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KPI Identification and Development for Road Transportation

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Abstract

Monitoring and evaluation are critical for determining and ensuring the effectiveness of an action. Thus, every action of an organization needs to be monitored and evaluated. Therefore, identifying and using the key performance indicators (KPIs) is crucial for monitoring and evaluation. Building the ideal KPI approach can be difficult for many reasons, such as lack of organizational attention or investment, establishing a KPI-driven culture and literacy, using too many unnecessary key performance indicators (KPIs) etc. In this backdrop, the specific objectives of the study are: 'Finding some good practices in key performance indicator (KPI) management and using them for monitoring and evaluation (M&E) in road transportation by reviewing the literature'; and 'Finding challenges of using KPIs'. It is impossible to cover all aspects of these topics in a single study. As a result, this study was limited to mainly road transportation logistic-based KPIs, and thus monitoring and evaluation in the same field. Since it is a literature review-based approach, a comprehensive literature review was conducted throughout the entire duration of the study. Qualitative review methods were followed for the study. The study presents the good practices of KPI management, important KPIs for road transportation, overall and KPI-specific challenges in KPI management, ways to tackle such challenges, and the role of modern tools, techniques, and algorithms in KPI management. The result illustrates a sample M&E plan for road transportation using the identified KPIs. It is anticipated that implementing KPIs to promote behaviours increasingly supportive of innovations would ultimately help change the company culture and make it more opportunity friendly. The obstacles identified in the study will not typically exist with a more dynamic and positive company culture; thus, introducing KPIs to gauge the performance of innovation activities may be more straightforward. Recent technological advancements are rapidly changing the concepts of operating supply chains, handling materials, and human resources management. Businesses are under pressure from the economy to be more productive and efficient. Using advanced technology can be helpful to satisfy this increased pressure. Further research should emphasize the blockchain-based infrastructure.

Keywords/tags (subjects)

monitoring, evaluation, monitoring and evaluation, M&E, key performance indicators, KPI, road transportation

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1 Introduction

1.1 Background of the study

Monitoring is the continuous practice of collecting operational and program data to compare to prior baseline standards aligned with a project's objectives and goals. Corrective actions can be undertaken by regularly monitoring how far an operation has progressed and whether the objectives have been attained (*Monitoring and Evaluation - Logistics Operational Guide (LOG) - Digital Logistics Capacity Assessments*, n.d.). Evaluation is the continuous measurement of the excellence of output produced by logistics operations or services to assess progress toward meeting set objectives and goals. The evaluation must also be regularly incorporated into the planning phases so that the planned intervention strategy can be modified or revised to reflect the assessment findings and present circumstances. Evaluation gives management valuable suggestions on whether plans have been accomplished and the factors behind failure or success, allowing them to keep focus.

Performance is measured to evaluate the effectiveness of an operational procedure or individual operation by developing indicators for the critical logistics operation elements (*Monitoring and Evaluation - Logistics Operational Guide (LOG) - Digital Logistics Capacity Assessments*, n.d.). Therefore, identifying and using the key performance indicators (KPIs) is crucial for monitoring and evaluation. Key performance indicators (KPIs) are measurable benchmarks of how well a business or department is executing its operations (*Monitoring and Evaluation - Logistics Operational Guide (LOG) - Digital Logistics Capacity Assessments*, n.d.). Key performance indicators (KPIs) differ depending on the businesses, organizations, divisions, and corporate objectives. For example, a transportation company may find fuel and route efficiency an essential key performance indicator, while a retail business may emphasize sales performance more.

1.2 Objectives of the study

Building the ideal KPI approach can be difficult for many reasons. Additionally, many organizations do not pay adequate attention or effort to develop scientific literacy on the topic. Furthermore, establishing a KPI-driven culture is challenging when the employees are unsure what their key per-

formance indicators (KPIs) mean (USAID, 2006) and what they are used for. Moreover, overwhelming the monitoring and evaluation (M&E) tasks with too many key performance indicators (KPIs) also creates another problem. In this backdrop, the specific objectives of the study are:

- Finding some good practices in key performance indicator (KPI) management and using them for monitoring and evaluation (M&E) in road transportation by reviewing the literature
- Finding challenges of using KPIs

1.3 Scope of work

The study is limited to preparing general guidelines for monitoring, evaluating, and identifying the road transportation field's key performance indicators (KPIs). The study aims to:

- Finding out general good practices while creating a monitoring and evaluation (M&E) plan through KPIs focusing on the road transportation sector
- Finding out practices that should be avoided in developing the key performance indicators (KPIs)

1.4 Methodology and approach

The study will seek effective key performance indicators (KPIs) for monitoring and evaluation (M&E), focusing the transportation logistics and providing necessary recommendations for further improvement. Figure 1 depicts the study's overall methodological structure. The structure included research questions, literature review, analysis, findings, and discussion.

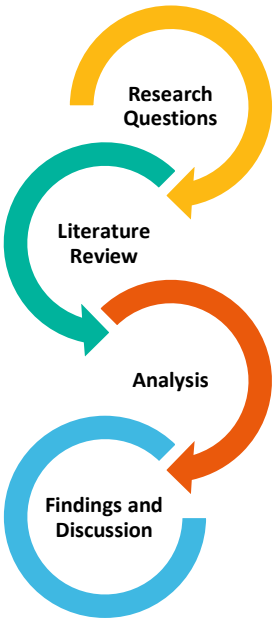

Figure 1: Methodological Framework

1.4.1 Research question

The research will mainly include a thorough literature review and quantitative methods. The final findings will focus on the following questions:

- Which are good practices of KPI management, especially for road transportation-related KPIs?
- Which are the most important KPIs to be measured in road transportation?
- What are the challenges in using these KPIs?
- What is the role of Blockchain technology in these KPIs?

1.4.2 Study area

Topics such as monitoring and evaluation (M&E) and key performance indicators (KPI) are vital and extensive. It is impossible to cover all aspects of these topics in a single study. As a result, this study was limited to mainly road transportation logistic-based KPIs, and thus monitoring and evaluation in the same field.

1.4.3 Literature review

The study team carefully reviewed numerous international research papers, case study findings, journals, databases, white papers, and digital sources. The literature review has helped develop an advanced understanding of the current situation, challenges, barriers, and future development of key performance indicators (KPI) and monitoring and evaluation (M&E) in the road transportation sector. Since it is a literature review-based approach, a comprehensive literature review was conducted throughout the entire duration of the study.

Qualitative review methods have been followed for the study, and a period of nearly 30 years (1991-2022) was chosen for selecting literature to review. The 30-year chronology may seem long; however, it was preserved this way since the concepts have changed much over time. Moreover, it is crucial to comprehend the fundamental ideas as well. Keyword search is an excellent way to save time when looking for pertinent documents. Electronic resources and literature databases are excellent tools for searching. JAMK offers a great collection of resources that is accessible both physically and digitally. Additionally, this study involved scholarly resources, including JSTOR, SciFinder, ResearchGate, Semantic Scholar, Elsevier, etc. Two excellent methods for quickly discovering pertinent and dependable study papers are backward search and forward search, which was also used for the literature review.

