COVER PAGE AND DECLARATION

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Student's Full Name:	Mohamed Mahmoud Ibrahim Abo-Elsoud
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E-SIGNATURE: Mohamed Aboelsoud

DATE: October 07 2023

EIU Paris City Campus
Address: 59 Rue Lamarck, 75018 Paris, France | **Tel:** +33 144 857 317 | **Mobile/WhatsApp:** +33607591197 | **Email:** paris@eiu.ac

EIU Corporate Strategy & Operations Headquarter
Address: 12th Fl. Amarin Tower, 496-502 Ploenchit Rd., Bangkok 10330, Thailand | **Tel:** +66(2)256923 & +66(2)2569908 | **Mobile/WhatsApp:** +33607591197 | **Email:** info@eiu.ac

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Managing Operations

Introduction

Managing operations is an aspect of administration associated with business operations. The organization benefits from having maximum effectiveness. In order to reach their aims and intended goals, corporate organizations rely heavily on operations management. Nearly all large or small companies have an operations management department, just like any other department, such as sales, finance, or human resources (Halai & Halai, 2021).

The case study demonstrates that Big Green Tractor is a well-known company in the tractor manufacturing sector. It has been found that the company has had serious problems with growth slowdown during the past few years. Big Green Tractor has significant processes in place to streamline operations. An appropriate plan must be created for such practices. In addition, the case scenario highlights problems with the organization's limited compliance with environmental standards and norms.

In recent years, the growth of Indonesian industrial tractor manufacturer The Big Green Tractor has slowed in operational streamlining procedural guidance to enhance efficiency and environmental responsibility to handle these challenges. Access to production may be achieved by combining 21st-century tools, cost-effective manufacturing procedures, and minimizing defects. A socially acceptable operating manual for managing pollutants is also provided, including guidelines for the proper disposal of chemical waste and green alternatives to traditional processes for manufacturing.

Streamline Procedure

a. Cost-Efficient Manufacturing Processes

We provide a thorough plan that incorporates the strategies that follow to help The Big Green Tractor achieve cost-efficiency in its manufacturing process:

Implement lean manufacturing principles.

Lean manufacturing is an organized approach that seeks to reduce waste as well as improve processes. Lean manufacturing techniques may be taken into account in Big Green Tractor together with other steps to reduce the cost of production. This way, low-value tasks, and less essential processes can be eliminated from the company's manufacturing facility. It can be concluded that Big Green Tractor can concentrate on the procedures and methods essential for producing tractors due to lean manufacturing. This reduces the likelihood that the business will face extra expenses. The following recommendations should be considered:

Value stream mapping (VSM): Use VSM to locate inefficient and wasteful regions in the production process. This will facilitate streamlining processes and lessen non-value-added activities.

Continuous improvement (Kaizen): Encourage employees to propose and implement small, gradual modifications that increase efficiency to foster a culture of constant improvement.

5S methodology: Use the 5S process (sort, shine, set in order, standardize, and sustain) to organize the workplace and reduce time spent looking for materials and tools (Wilson, 2015).

JIT inventory management: By using Just-In-Time (JIT) management of inventory, you can reduce excess stock, save carrying costs, and guarantee that things are accessible exactly when you need them.

Embrace automation and robotics.

Robotic process automation (RPA): For time-consuming as well as repetitive operations in the production process, think about incorporating RPA. This can result in lower cost of labor and more accuracy.

Flexible automation: Invest in flexible automation technology that can handle various production requirements and allow cost-effective manufacturing at different scales.

Digital manufacturing tools.

Digital twins: Use the technology of digital twins to build digital duplicates of industrial systems. This enables detectable inefficiencies, as well as real-time monitoring and optimization.

Internet of Things (IoT): Use IoT devices and sensors to install equipment to get information on the usage of energy, performance, and maintenance requirements. Finding cost-saving ideas from this data analysis.

Predictive maintenance: Predictive maintenance algorithms can be used to keep an eye on the condition of the equipment and avoid unexpected breakdowns, which will decrease downtime and cost of repairs.

Optimize supply chain management.

Supplier collaboration: Work closely with suppliers to increase the effectiveness of the supply chain, shorten lead times, and bargain for better terms for the purchase of supplies.

