-phase approach may be necessary to implement all the required changes.

Such an assessment is best left to experienced professionals who have worked in the reliability industry for many years and eliminated similar obstacles by implementing tools, processes, and methodologies to overcome asset management deficiencies. They can help identify specific gaps and make recommendations to close those gaps, delivering a complete asset strategy that aligns with your tire manufacturing business strategy.

PROACTIVE MAINTENANCE

Determining what areas of maintenance and reliability are doing well and what areas need improvement is critical to improve the integrity of production and the quality of systems.

Proactive maintenance places an emphasis on preventive and predictive maintenance techniques, and strives for:

- NO breakdowns
- NO unplanned downtime
- NO defects
- NO accidents

While these goals may overlap with the traditional asset management lifecycle concept, proactive maintenance utilizes additional workstreams to ensure improvements are made and sustained over time. On the path towards a proactive mindset, there must be established roles, governance, and change management best practices to achieve the desired increase in productivity and ensure it will be workable in the future to support continuous improvement efforts.

COMMON INDUSTRY GOALS AND OBJECTIVES

Given the current state of tire manufacturing, and the need for modernization to improve productivity, industry leaders—the Tire Industry Project (TIP) being among them—have developed goals and objectives that tire companies can follow to meet the demands of today, and the unforeseen issues of tomorrow.

Some common goals and objectives include:

- Increase productivity and manufacturing efficiency
- Lower operating and energy costs, and scrap rate
- Mitigate extreme operating conditions that challenge fluid power systems and their components and seal elements
- Implement infrastructure upgrades and equipment retrofits to make them sustainable
- Increase the share of recycled or renewable raw materials in tires to 50% by 2030
- Address human health and environmental impacts associated w h the lifecycle impacts of tires

Solutions

Here are five ways to begin to meet tire industry goals and objectives:

1. **ADHERE** to the industry's environmental and safety standards, from the sourcing of materials to packaging. To move towards more sustainable business operations, companies within this industry must look at the potential areas where they can reduce rubber waste, energy, and water consumption to minimize the negative environmental impacts.

   This transition involves an understanding of the intersection of Asset Management strategies and ESG through proper alignment of its corporate environmental initiatives with the everyday operations and maintenance strategies they deploy. When daily activities and processes begin to mirror the sustainability goals and expectations of the industry, companies can minimize risk.

2. **STANDARDIZE** business processes, equipment maintenance strategies, and KPIs across all operating tire facilities. To manage and improve, one must have common processes as a baseline to compare variance and compliance. This also means having common equipment maintenance strategies that provide the proper foundation of how to care for and identify equipment problems well in advance of failure which directly impacts production and profitability.

3. **DEVELOP** a team of skilled and trained employees to operate and maintain equipment, effectively and efficiently plan and schedule the required corrective and preventive work and manage the MRO supply chain needed to provide the materials to perform the work. Finally, a team of skilled professionals is also needed to understand and use the data produced by the equipment and processes to proactively identify problems before a full functional failure is realized, impacting production.

4. **BECOME DATA-DRIVEN** through insights and improvement actions by leveraging technology (e.g. IoT, edge devices, sensors, etc.) to gather and analyze data for operations, maintenance, and reliability. By utilizing the latest technology to become less dependent on labor, companies can directly impact the results of labor shortages and the widely varying availability of employees (e.g. due to attendance). Tremendous amounts of data (line speeds, quality, fill metrics, vibration, temperature, etc.) are produced each minute by assets and processes, but being able to analyze the data and provide meaningful insights and actions in a timely manner is the key to using the data to the utmost potential.

5. **MANAGE** continuous improvement and operational risk to remain competitive as the market becomes more saturated and product offerings become more diverse. As production lines and people interact with one another, opportunities for improvement should be continually identified, stored, reviewed, prioritized, and implemented to impact business. These methods, processes, and KPIs must be visible to executive management in order for them to manage and maintain a low-cost structure via capital and operational risk activities (risks impacting safety, operations, maintenance, environment, reliability, and more).

INDUSTRY METRICS FOR SUCCESS

In any business initiative, metrics provide a measure of success. Below are several key metrics used to track manufacturing performance in the tire industry.