1.4.4 Analysis

The analysis is focused on analyzing the information and presenting it systematically. The analysis from this step will influence the next step, i.e., 'Findings and Discussion'. Since it is a literature review-based approach, the analysis of the knowledge gathered from the literature, contrasting theories, and the author's own point of view has been done.

1.4.5 Findings and discussion

The findings and discussion aim to interpret the analysis into answers to the research questions. It also focuses on the explanation of the findings. The future potential of studies and development is also discussed here.

1.5 Chapters overview

There are seven chapters in the report. The background, objective, scope, and research methodology are described in the first chapter. The second chapter reviews the literature on performance measurement and key performance indicators (KPI). The third chapter represents the good practices of key performance indicator (KPI) management and the key performance indicator (KPI) development process for transportation logistics. The fourth chapter explains the challenges of using the key performance indicator (KPIs). The fifth chapter focuses on the future development aspects of transportation logistics. The sixth chapter compiles the overall findings from the study. Finally, the seventh, i.e., the last chapter, concludes the study with further research recommendations.

2 Measuring performance and KPI management

2.1 Measuring Performance

Performance measurement is the mechanism of calculating the efficacy and efficiency of a given operation (Djordjevic & Krmac, 2016). An effective measurement must be quantifiable, clear, and well-defined and promote acceptable actions. It should also be developed with individuals or teams whose performance is assessed and aligned with the company strategy or aim (Djordjevic & Krmac, 2016). According to Waters (2009), although measuring performance is not a goal in and of itself, it does assist logistics professionals in decision-making. These may be applied, for instance, to assess how effectively objectives are being met, compare present and previous performances, assess performance against other companies, assess the consequences of supply chain transformation, and identify areas that require development. A similar ideology came from Ishaq Bhatti et al. (2014), who explained that companies use performance assessment to determine whether or not they are moving forward correctly.

2.2 Key performance indicator (KPI)

Performance indicators can be defined as the efficiency and effectiveness of the process of quantifying operations (Neely et al., 1995). Gosselin (2005) defined performance indicators as the tangible quantities applied to evaluate, compare, and control the entire organizational performance. Isoraite (2005) defined KPIs as chosen parameters or indicators to track performance regarding the effectiveness of the actions to accomplish the aims and targets of the organization. According to Heckl

and Moormann (2010), KPIs are measurement parameters to evaluate a company's performance. Since only vital elements should be measured, a performance indicator is referred to as a "key" performance indicator (Djordjevic & Krmac, 2016). Isoraite (2005) also supports the idea that KPIs can be used as tools for future development instead of only a performance measurement tool. A company acquires insight into what should be measured most when it utilizes data to identify further its fundamental goal, an integrated approach that might take time. Moreover, the company that uses performance measurement is thought to perform better than the one that does not (Neely, 2005).

2.3 Key performance indicator (KPI) development and management

The standard commercial supply chain uses several performance measures, but given the unique traits of supply chains, some may be unsuitable or unnecessary (Beamon & Kotleba, 2006). Therefore, companies must understand performance indicators to manage, compare, and measure performance (Ishaq Bhatti et al., 2014). Haber and Schryver (2019) support the idea and explains that companies should realize the long-term benefits of building the organizational ability to develop meaningful KPIs. Therefore, a crucial stage in the performance assessment is choosing the right performance indicator. When selecting a set of performance measurements, it is essential to understand the distinction between input, output, and outcome metrics (Djordjevic & Krmac, 2016). Furthermore, performance assessment offers crucial data that aid in prioritization and warnings of prospective issues so that decision-makers may correct course and reach goals and objectives (Djordjevic & Krmac, 2016).

Numerous researchers have proposed various classifications of indicators for various performance-measuring methodologies. (Ishaq Bhatti et al., 2014) proposed two basic categories of indicators, i.e., the financial or cost-based measurements and the non-financial or non-cost-based measurements. However, according to other researchers, performance indicators can be classified into many other focus points, such as cost (Neely et al., 1995), finance (Parmenter, 2009), quality (Gosselin, 2005; Heckl & Moormann, 2010), reliability of delivery (Heckl & Moormann, 2010), customer satisfaction (Neely et al., 1995; Parmenter, 2009), employee satisfaction (Parmenter, 2009), environment and community (Neely et al., 1995; Parmenter, 2009), growth and learning (Parmenter, 2009), safety (Parmenter, 2009) etc. Ishaq Bhatti et al. (2014) identified a correlation between indicators, i.e., a positive correlation between quality and time, reliability of delivery and safety, and a positive

correlation between time and flexibility and safety. However, other researchers also suggest that there can be conflicts or trade-offs among the performance indicators. That means if the value of an indicator rises, there can be a drop in value for another indicator (Mapes et al., 1997). For instance, Mapes et al. (1997) observed that indicators for cost, quality, delivery reliability, time and flexibility exhibit major conflicts or trade-offs among each other. However, the need for the indicators, their correlation and their importance may vary for different supply chains, industries and sectors.

Researchers have identified numerous essential aspects that an effective performance measuring system should include, such as individual measurements of the efficacy and efficiency of acts (Kennerley & Neely, 2002); a set of metrics used to analyze an organization's overall performance (Kennerley & Neely, 2002); and supportive infrastructure for data acquisition, collation, sorting, analysis, interpretation, and dissemination (Neely, 1999). Isoraite (2005) identified four major elements that are necessary to be present in a KPI-driven management system, i.e., a declaration of the relevant objectives; SMART (Specific, Measurable, Attainable, Relevant, Time-bound) KPIs connected to the overall strategic objective; actions to carry out the goals; reliable costing programs and accounting tools and methods for gathering accurate cost data (Beamon & Kotleba, 2006; Ishaq Bhatti et al., 2014).

3 Good practices of transportation KPIs

3.1 Building the foundation

Choosing the crucial elements and measuring them is a standard procedure for defining KPIs. Thus, the first phase is essential and involves selecting highly relevant and strategic KPIs. However, before implementing any new KPIs, it is crucial to assess how well-received, understood, and utilized these will be by the staff and whether they will be able to respond appropriately to enhance performance. Therefore, the following three considerations should be taken care of (QlikTech International AB, n.d.):

- **Carefully Choosing the Right KPIs**: First, it is crucial to understand what to measure. The KPIs should be quantifiable, clear, and well-defined and promote acceptable actions. Moreover, a broad set of KPIs may not be effective for a particular supply chain (Beamon & Kotleba, 2006). Therefore, choosing suitable KPIs is significant. It should also be aligned with the company strategy or aim (Djordjevic & Krmac, 2016).