Dual sourcing: To reduce supply chain risks and guarantee an ongoing supply of resources, consider dual sourcing for essential components.

Energy efficiency initiatives.

Energy audits: Identify opportunities for lowering energy use in manufacturing plants by conducting regular audits.

Renewable energy integration: To minimize energy costs and the impact on the environment, examine the possibility of incorporating renewable energy sources like wind or solar power.

Continuous cost monitoring.

Cost tracking tools: Utilize cost-tracking tools or software to monitor and analyze costs associated with various production-related activities.

Cost reduction teams: Create cross-functional teams to find and aggressively execute cost-saving suggestions (Rowse, 2020).

Employee training and engagement.

Employees should get continual training in lean principles, innovative technology, and cost-cutting strategies. Encourage employees to participate in cost-cutting initiatives by welcoming their ideas and opinions.

b. Plan to Minimize Defects throughout the Manufacturing Process

The Big Green Tractor ought to establish a comprehensive strategy that addresses all facets of the production process to reduce faults and efficiently guarantee product quality. This strategy should include preventive measures, quality assurance procedures, and ongoing improvement programs. The Big Green Tractor Six Sigma DMAIC cycle is the most efficient way to reduce weaknesses throughout manufacturing. An approach for company improvement, the DMAIC research identifies and eliminates the problems and root causes of manufacturing unit defects. It’s a five-step procedure: define, measure, analyze, improve, and control. The DMAIC

method is now often utilized by businesses to address issues successfully. It is a collection of statistical tools used in quality management to provide a framework for improving processes. The DMAIC technique may reduce process variation to achieve customer satisfaction, cost savings, and organizational profitability. Explains that the core strategy of the Six Sigma concept is continuous process monitoring to eliminate or minimize defects from manufacturing processes (Singh et al., 2017). The DMAIC methodology consists of five interconnected phases that methodically help companies in problem-solving and process improvement. The DMAIC phases of the Six Sigma Process are as follows:

Figure 1: DMAIC phases

1. Define phase

Within the DMAIC process, the define stage involves defining the role of the team, project boundary and scope, customer expectations and requirements, and the selected project goals. This stage aims to clarify the problems and make the defects evident. The project's objective must be clearly stated through this phase, and the procedures will begin. We must be aware of all necessary components of a process improvement before we start working. The technique to display the process map about this information is the SIPOC (suppliers, inputs, process, outputs, and customers) diagram. The main goal is to reduce the proportion of defects, which lowers

manufacturing costs, raises quality, reduces waste, and raises the sigma level. SIPOC is the process output-based measure of a process's quality.

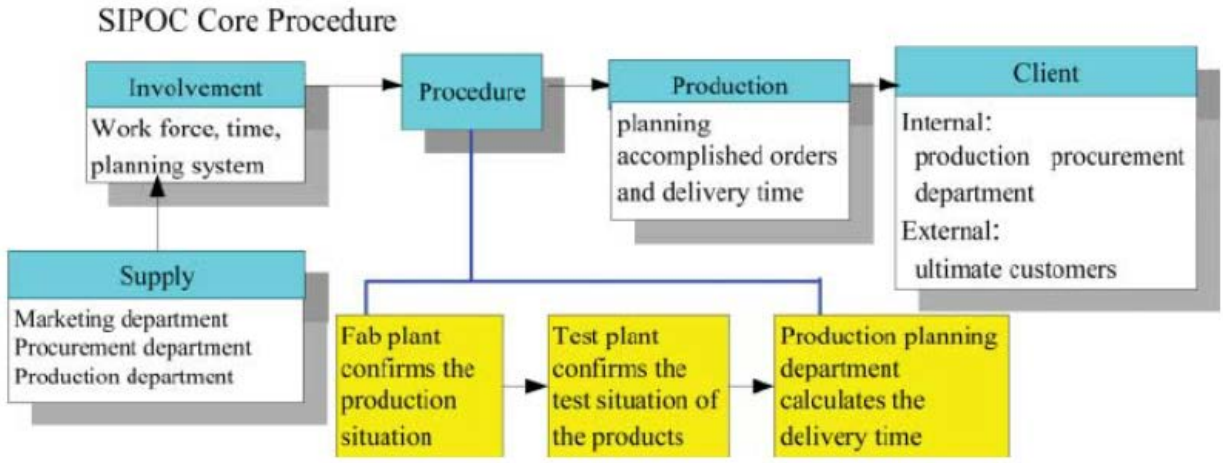

Figure 2: SIPOC Diagram

2. Measure

At this phase, the measurement factors that need to be improved are chosen, a framework for assessing present performance is provided, and subsequent improvements are assessed, compared, and monitored for their effectiveness. The Measure phase starts with two activities:

- Measure the current activity or process
- Establish a baseline for process capabilities using those existing data sets to compare process improvement data.

Pareto and fishbone diagrams are used to carry out the analytical procedure. The two major goals of the analysis stage are finding the primary aim of the repair process and the underlying cause of different problems that arise throughout the repair process.

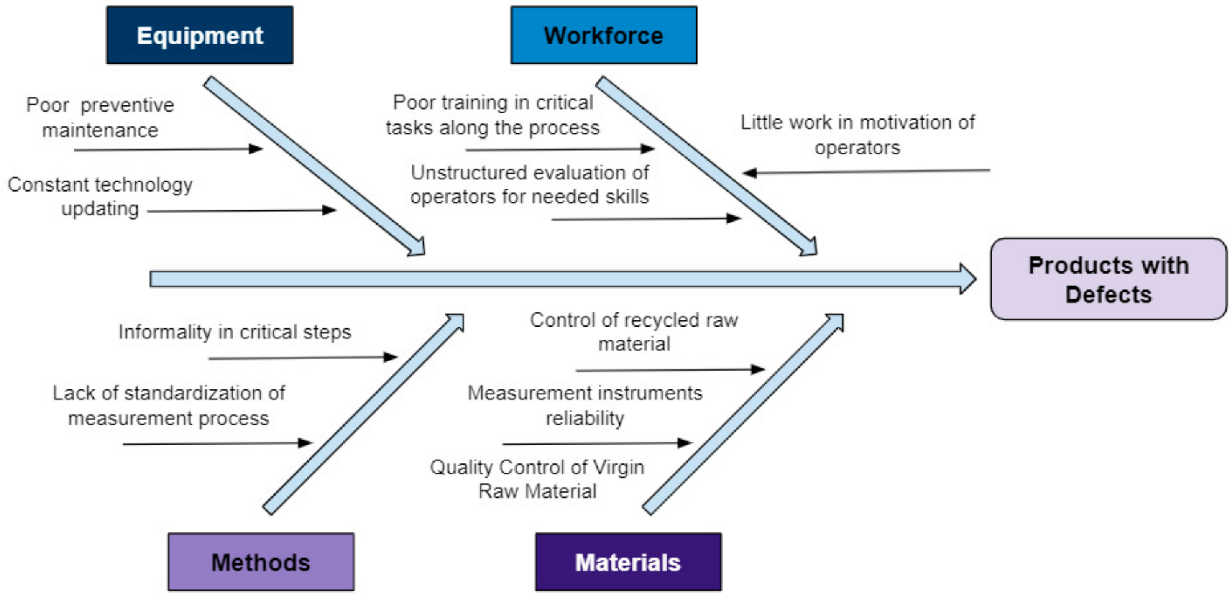

Figure 3: Fishbone diagrams (Rodriguez Delgadillo et al., 2022)

3. **Analyse**

This stage is focused on identifying the underlying causes of issues (faults), comprehending why defects occurred, and comparing as well as prioritizing options for advanced improvement.

4. Improve phase

Finding, testing, and implementing a partial or complete solution to the difficulties is the goal of this stage. The reasons and remedies for the various faults' root causes have been found. This stage focuses on using statistical methods and experimentation to create potential changes that might lower the number of quality issues and defects (Jirasukprasert et al., 2014). The three key areas for improvement are (i) input quality of raw material, (ii) accuracy of measurements and assessments, and (iii) human factor effectiveness.