Line utilization	**Improved material yield**	**Final tire quality**
Tire production rate	**Mechanical efficiency**	**Employee safety**
Sustainability and recyclability of materials used	**Cost per tire**	

Each metric is impacted by certain manufacturing conditions. Line utilization and mechanical efficiency, for example, are affected by processing time or downtime. If the equipment supporting the line fails in any way, it immediately impacts these metrics. Therefore, operations and maintenance of this equipment is paramount for increasing these metrics.

Cost per tire is another key metric that includes ALL company costs (e.g., overhead, maintenance, materials, utilities, and more). Many of these costs can be eliminated or optimized through reliability enhancement efforts.

Finally, employee safety is measured by the number of incidents or near misses. Any effort that can reduce the direct engagement of personnel with operating equipment will directly reduce the number of incidents and near misses. Furthermore, a more reliable asset base reduces the potential of injuries due to unplanned repair needs, which are high risk activities.

Thus, utilizing the proper equipment maintenance strategy can alter the frequency and duration of interactions with equipment, by using technology to gather and analyze data when possible and economically feasible. While these KPIs are visible to executive management, many times, the underlying activities that drive them must be understood by all personnel to continually impact them in a positive direction.

CHALLENGES AND TRENDS IN THE TIRE INDUSTRY

As the global tire industry experiences further growth, it faces more complexity, including a mix of tire types, sophisticated vehicle designs, different regional demands and regulations, and supply chain issues around the world. According to Smithers' latest market report, The Future of Global Tires to 2024, the following trends will challenge the tire manufacturing industry for years to come:

GLOBAL ECONOMIC GROWTH

The tire industry must support an increase in vehicle production and the number of vehicles in use. Adoption of high-performance (HP) and premium tires will be strong, as greater performance and load demands are placed on many vehicles. Up and coming economies (e.g. India) will also need to be served with greater use of radial and premium tires.

REPLACEMENT DEMAND

The replacement of tires will grow in proportion to a wider variety of end uses—ranging from passenger cars and light trucks, and medium and heavy-duty trucks and buses to specialty applications, such as motorcycles, off-the-road (OTR) equipment (include mining, construction, ports, agricultural, and industrial uses), and aviation.

TRANSPORT AND TIRE REGULATIONS

In a highly regulated environment, fuel economy mandates on vehicle manufacturers and consumer labeling standards, for example, will continue to drive innovation and technology adoption both by OEMs (original equipment manufacturers of vehicles) and tire manufacturers, and in turn their suppliers. The further pursuit of low rolling resistance (LRR), with additional emphasis on tire weight reduction (and aerodynamics), is becoming more important.

ADAPTATION AND EVOLUTION OF TIRES

Tires will have to adapt and evolve at a fast pace to better meet end-use requirements, such as fuel efficiency, performance, reliability, durability, and intelligence/data/predictive analytics. Further evolution of ownership will occur as vehicle sharing and fleets become more common and sophisticated in more applications. Expansion of e-commerce and greater efficiencies (including wholesale and retail rationalization, drawing interest from the private equity sector) are changing distribution.

A GROWING FOCUS ON SUSTAINABILITY

Sustainability concerns span the whole lifecycle of the tire, from raw materials all the way to recycling. Greater automation and efficiency in production (including artificial intelligence and "smart factories"), relative reduction in materials used, and the goal of zero waste and defects are changing tire manufacturing practices and helping to limit costs of production.

ADDRESSING BUSINESS CHALLENGES WITH ASSET MANAGEMENT

Allied Reliability has an asset management lifecycle strategy to help tire manufacturers address modern challenges using a formalized, proven methodology, illustrated in the below diagram. The aim is to reduce asset risk to optimize the tire manufacturing process, from planning through disposal.

Figure 3: Asset management lifecycle diagram

ADOPTING NEW TECHNOLOGIES AND USING BEST PRACTICES

The asset management lifecycle approach highlights the commonly overlooked barriers of adopting new technologies and the importance of looking at the foundational elements of reliability best practices before implementing predictive technologies. This approach supports the digital transformation of players in the tire manufacturing space and aids in directly overcoming industry challenges.