- **Creating a KPI-driven Company Culture:** According to QlikTech International AB, only 24% of the decision-makers in the USA were fully capable of comprehending, working with, evaluating, analysing data and taking decisions accordingly in 2018. Because of this, increasing data literacy has become a primary concern for many business executives. Employees will feel more motivated and driven to concentrate on the task with the most excellent effect if they understand what the statistics imply. The employees should undergo training activities to understand the meaning of these KPIs if needed.

- **Well-structured KPI Development Process:** KPIs are not something to change every year. However, it is not very unusual to find that a KPI is not advancing the company towards its aim or that it is inciting incorrect actions. Thus, Establishing a systematic development process is essential to monitor what is effective and what is not. For this, a recurring cycle of monitoring the KPIs' effectiveness can be created. Then, after careful monitoring, the decision makers can decide if the current KPIs are doing well or need to change.

3.2 Transportation-specific Questions and Criteria to Build the KPIs

Even though the importance of performance assessment in the practical and successful management of organizations has long been acknowledged, the topic is still vital and frequently argued (Kennerley & Neely, 2002). Considerable research endeavour is being put forward from a broad range of managerial disciplines as they strive to improve the grasp of the matter and associated concerns. Extensive effort is being spent on the opinions of how and what must be evaluated (Neely, 1999). Lynch and Cross (1991) stressed the importance of dynamic and relevant measurement indicators that tend to represent the issues that are significant to the organization. From the wide range of research, the table below summarises the ’how and what’ to measure question and also the associated criteria to carry out the measurement:

Table 1: Questions and criteria to build the KPIs

Questions to Ask While Developing the Measurement Indicators	Criteria to Maintain
• **Which transport indicators are to be applied?** • **How much will the indicators help to identify good practices and alert about failures?** • **Will all stakeholders (employees, authority etc.) be able to adopt and apply indicators?** • **Will the indicators perform as a device for institutional administration?** • **How will priority issues be determined for modifying or improving the process?**	• The identification and attention to the functions and operations of the company are crucial to developing practical and usable KPIs • The indicators should cover significant and relevant aspects without becoming too complex to employ in a clear, logical and practical manner • The formation of a systematized hierarchy of indicators that can be divided for use at various levels • The development of terminologies and information sources that are consistent among all stakeholders, ensuring that even if the data or indicators are changed or modified, the database will still include the definitions and terminologies of the previous and current data

Source: adapted from (Lynch & Cross, 1991; Neely et al., 1995; Neely, 1999; Kennerley & Neely, 2002; Isoraite, 2005; Neely, 2005; Djordjevic & Krmac, 2016; Torbacki & Kijewska, 2019)

3.3 Road Transportation KPIs

KPIs should be chosen by thoroughly considering the organization's objectives and goals. KPIs explicitly outline expectations, essential considerations, and best practices for daily tasks. Reaching maximum efficiency and corporate performance excellence may be accomplished by defining KPIs properly, which can also increase service levels, lower costs, and enhance the environment. A thorough list of road transportation KPIs from the literature review is mentioned in Annex 1 regarding safety, cost, quality, delivery and management. However, as mentioned earlier, this study will focus on the most important and widely used KPI practices. Therefore, the table below illustrates the most useful and specific KPIs for transportation:

Table 2: Road Transportation KPIs

No	KPI	Description
1	Fuel Efficiency	The word fuel-efficiency refers to the quantity of fuel utilized in liters per distance travelled or kilometers per liter. Fuel efficiency is usually represented in Europe as liters per 100 kilometers *t*ravelled. Fuel consumption rate may vary for several reasons, including incorrect scheduling, poor fleet utilization, and various road conditions (slope, uneven road, bad weather conditions etc.)
2	Total number of maintenance per vehicle per month	Maintenance of vehicles indicates the vehicle health, the need for new investment in buying vehicles and the additional costs occurring due to the maintenance.
3	The ratio of distribution cost to the value of goods distributed	It is described as the cost of transporting or delivering orders divided by the order value. This indicator is typically determined for every delivery route provided. It may be calculated over any period, although one year is the most common. *Ratio of distribution cost to value of commodities dis-tributed= cost of transporting commodities/ value of commodities transported* Checking the transportation costs against the total income is also important. If the cost gets too high, the company has to look for alternatives to reduce costs. *% of Average transport cost = (Average Total transport cost / monthly gross income) × 100*
4	Lead Time and Avg. Transportation time	Lead time is the interval between placing an order and getting it fulfilled. The transportation lead time can be the interval between the start and end of the transportation process. *Lead time (LT) = Order Delivery Date – Order Request Date* Transportation time is the ratio of the actual delivery time to the predicted transportation time for every cargo. Furthermore, values less than one suggest that the transportation network performed better than planned and vice-versa. *Transportation time per delivery= real-time delivery/estimated delivery time* *Avg. Transportation Time per Delivery= Total Transportation Time per delivery/no. of deliveries*
5	Percentage of on-time and accurate delivery (including the percentage of lost or damaged items during transportation)	It is the proportion of items delivered on time to clients compared to the total number of products supplied. The KPI assesses the delivery performance. *Percentage of on time Delivery = ((Units delivered on-time) / (Total units))× 100* *Percentage of lost or damaged items= ((Units damaged + Units lost) / (Total units))× 100* These are used to understand the efficiency of service and customer satisfaction

6	Percentage of vehicle fill or Vehicle Management Efficiency	This indicator shows how efficiently a company is using its truckload capacity. It might be measured in terms of weight and cage/pallet spaces. Need to be aware of the weight or number of components the vehicles are capable of transporting, as well as the weight or number of units that the company as a whole sent over a specific time frame.

Source: adapted from (Išoraitė, 2005; USAID, 2006; Benchmarking Success, 2015; Bradley, 2021; 20 Best Logistics KPIs and Metric Examples for 2022 Reporting, 2021; Roh et al., 2022; Cedillo-Campos et al., 2022)

4 Challenges in using the road transportation KPIs

4.1 Overall challenges

The significance of KPIs is widely acknowledged worldwide since they are inextricably tied to the achievement of goals and the strategic vision of a company. They are critical components of the road to accomplishing objectives; they assess and signal progress, drive organizational strategies, and may be regarded as the qualitative or quantitative reflection of strategy implementation (Popa, 2015). Companies must exercise enormous caution while developing and implementing KPIs, considering their importance. Popa (2015) identified one of the most common issues due to the overuse of such indicators, implying that not everything should be evaluated. Only which assist in developing better-informed judgments and are most essential for an organization should be measured to reduce confusion and provide a clear explanation of the approach to be pursued (Popa, 2015). As a result, determining the appropriate indicators becomes challenging. Therefore, a measure can be a KPI if utilized as a resource for insights that may affect current and future actions favourably. The table below discusses the key challenges in using road transportation KPIs:

Table 3: Overall challenges in using the road transportation KPIs

Challenges	Description
Unclear, Illogical and Unachievable KPIs and Too many KPIs	The KPI has to reflect on the strategic goals of an organization. If the KPI or the measuring criteria or system is unclear, it will create a problem in measuring. Moreover, KPIs must be realistic and not look for unachievable performance standards. Having too many KPIs also cause problem and confusion.
Lack of skills and/ or human resources in understanding and utilizing KPIs	Management must effectively articulate the advantages and significance of KPIs concerning the organization. The employees must understand why and how the metrics will be used clearly. Otherwise, it will create a significant barrier to utilizing the KPIs.