5. **Control phase**

The effectiveness of the activities taken to improve quality is assessed during the Control phase. Concerning how compliance with the anticipated quality standards will be assessed, it is crucial to be explicit and open. In order to compare and easily assess the effects of the decrease in variability, the indicators chosen for the control phase must be a component of the suggested framework and have a concise and objective measurement. Best controls, including irreversible product modifications and process design, will require little or no monitoring instead of calling for these. However, specific process settings, setup steps, or other modifications will make everyday operations and monitoring needs (Montororing et al., 2022).

c. 21st Century Tools To Create a Greener Process

Adopting 21st-century tools and technology can substantially enhance sustainability and produce a greener process for manufacturing at a time when environmental responsibility is vital. The development of greener processes might greatly benefit from the use of a number of 21st-century tools and technology by Big Green Tractor. The following is an overview of these tools and technologies.

Process mass intensity calculator.

The process mass intensity calculator is one of Big Green Tractor's standout tools for designing green manufacturing procedures. This technique is quite effective at estimating the decrease in material requirements throughout product production in production locations. This technology could be used by Big Green Tractor to recognize the requirement for materials like tractor spare parts and other things. The PMI value that the tool provides may be evaluated to show the corporation where it needs to invest money in order to make certain acquisitions. If the PMI value is shown to be low, the business may minimize the purchase as well as change the tractor specifications appropriately. It seems understood that a decrease in material purchases

will result in less processing, which might eventually decrease energy use and harmful substance emissions. Big Green Tractors may use the process mass intensity calculator as their primary tool to develop greener manufacturing and production processes in Indonesia.

Robotics and software.

Robotics is one of the key technologies companies are incorporating into their manufacturing procedures in the twenty-first century. Numerous studies have shown that organizations nowadays use sophisticated software and tool systems, which may indicate a sign that they are implementing green business practices. Using robots and software algorithms can be quite helpful in assessing the greenhouse gas emissions from Big Green Tractor's manufacturing plans. This is similar to how intelligent software systems may suggest specific activities that might be performed to reduce emissions. Additionally, Big Green Tractor may greatly benefit from the use of robots, automated technologies, and other tools to harness greener operations. The company may be able to solve the problems with waste management and apply greener practices by using machines in the manufacturing and assembly lines. For instance, intelligent software may be used to assess how material-cutting processes, including those for iron sheets as well as many others, might be improved to save waste. In this approach, Big Green Tractor may overcome present challenges using robots and software technologies (Tomlinson & Woodward, 2013).

Reagent guides and solvent selection tools.

To adopt greener processes in the company's manufacturing facilities, Big Green Tractor also has several additional instruments at its service. The research and development division of the company may be able to assess the degree of toxicity of various chemicals used in the

production of tractors, including paints, bases, acids, and a variety of other chemicals, with the use of reagent guides along with solvent selection tools. These tools' outputs may be examined to choose the least dangerous substances that have the least negative effect on humans and the environment.

Digital twins and real-time monitoring.

By using digital twin technology, physical production systems may be virtually replicated. The Big Green Tractor can achieve the following by deploying digital twins:

Real-time monitoring: Real-time process and equipment monitoring is possible because of digital twins. Machine sensors gather information on pressure, temperature, and energy usage. The data can be examined to spot inefficiencies and improve resource consumption.

Predictive maintenance: In order to predict when breakdowns in machinery may occur, predictive analytics may be used for digital twin data. This makes it possible for preventative maintenance to be performed, minimizing downtime and costly breakdowns.

Resource optimization: The most resource-efficient procedures are found by modeling numerous operating situations using digital twins. Companies may minimize resource usage by identifying energy-intensive or inefficient practices and making data-driven decisions (Pylianidis et al., 2021).

3D printing and additive manufacturing.

A digital fabrication process called additive manufacturing, sometimes called 3D printing, creates real objects out of geometric models by layering materials on top of one another. The use of 3D printing is a fast-growing industry. The use of 3D printing has become widespread

in recent years. In the healthcare, agricultural, locomotive, and automotive sectors, mass customization and production of open-source designs are becoming more prevalent uses of 3D printing (Jadhav & Jadhav, 2022). It has a number of benefits for sustainability:

Material efficiency: The effectiveness of 3D printing techniques in using materials is well recognized. They minimize waste by using only the materials required to manufacture a product.