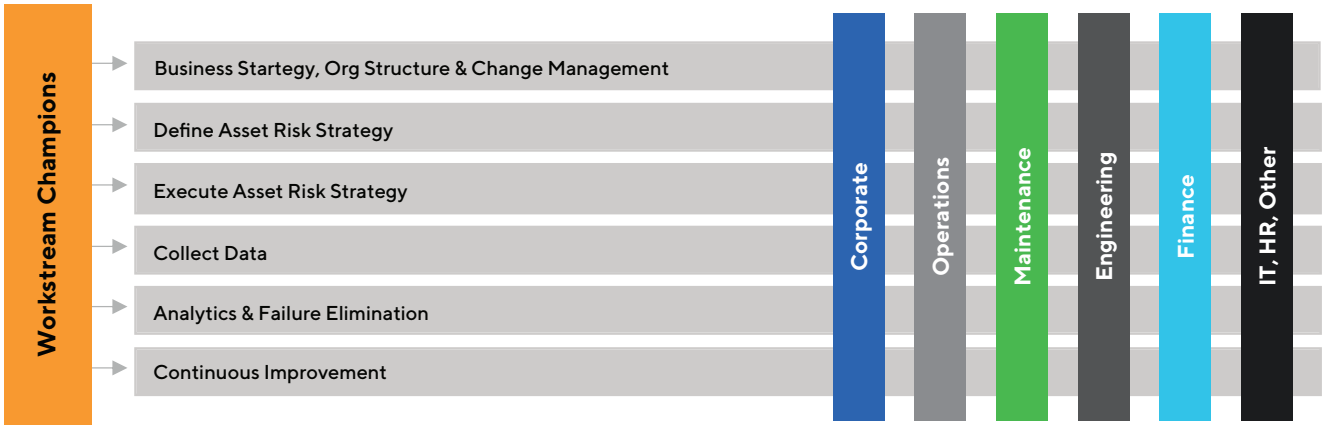
One barrier of adoption is a culture change with respect to updating obsolete processes and practices. To ensure the success of any reliability program initiative, it is critical to establish a strategy for organizational alignment and change management, which first and foremost entails team training.

The next areas of focus are what Allied Reliability considers to be asset management best practice workstreams: defining the asset risk strategy, executing the asset strategy, collecting data, analytics and failure elimination, and enabling continuous improvement.

Following these best practices, tire manufacturing companies will be executing the right work, on the right pieces of equipment, while validating their efforts with proper data representation. The value of incorporating these elements into your reliability program enables you to manage and drive business through dependable data derived from smart condition-based maintenance technologies, work management execution, production losses, and real-time operations data.

Condition monitoring is just one aspect of the reliability journey. The implementation of strategic asset management strategies allows companies to be more data-driven when monitoring production loss, maintenance KPIs, and process compliance. Aligning these components before adopting new technologies for process optimization allows you to get the most out of your condition monitoring program and ensure continued success and improvement. Otherwise, it can be difficult to justify the cost and culture change of integrating new technologies within your organization.

One way to obtain widespread buy-in is to engage the following organizations (Corporate, Operations, Manufacturing, Engineering, Finance, and IT/HR/Other) as champions in your reliability journey. This will make it an enterprise-wide charter to successfully address the leading challenges in the tire industry.



SUMMARY

There are many challenges facing the tire industry today, including sustainability, quality and safety regulations, technological innovation, waste reduction, supply chain shortages, and more. The described methods provide a useful roadmap, with the tools and processes to directly address these challenges and support the digital transformation of tire manufacturing companies—all while positively impacting key metrics.

Looking to the future, the trajectory of the tire industry is moving toward a holistic vision of tires, from design to sustainability. As tires continue to add more value for consumers, providing the assurance of a quality product engineered for the environment and for greater safety will remain top priorities.

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ABOUT ALLIED RELIABILITY

Allied Reliability's production and asset management experts are committed to optimizing equipment, processes, and people. Our experts work with you for best outcomes.

Understanding how critical asset failures impact the environment, production, financials, and safety enables us to deliver the right monitoring, analytics, decision making and maintenance plans.

We bring unique asset management content along with best practices, advanced tools, and proven methodologies to help customers move forward in their Digital Transformation journey to deliver enhanced performance.

Contact us for more information about our offerings in:

Reliability Services

- Criticality Analysis
- PM Evaluation
- Asset Health Matrix
- PdM Technologies Evaluation
- Work Management Evaluation
- Contract PdM
- Remote Diagnostics
- SmartCBM® Real-time Data Visibility & Analysis
- Coaching and Mentoring

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