Absence of an effective action plan and process	One of the most significant barriers to performance analysis is the absence of an effective procedure and plan. Choosing suitable KPIs requires significant money, time, and effort. The strategy can be divided into smaller and achievable parts to achieve it correctly and prevent excessive resource expenditures. Making a precise action plan helps people understand the goals and what has to be performed.
Rigid Systems	Changing the KPIs, management and action plans every now and then is ineffective. However, there should be room for future development and corrections. For example, with the change in the business environment, objectives, situations, and urgent or sudden changes, the KPIs may need to be revised, modernized or changed.
Inappropriate Company Culture	In general, good company culture should foster the involvement of its employees in decision-making; it should support consistency in the goals and objectives while keeping room for future adaptability. Unfortunately, company culture is usually unseen to employees, even though it influences all staff behaviours, thoughts, actions, and organizational outcomes. Therefore, the company culture has to be appropriate and supportive in KPI management and utilization.
Poor Data Quality	KPIs may need the collection of data from many sources. Data is frequently stored in layers throughout the organization and needs to be accessed from numerous systems. Poor data quality can occur due to a deficiency of understanding of the standards or administrative issues, such as apprehension that published results would have ramifications for departments or people. Moreover, to ensure data accuracy, data needs to be cleaned, and the organization must have capable human resources and automated systems. Therefore, the accuracy of the data supplied is highly reliant on the utilization of KPIs.
Absence of Proper Tools in Data Collection, Data Management and Analysis	Data management and Data analysis tools play a vital role in KPI measurements. There are plenty of great tools to do so. However, a company unwilling to invest in that or too reluctant to use it may face challenges in KPI utilization.

Source: adapted from (Neely, 1999; Kennerley & Neely, 2002; Neely, 2005; Rialland et al., 2014; Popa, 2015; Graham et al., 2015; Lakiza & Deschamps, 2018; Cito Research, n.d.)

4.2 Challenges in utilizing the identified KPIs

There is an enormous list of road transportation performance indicators in the previous literature and research. The most useful and effective ones from the point of view of efficiency and customer satisfaction have been chosen in table 2 of section 3.3. The table below will focus on the challenges associated with utilizing these KPIs:

Table 4: Challenges in Utilizing the Identified KPIs

No	KPI	Challenges
1	Fuel Efficiency	• Shortage of real-time fuel consumption data if not appropriately recorded or poor data quality • Unable to analyze and interpret the data correctly with an explanation or reason as consumption rate may vary due to different road conditions, climatic conditions etc.
2	Total number of maintenance per vehicle per month	• Shortage of real-time data if not appropriately recorded or poor data quality • Absence of Proper Tools in Data Collection, Data Management and Analysis • Lack of skills and/ or human resources in calculating • Unable to analyze and interpret the data correctly with an explanation or reason as maintenance may vary due to sudden accidents, road or weather conditions etc.
3	Ratio of distribution cost to value of commodities distributed	• Absence of Proper Tools in Data Collection, Data Management and Analysis • Lack of skills and/ or human resources in calculating • Shortage of accurate data or poor data quality
4	Lead Time and Avg. Transportation time	• Absence of Proper Tools in Data Collection, Data Management and Analysis • Lack of skills and/ or human resources in calculating • Shortage of accurate data or poor data quality
5	Percentage of on-time and accurate delivery (including the percentage of lost or damaged items during transportation)	• Absence of Proper Tools in Data Collection, Data Management and Analysis • Lack of skills and/ or human resources in calculating • Shortage of accurate data or poor data quality • Unable to analyze and interpret the data correctly with an explanation or reason as delivery time, the number of accurate/lost/damaged deliveries may vary due to sudden accidents/incidents, road and/or weather conditions etc.
6	Percentage of vehicle fill or Vehicle Management Efficiency	• Absence of Proper Tools in Data Collection, Data Management and Analysis • Lack of skills and/ or human resources in calculating and understanding the facts • Shortage of accurate data or poor data quality

Source: adapted from (Neely, 1999; Kennerley & Neely, 2002; Neely, 2005; Rialland et al., 2014; Popa, 2015; Graham et al., 2015; Lakiza & Deschamps, 2018; Cito Research, n.d.)

4.3 Tackling the challenges of utilizing KPIs

As discussed in the earlier sections, an organization must track its performance towards its own goals after analyzing its mission and defining the goals. KPIs offer a tool for measurement and facilitate the company to track performance. There can be plenty of issues and challenges in KPI development and management. Below are some general good practices for tackling common challenges. However, it should be kept in mind that some specific KPIs or situations may exhibit particular challenges which may need to be solved differently.

4.3.1 Create a well-organized KPI action plan, including capacity-building training

Creating a well-organized KPI action plan that includes capacity-building training will address the challenges mentioned below:

- Lack of skills and/ or human resources in understanding and utilizing KPIs
- The absence of an effective action plan and process

The tasks have greater meaning when the employees see how their efforts affect larger corporate aims. Instead of getting expected to complete yet another duty that increases the workload, it also makes them feel included and important. This creates a positive work environment. Moreover, a company should have periodic needs-based assessment programs to understand the employees' needs or shortcomings. The employees can be provided training to boost their skills if their requirement is known.

The type of data-gathering tools a company utilizes will depend on the objective and target of the assessment and measuring operation. Qualitative or quantitative techniques or both can be needed in the measurement. Therefore, it is vital to ensure that the company has enough tools and human resource capabilities to carry out the techniques they require for the measurement. Only introducing some KPIs and trying to record and report the measurement will not be beneficial, instead having a solid plan with the following is required:

- Well-defined logical KPIs, their importance, and the process of measuring and reporting them

- Assessment of tools and training required; Yearly/quarterly budget for tools upgradation and training sessions

- Interactive employee sessions to make them understand the requirement and importance of the KPIs and room for modifying the monitoring plan on the discussion (if required)

4.3.2 Ensure data sources, tools and techniques

Ensuring the data sources, tools, and techniques will address the three challenges below:

- Absence of Proper Tools in Data Collection, Data Management and Analysis

- Shortage of accurate data or poor data quality

Lack of real-time data, reliable data sources, and poor data quality hinder the measurements. Data is the key role player. Poor or unacceptable data quality might originate from a deficiency of awareness of the standards or administrative problems, such as concern that released results will have consequences for specific departments or individuals. Additionally, data must be cleansed to verify its correctness, and the company needs both competent human resources and automated tools to achieve this. KPIs significantly influence the reliability and accuracy of the data provided. Therefore, it is a must to identify the data required for each KPI. For example: to measure the 'ratio of distribution cost to value of goods distributed, it is essential to calculate the cost of transporting commodities and the total value of commodities transported. Costs associated with providing transportation services are referred to as transportation costs. Depending on factors such as geographical location, infrastructure, organizational strategies, fuel, and the method of transporting goods, there are fixed infrastructure and variable operational expenses. For example, there can be apparent costs like waiting in line, collection and delivery, terminal management, billing and receiving payment, fuel and maintenance costs, costs for real-time tracking vehicles etc. So, it is a must to have a list of all the potential transportation-related expenditure types and update the associated amounts. Then the summation is the total transportation cost. It can be understood that every KPI may need multiple types of data collected from multiple sources. So data accuracy and reliable data sources are vital.