Customization and on-demand production: On-demand production and customization made possible by 3D printing eliminate the need for big stocks and surplus production.

Lightweight design: Designing products with optimum geometry might result in a reduction in weight and material use. This is especially advantageous for sectors like transportation, where lowering weight results in energy savings (Jadhav & Jadhav, 2022).

Socially Responsible Operational Guide for Pollution Management

Sustainability and social responsibility are crucial for companies in the modern world. The Big Green Tractor must actively manage and reduce pollutants produced during industrial operations. The guide on how the business can comply with industry standards for chemical waste disposal and green alternatives to traditional manufacturing processes.

a. Industrial Standards on Disposal of Chemical Waste

To maintain the preservation of the environment and public health, Indonesia has several regulations and guidelines governing the disposal of chemical waste. The main industrial regulations and standards governing how chemical waste is disposed of in Indonesia include:

Regular audits and inspections.

Conduct regular inspections and audits of chemical storage facilities, waste management processes, and documents to ensure adherence to industry regulations and standards.

Indonesian National Standard (SNI).

Managing and removing specific chemical waste may be subject to SNI requirements. SNI 19-2454-2002, for instance, offers instructions on how hazardous waste should be handled and disposed of. The Indonesian National Standard (SNI) aims primarily to:

- Increasing security, safety, health, and environmental preservation of customers, business owners, employees, and other communities.
- Help in facilitating smooth trade.
- Achieving fair commercial competition (SGS, 2016).

Hazardous waste identification.

Chemical waste produced at the plant should be identified and categorized. Sort it into categories based on its hazardous characteristics, including flammability, reactivity, toxicity, and corrosivity. Make careful to mark correctly by using the Hazardous Waste Identification System (Krishna et al., 2017).

Regulatory compliance.

Select a compliance officer responsible for complying with all applicable national, local, and international laws and regulations relating to chemical waste disposal. Additionally, monitor regulatory updates and modifications to guarantee continued compliance and make any procedure adjustments.

Waste characterization and segregation.

Prepare and maintain a list of all chemicals used in manufacturing processes, including information on their hazards and qualities. Establish classifications for waste generation (such as hazardous as well as non-hazardous) and make sure that labels and segregation are accurate.

Pollution prevention.

Create and execute waste reduction strategies in manufacturing activities while actively looking for ways to cut the amount of chemical waste you produce. Explore alternatives for reusing or recycling chemical waste materials where this is both feasible and ethical. In addition, look for and implement eco-friendly substitutes for hazardous materials and methods, prioritizing green fixes to stop pollution at its source.

Emergency response plan.

Ensure the safety of the community, employees, and the environment by developing and regularly reviewing an emergency response plan to address chemical waste incidents. Employees should get emergency response training, including processes for spill control, spill clean-up, and reporting. In an incident involving chemical waste, establish open contact lines with regional authorities, environmental agencies, and emergency responders (Das, 2020).

Waste disposal methods.

The chemical waste disposal follows these guidelines:

- Follow all national, state, and local regulations governing the disposal of hazardous waste.
- To ensure appropriate handling and disposal, contract with authorized waste management companies.

- Waste containers should be marked with information regarding their contents.

Reporting & documentation.

Maintain complete records of all disposal actions for chemical waste, particularly receipts, manifests, and regulatory reports. Reports must be submitted on schedule to regulatory bodies.

The Big Green Tractor must comprehend and abide by these guidelines while dealing with and eliminating chemical waste in Indonesia. The Big Green Tractor will lessen its effect on the environment by complying with these industry standards and recommended procedures for the disposal of chemical waste. It will also show a strong commitment to sustainability and social responsibility.

b. Green Alternatives to Traditional Manufacturing Processes

Industries now look for green alternatives to traditional manufacturing processes due to the need to minimize environmental effects. While preserving or enhancing product quality, these alternatives seek to reduce resource use, waste production, and emissions. The Big Green Tractor should take into account these critical green alternatives:

Sustainable materials.

Resources-intensive materials, including metals and plastics, are frequently used in traditional manufacturing. When considering green alternatives, consider using sustainable resources like:

Bioplastics: Bioplastics lessen the carbon footprint and reliance on fossil fuels since they are made from renewable materials like sugarcane or corn.