Data analysis and interpretation greatly depend on the tools and techniques used. There are various good data analysis tools in the market. A company should first understand their requirements and

then invest in such tools. Moreover, using the tools and techniques need training. The importance of periodic and need-based training has already been mentioned in the previous section, which also applies to this section.

4.3.3 Dynamic and Data-Driven Company Culture

Dynamic and data-driven company culture will effectively avoid rigidity and inadequate output quality. Successful data utilization is something that every company is intrigued by. Nevertheless, the correct procedures and the appropriate technologies must be used to obtain KPI data. Decisions about technology can be matched with organizational objectives. Nevertheless, companies may profit the most by fostering a business culture prioritizes action-centric data. In order to be in a stronger position to select the solutions that best suit requirements, the technical team must participate in strategic business discussions. Instead of viewing viability as a chance to improve and actively affect business performance, KPIs may cause companies to adopt mostly reactive measures that try to adhere to legislation or increase brand value (Bonini & Görner, 2011). Issues have also been expressed regarding businesses frequently taking a reactionary progressive strategy to progressively become "least unviable" instead of tackling the root causes of the current issues (Taghavi et al., 2014). Therefore, company culture and values, strategic dynamics, and responsiveness towards challenges play a vital role in successful KPI management.

4.3.4 Using a third-party assessment as a hassle reducer

Some companies use third-party auditors to assess their performance. However, it is quite hard to comment if it is a good practice or bad. The company size, objectives and goals, company structure, business, etc., are many variables related to the decision to hire a third-party KPI auditor. What is suitable for one company may not be suitable for another. Moreover, outsourcing such a service is a great deal of investment. Additionally, the company needs to provide a lot of data/information to the third party, which is sometimes more complicated, and there is always a chance of sensitive data leakage. On the other hand, a company can have relatively fewer tasks in terms of performance measurement if a third party does that, which means they can have more time and scope to focus on their goals and targets. There are both benefits and problems in using a third-party auditor. However, as mentioned earlier suitability of using such a service depends on several issues.

5 Role of modern algorithms, tools and technologies in transportation

5.1 Role of modern algorithms in transportation

5.1.1 Intelligent transportation systems (ITS)

The massive growth in global and local transportation needs, especially cargo, private vehicles, and mass transportation, is leading to more severe overcrowding, accidents, and environmental hazards. According to the research of Sumalee and Ho (2018), intelligent transportation systems (ITS), which may combine a wide range of technologies involving sensors, communications, information transmission, and traffic control, have been created to address these problems. They also identified that intelligent transportation systems (ITS) must have these three fundamental elements to carry out their functions: data collecting, data analysis, and data/information dissemination (Sumalee & Ho, 2018). Sumalee and Ho (2018) further divided the ITS into two major categories i.e., advanced traveller information systems (ATIS) and advanced management systems (AMS).

5.1.2 Advanced management systems (AMS)

To maintain the effectiveness and safety of the transport network, advanced management systems (AMS) strive to regulate and manage various operators and infrastructures inside the network throughout various conditions (Sumalee & Ho, 2018). Such regulation and management techniques are used for arterials (Day et al., 2017) and highways (Wang et al., 2016), transportation of goods (Jiang & Mahmassani, 2014), mass transport (Fu & Yang, 2002), and mishap or emergencies (Kurkcu et al., 2015). Enhanced real-time and comprehensive management is feasible through expanded data sources, increased data clarity, and superior information distribution techniques (Sumalee & Ho, 2018).

5.1.3 Artificial neural networks (ANN)

Sumalee and Ho (2018) described another category of intelligent transportation systems (ITS) named Artificial neural networks (ANN) within the context of smart cities, the concept of intelligent mobility solutions. Artificial neural networks (ANN) are a type of supervised machine learning algorithm (Chou et al., 2022). They can conduct ‘non-linear mapping between the inputs and outputs by taking into account concealed layers and receiving enough learning (Sumalee & Ho, 2018). Thus, artificial neural networks (ANN) are highly suited for solving transportation issues when the

parametric correlations among variables are unclear. Artificial neural networks (ANN) are often used for behavioural analysis (Chong et al., 2013), occurrence identification (Srinivasan et al., 2007), traffic and infrastructure management (Ghanim & Abu-Lebdeh, 2015), and status evaluation and status prediction (Ye et al., 2010).

5.1.4 Other Algorithms

Castaneda et al. (2021) used machine learning algorithms such as decision trees, discriminant analysis (DA), the nearest neighbour (KNN), support vector machines (SVM), and naive Bayes to evaluate the accuracy of the algorithms in KPI management for transportation and logistics. They used environmental, social, and economic KPIs (Castaneda et al., 2021) for the research, many of which match the KPIs identified in this study. Their findings show that the optimized SVM classifier produced by Bayesian optimization has demonstrated the finest data adaption and more accurate prediction (Castaneda et al., 2021).

5.2 Role of modern tools in transportation: Blockchain

Another popular buzzword in advanced technology is ‘blockchain’. Satoshi Nakamoto (Nakamoto, 2019) introduced the Blockchain in 2008 to operate as the public transaction record for the cryptocurrency bitcoin (Chen, 2020). Blockchain in logistics enhances collaboration in transportation contracts, promotes supply chain transparency, and enhances overall service management inside businesses (Helo & Shamsuzzoha, 2020). Transportation resources may be handled quickly and with excellent information safety by utilizing the Blockchain-based approach. A solution like this can prevent the circumstance where an order is incomplete after long waiting, shorten the container's waiting time, increase throughput, and accomplish the goal of increasing efficiency (Koh et al., 2020).

Furthermore, it provides information on the products at every step, including manufacture, transportation, logistics, and distribution etc. Blockchain can monitor updates throughout the entire value stream and all activities (Helo & Shamsuzzoha, 2020). Therefore, it is necessary to precisely trace each activity and identify the specific event's stage. Furthermore, ensures the quality of the product and the complete transportation service by preventing fraud and validating the provenance of the goods (Chen, 2020). Therefore, Blockchain is becoming an influential tool in KPI management.