Recycled materials: By keeping waste out of landfills, using recycled materials like metals or plastics may greatly influence the environment.

Bamboo and hemp: These are two renewable resources that may replace traditional materials in items like textiles, panels, and packaging, lowering water and deforestation costs.

Lean manufacturing.

The main goals of lean manufacturing are to reduce waste and increase productivity. This approach entails:

Just-in-time (JIT): Reducing inventory levels while maintaining material availability to reduce waste, cost of storage, and overproduction (Goyal, 2023).

Kaizen: Encouraging continual improvement by making small, gradual changes to operations, which can boost productivity and reduce waste.

Digital manufacturing.

Green benefits of digital manufacturing technology like 3D printing include:

Material efficiency: In comparison to traditional subtractive manufacturing, 3D printing manufactures items layer by layer with less material waste.

Production on demand: 3D printing enables localized manufacturing on demand, eliminating the need for warehousing, mass production, and long-distance shipping (Javaid et al., 2021).

Energy efficiency.

Energy efficiency is prioritized in green manufacturing in several ways:

Energy audits: Regular evaluations of energy use assist in identifying areas for developing and implementing energy-saving strategies into action.

Renewable energy: Integrating renewable energy sources, such as solar panels and wind turbines, lessens the need for fossil fuels and cuts carbon emissions.

Sustainable packaging.

Eco-friendly packaging decisions can significantly lessen a product's effect on the environment:

Biodegradable and compostable packaging: Compostable cardboard and biodegradable plastics provide ecologically beneficial substitutes for traditional packaging.

Minimalist packaging: Cutting out unnecessary packaging materials and focusing on simple designs reduces waste.

Water conservation.

Water use in manufacturing operations is frequently high; green substitutes consist of:

Water recycling: Reusing and treating water in manufacturing processes through water recycling technologies.

Closed-loop water systems: By recycling and circulating the water, closed-loop systems reduce water waste.

Lean supply chain.

Sustainability is given top priority throughout the whole production process in a green supply chain:

Collaboration with suppliers: Ensuring suppliers adhere to sustainability requirements and minimizing the supply chain's carbon footprint.

Local sourcing: By using local manufacturers and suppliers, you may save emissions caused by transportation and boost regional economies.

Green chemistry.

Green chemistry focuses on developing chemical products and procedures that utilize the fewest hazardous substances and have the least negative environmental effects:

Safer chemicals: Using safer chemicals in place of hazardous ones throughout production operations.

Waste reduction: Establishing chemical procedures that produce less waste and don't require harmful byproducts (Singh & Kaur, 2021).

Environmental impact assessments.

Environmental impact assessments (EIAs) are carried out to identify and reduce any potential environmental dangers related to manufacturing operations. EIAs influence decisions to adopt greener practices (Amuah et al., 2023).

Conclusion

The operational streamline procedure guide offers suggestions to The Big Green Tractor to boost productivity, reduce defects, and uphold its environmental and social responsibilities. By implementing these recommendations, the Big Green Tractor may improve its manufacturing procedures, lower production costs, increase competitiveness, and improve overall cost-

efficiency. Continuously monitoring and adjusting will be necessary to maintain these gains over time.

According to the Big Green Tractor Six Sigma DMAIC cycle, the strategy for minimizing defects throughout the production process is the most efficient. The Big Green Tractor may considerably lower defects throughout the production process by adhering to the meticulous plan, which will raise product quality, boost satisfaction with consumers, and cut costs related to rework and claims for warranty. Constant observation and improvement are necessary to continue to be successful in defect reduction.

Moreover, The Big Green Tractor may develop a greener manufacturing process that eliminates waste, decreases energy use, and lowers emissions of greenhouse gases by utilizing 21st-century tools and technology. These developments not only support environmental sustainability but also have the potential to reduce costs and raise market competition. To maintain its position at the cutting edge of environmentally friendly manufacturing, the company must adopt these contemporary tools, monitor their use, and constantly modify its procedures.

Incorporating the above-stated green alternatives into manufacturing processes can help the Big Green Tractor show its commitment to sustainability by reducing its environmental impact. To keep in line with changing environmental requirements and customer expectations, it is critical to assess and adapt this decision continually.

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