5.3 Levels, layers and tools associated with KPI analysis: extracted from the literature

Data is a crucial element of KPI management. Measuring the parameters is impossible without a proper source of real-time data, data analysis tools, and capable human resources for data analysis and interpretation. Data is produced at several levels depending on the period. Helo and Shamsuzzoha (2020) showed an excellent example of data layering, tools and elements. The figure below has been extracted from Helo and Shamsuzzoha (2020) as an example of such:

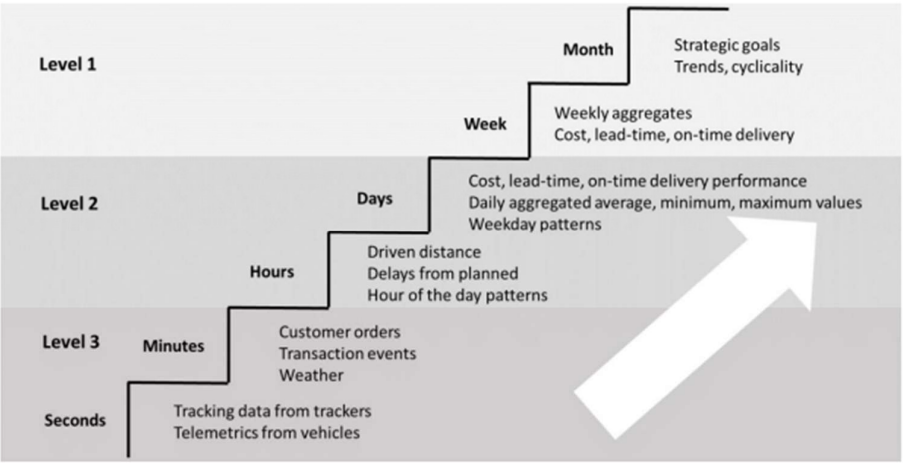

Figure 2: Levels, Layers and Tools associated with KPI Analysis

Source: adapted from (Helo & Shamsuzzoha, 2020)

According to Helo and Shamsuzzoha (2020), the KPIs are connected to the strategic objectives of supply chains, specific lead times, performance in terms of on-time delivery, and costs. The daily layer provides a more accurate degree. It is often facilitated by operational logistics information systems, including warehouse management systems (WMS), transportation management systems (TMS) as well as enterprise resource planning (ERP) (Helo & Shamsuzzoha, 2020). All businesses may not use this level of KPIs management. However, the most in-depth performance data comes from machines, which follow each delivery item or vehicle multiple times every second and operation (Helo & Shamsuzzoha, 2020).

6 Results and Discussion

To make it simpler for readers to locate and comprehend the outcomes, the author esteemed to provide the study findings in the exact order as the research questions.

6.1 Key performance indicators

Performance indicators can be defined as the efficiency and effectiveness of the process of quantifying operations (Neely et al., 1995). Isoraite (2005) defined key performance indicators (KPIs) as chosen parameters or indicators to track performance regarding the effectiveness of the actions to accomplish the aims and targets of the organization.

6.2 Good practices in utilizing KPIs

Since only vital elements should be measured, a performance indicator is referred to as a "key" performance indicator (Djordjevic & Krmac, 2016). Choosing the essential elements to measure and then measuring them is a standard procedure for defining KPIs. Therefore, the following three considerations should be taken care of (QlikTech International AB, n.d.):

- Carefully Choosing the Right KPIs
- Creating a KPI-driven Company Culture
- Well-structured KPI Development Process

Extensive effort is being spent on the opinions of how and what must be evaluated (Neely, 1999). From the wide range of research, table 1 in section3.2 summarizes the ’how and what’ to measure question and also the associated criteria to carry out the measurement. However, below are the questions that have to be kept in mind while developing road transportation KPIs:

- Which transport indicators are to be applied?
- How much will the indicators help identify good practices and alert about failures?
- Will all stakeholders (employees, authority etc.) be able to adopt and apply indicators?
- Will the indicators perform as a device for institutional administration?

- How will priority issues be determined for modifying or improving the process?

6.3 Most important KPIs in road transportation

KPIs explicitly outline expectations, essential considerations, and best practices for carrying out daily tasks. Therefore, achieving maximum efficiency and corporate performance excellence may be accomplished by adequately defining KPIs, increasing service levels, lowering costs, and enhancing the environment. A thorough list of road transportation KPIs from the literature review is mentioned in Annex 1. However, as mentioned earlier, this study will focus on the most important and widely used KPI practices. Therefore, the list below is extracted from table 2 of section 3.3, illustrates the most useful and specific KPIs for transportation:

- Fuel Efficiency
- Total number of maintenance per vehicle per month
- Ratio of distribution cost to value of goods distributed
- Lead Time and Avg. Transportation time
- Percentage of on-time and accurate delivery (including the percentage of lost or damaged items during transportation)
- Percentage of vehicle fill or Vehicle Management Efficiency

6.4 Challenges in using the KPIs

Chapter 4 focused on the overall challenges in implementing the road transportation KPIs and the specific challenges of implementing the KPIs selected in section 3.3. The overall challenges in utilizing KPIs are:

- Unclear, illogical and unachievable KPIs and too many KPIs
- Lack of skills and/ or human resources in understanding and utilizing KPIs
- Absence of an effective action plan and process
- Rigid Systems
- Inappropriate company culture

- Poor data quality
- Absence of proper tools in data collection, data management and analysis

Table 4 of section 4.2 focused on the challenges associated with utilizing the selected KPIs. A common linkage has been seen among the identified challenges for the six different KPIs. The common challenges or linkages between these KPIs are listed below:

- Shortage of real-time data or poor-quality data
- Absence of Proper Tools in Data Collection, Data Management and Analysis
- Lack of skills and/ or human resources in assessment
- Unable to analyze and interpret the data correctly with an explanation or reasons for anomalies and incidents

Identifying the problem areas, challenges or barriers does not help improve the scenarios. It is equally necessary to find solutions. Some general good practices in combating the common challenges have been identified. However, it should be kept in mind that some specific KPIs or situations may exhibit particular challenges which may need to be solved differently.

A well-organised KPI action plan is required to address the challenges like lack of skills and/ or human resources in understanding and utilising KPIs and the absence of an effective action plan and process. The action plan should include capacity-building training. Such a plan should include the following: Well-defined logical KPIs, their importance, the process of measuring and reporting them; Assessment of tools and training required; Yearly/quarterly budget for tools upgradation and training sessions; Interactive employee sessions to make them understand the requirement and importance of the KPIs and room for modifying the monitoring plan on the discussion (if required).

Lack of real-time data, reliable data sources, and poor data quality hinder the measurements. Data is the key role player. Poor data quality might originate from a lack of awareness of the standards or administrative problems, such as concern that released results will affect specific departments or individuals. Additionally, data must be cleansed to verify its correctness, and the company needs both competent human resources and automated tools to achieve this. The use of KPIs significantly

impacts the accuracy of the data provided. Therefore it is necessary to ensure data sources, tools and techniques to combat the absence of proper tools in data collection, data management and analysis and the shortage of accurate data or poor data quality.

Moreover, dynamic and data-driven company culture is also necessary to avoid rigidity and inadequate output quality. Another great option can be hiring a third-party performance auditor. There are both benefits and problems in using such. However, as mentioned earlier suitability of using such a service depends on several issues.

6.5 Role of modern algorithms and Blockchain in transportation KPI management

Various modern technologies and algorithms are used to measure different parameters of performance. Chapter 5 explains them in detail. As a summary of the information provided in chapter 5, below are technologies and algorithms explained as modern tools and technologies of KPI management:

- Warehouse management system (WMS)
- Transportation management system (TMS)
- Enterprise resource planning (ERP)
- Intelligent Transportation Systems (ITS)
- Advanced Traveler Information Systems (ATIS)
- Advanced Management Systems (AMS)
- Artificial Neural Networks (ANN)
- Decision Trees
- Discriminant Analysis (DA)
- K Nearest Neighbor (KNN)
- Naive Bayes
- Support Vector Machines (SVM)
- Blockchain

Blockchain has been considered the most potential and new aspect of KPI management. Blockchain in logistics enhances collaboration in transportation contracts, promotes supply chain transparency, and enhances overall service management inside businesses (Helo & Shamsuzzoha, 2020). Transportation resources may be handled quickly and with excellent information safety by utilizing the Blockchain-based approach. To provide information on the products at every step, including manufacture, transportation, logistics, distribution etc., Blockchain can monitor updates throughout the entire value stream and all activities (Helo & Shamsuzzoha, 2020). Therefore, it is necessary to precisely trace each activity and identify the stage at which a particular event happened. Furthermore, it ensures the quality of the product and the complete transportation service by preventing fraud and validating the provenance of the goods (Chen, 2020). Therefore, Blockchain is becoming an influential tool in KPI management.

6.6 Sample monitoring and evaluation (M&E) plan

One of the objectives of this study was to find some good practices in KPI management and use them for M&E for road transportation. Figure 3 has been prepared for the same reason. The KPIs for Transportation Management are the exact ones identified as the critical KPIs for road transportation in section 4.2. However, an M&E plan usually contains all the sub-sectors of efficiency and performance management and many other KPIs for efficiency measurement. The sample M&E plan shown here contains some common measuring criteria found in the literature, i.e., operational efficiency, warehousing efficiency, and inventory efficiency. As shown in the plan, the M&E plan should define the units of measurement, the target of the company, data from the previous year(s), real-time monthly data, the variation between current and previous years' measurement in percentage, the variation between current measure and the target in percentage. Some measures can be taken daily, and some can be taken monthly. The plan here shows the monthly situation. The cumulative of the whole year can automatically translate into the yearly data.

KPI Code	KPI Group	Criteria	Unit	Monthly				
				Previous Year	Target	Actual	Act/PY %	Act/Trgt %
		OPERATIONAL EFFICIENCY						
		Perfect Order Measurement	%					
		Cash to Cash Cycle Time	Days					
		Customer Order Cycle Time	Days					
		Fill Rate	%					
		Supply Chain Cycle Time	Days					
		Days Sales Outstanding	Days					
		Avg. Payment Period for Goods	Days					
		On Time Shipping Rate	%					
		Days of Supply (DOS)	Days					
		INVENTORY MANAGEMENT						
		Inventory Turnover or Days on Hand	Units					
		Average Days to Sell Inventory (DSI)	Days					
		Average Inventory	Units					
		Inventory Days of Supply	Days					
		Lead Time	Days					
		Rate of Return	%					
		WAREHOUSE MANAGEMENT						
		Holding Cost						
		Stock-out						
		Service Level						
		Inventory Accuracy						
		TRANSPORTATION MANAGEMENT						
		Fuel Efficiency	%					
		Total number of maintenances per vehicle per month	units					
		Ratio of distribution cost to value of commodities distributed	%					
		Lead Time and Avg. Transportation time	Days					
		Percentage of on time and accurate delivery	%					
		Percentage of lost or damaged items during transportation	%					
		Percentage of vehicle fill or Vehicle Management Efficiency	%					

Figure 3: Sample M&E plan for a logistics company- main page

An efficient and functional M&E plan should contain a guideline for the definitions/ explanations of each KPI, the data source, frequency of measurement, department/persons responsible, reporting authority etc., so that everyone involved in the measurement can have a clarified idea of what and how to do the measurement. Figure 4 is a sample of such an explanation. Although the guideline must contain a thorough description of every measurement parameter and all the KPIs in use, this study limits the study area to road transportation KPI; therefore, the sample guideline (figure 4) is prepared only for the KPIs of the sub-category named 'Road Transportation'. Moreover, figure 5 explains the abbreviations used in figure 4.

M&E Guideline Measure Sub-Category: Transportation											
Indicator	Definition	Explanation	Unit	Data Source	Responsibility		Frequency of Measurement				R.A
					Dept.	Pr	D	W	M	Y	
Fuel Efficiency	*Refers to the quantity of fuel utilized in liters per distance traveled or in kilometers per liter. Fuel efficiency is usually represented in Europe as liters per 100 kilometers t raveled. Fuel consumption rate may vary because of a number of reasons, including incorrect scheduling, poor fleet utilization, and various road conditions (slope, uneven road, bad weather condition etc)*	Distance/100 km	%								
Total number of maintenances per vehicle per month	*Maintenance of vehicles indicate the vehicle health, the need of new investment on buying vehicles and the additional costs occurring due to the maintenance.*	counts	units								
Ratio of distribution cost to value of commodities distributed	*It is described as the cost of transporting or delivering orders divided by the order value. This indicator is typically determined for every delivery route provided. It may be calculated over any period, although one year is the most common.*	Ratio of distribution cost to value of commodities dis-tributed= cost of transporting commodities/ value of commodities transported	%								
		% of Average transport cost = (Average Total transport cost / monthly gross income) × 100									
Lead Time and Avg. Transportation time	*The interval between order placing and fulfillment is referred to as lead time. The transportation lead time can be therefore the interval between the start and end of the transportation process.*	Lead time (LT) = Order Delivery Date – Order Request Date	Days								
	Transportation time is the ratio of the real delivery time to predicted transportation time to for every cargo. Furthermore, values less than one suggest that the transportation network performed better than planned and vice-versa.	Transportation time per delivery= real-time delivery/estimated delivery time									
		Avg. Transportation Time per Delivery= Total Transportation Time per delivery/no. of deliveries									
Percentage of on time and accurate delivery	*It is the proportion of items delivered on time to clients comparing to the entire number of products supplied. The KPI assesses the delivery performance.*	Percentage of on time Delivery = ((Units delivered on-time) / (Total units))× 100	%								
Percentage of lost or damaged items during transportation	*These are used to understand the efficiency in service and customer satisfaction*	Percentage of lost or damaged items= ((Units damaged + Units lost) / (Total units))× 100	%								
Percentage of vehicle fill or Vehicle Management Efficiency	*This indicator shows how efficiently a company is using its truck load capacity. From the standpoint of weight or cage/pallet spaces, it may be computed. Just simply need to be aware of the weight or number of components that the vehicles are capable of transporting, as well as the weight or number of units that the company as a whole sent over a specific time frame.*		%								

Figure 4: M&E Sample Guideline

M&E Guideline
Measure Sub-Category: Transportation

Abbreviation

Pr	Person Responsible
D	Daily
W	Weekly
M	Monthly
Y	Yearly
RA	Reporting Authority

Figure 5: Abbreviation of terms used in figure 4

Please see Annexes 2 and 3 for clearer visibility of figures 3 and 4.

7 Conclusion

It is anticipated that implementing KPIs to promote behaviours increasingly supportive of innovations would ultimately help change the company culture and make it more opportunity friendly. The obstacles identified in the study will not typically exist with a more dynamic and positive company culture; thus, introducing KPIs to gauge the performance of innovation activities may be more straightforward. A dynamic performance management system will require to modify its metrics and criteria over time if its objective is to focus on increasing performance gradually and with the changes scenario. Trying to raise requirements such as standards must be encouraged. To enhance performance, emphasis should be given to the procedure for reporting and assessing data. Such a shift in the operational strategy can facilitate a better understanding of the significance of data collecting, comparison of findings with established criteria, and process adjustments, all of which can improve overall performance.

Recent technological advancements are rapidly changing the concepts of operating supply chains, handling materials, and human resources management. Businesses are under pressure from the economy to be more productive and efficient. Using advanced technology can be helpful to satisfy this increased pressure. Organizations are simultaneously motivated by the sustainable objective. Further research should emphasize the blockchain-based infrastructure.

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Annex 1: List of Road Transportation KPIs

Area of Measure	KPI	Reference
Safety	Injury Frequency Index	(Bradley, 2021)
	Percentage of Accidents per year	(Bradley, 2021)
Cost	Avg. Logistic Cost per Vehicle	(USAID, 2006)
	Urgent Transportation Cost (national and international)	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Total Handling Cost	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	% Urgent Transportation (value)	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Fuel Efficiency	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Labor Efficiency	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Total number of maintenances per vehicle per month	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Ratio of distribution cost to value of commodities distributed	(USAID, 2006)
	Percentage of stock Wasted due to Damage in transportation	(USAID, 2006)
Quality and Delivery	Average Delivery Time and Lead Time	(USAID, 2006), (Cedillo-Campos et al., 2022), (Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Percentage of on time and accurate delivery	(Roh et al., 2022), (Cedillo-Campos et al., 2022), (Išoraitė, 2005), (Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021) (USAID, 2006)
	Percentage of Items damaged or lost during transportation	(Cedillo-Campos et al., 2022), (USAID, 2006)
	Percentage of movements without Delivery and Reception Notes.	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Percentage of vehicle logbooks filled correctly	(Išoraitė, 2005), (Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)

	Total number of maintenances per vehicle in a month	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Percentage of vehicles that meet the mechanical and safety standards	(Bradley, 2021), (*20 Best Logistics KPIs and Metric Examples for 2022 Reporting* , 2021)
	Ratio of Order Vs. Actual Delivery	(Bradley, 2021)
Management	Percentage of driver trainings	(Bradley, 2021)
	Percentage of operating hours vehicles are fully booked	(Bradley, 2021)
	Percentage of vehicles with the necessary tools	(Bradley, 2021)
	Percentage of route efficiency	(Bradley, 2021)

Annex 2: Sample M&E Plan

KPI Code	KPI Group	Criteria	Unit	Monthly				
				Previous Year	Target	Actual	Act/PY %	Act/Trgt %
		OPERATIONAL EFFICIENCY						
		Perfect Order Measurement	%					
		Cash to Cash Cycle Time	Days					
		Customer Order Cycle Time	Days					
		Fill Rate	%					
		Supply Chain Cycle Time	Days					
		Days Sales Outstanding	Days					
		Avg. Payment Period for Goods	Days					
		On Time Shipping Rate	%					
		Days of Supply (DOS)	Days					
		INVENTORY MANAGEMENT						
		Inventory Turnover or Days on Hand	Units					
		Average Days to Sell Inventory (DSI)	Days					
		Average Inventory	Units					
		Inventory Days of Supply	Days					
		Lead Time	Days					
		Rate of Return	%					
		WAREHOUSE MANAGEMENT						
		Holding Cost						

Stock-out		
Service Level		
Inventory Accuracy		
TRANSPORTATION MANAGEMENT		
Fuel Efficiency	%	
Total number of maintenances per vehicle per month	units	
Ratio of distribution cost to value of commodities distributed	%	
Lead Time and Avg. Transportation time	Days	
Percentage of on time and accurate delivery	%	
Percentage of lost or damaged items during transportation	%	
Percentage of vehicle fill or Vehicle Management Efficiency	%	

Annex 3: Sample M&E Guideline

M&E Guideline Measure Sub-Category: Transportation											
Indicator	**Definition**	**Explanation**	**Unit**	**Data Source**	**Responsibility**		**Frequency of Measurement**				**Reporting Authority**
					Dept.	**Pr**	**D**	**W**	**M**	**Y**	
Fuel Efficiency	*Refers to the quantity of fuel utilized in liters per distance traveled or in kilometers per liter. Fuel efficiency is usually represented in Europe as liters per 100 kilometers t*raveled. Fuel consumption rate may vary because of a number of reasons, including incorrect scheduling, poor fleet utilization, and various road conditions (slope, uneven road, bad weather condition etc.)	Distance/100 km	%								
Total number of maintenances per vehicle per month	*Maintenance of vehicles indicate the vehicle health, the need of new investment on buying vehicles and the additional costs occurring due to the maintenance.*	counts	units								

Ratio of distribution cost to value of commodities distributed	*It is described as the cost of transporting or delivering orders divided by the order value. This indicator is typically determined for every delivery route provided. It may be calculated over any period, although one year is the most common.*	Ratio of distribution cost to value of commodities distributed= cost of transporting commodities/ value of commodities transported	%								
		% of Average transport cost = (Average Total transport cost / monthly gross income) × 100									
Lead Time and Avg. Transportation time	*The interval between order placing and fulfillment is referred to as lead time. The transportation lead time can be therefore the interval between the start and end of the transportation process.*	Lead time (LT) = Order Delivery Date – Order Request Date	Days								
	Transportation time is the ratio of the real delivery time to predicted transportation time to for every cargo. Furthermore, values less than one suggest that the transportation network performed better than planned and vice-versa.	Transportation time per delivery= real-time delivery/estimated delivery time									
		Avg. Transportation Time per Delivery= Total Transportation Time per delivery/no. of deliveries									

Percentage of on time and accurate delivery	*It is the proportion of items delivered on time to clients comparing to the entire number of products supplied. The KPI assesses the delivery performance.*	Percentage of on time Delivery = ((Units delivered on-time) / (Total units))× 100	%								
Percentage of lost or damaged items during transportation	*These are used to understand the efficiency in service and customer satisfaction*	Percentage of lost or damaged items= ((Units damaged + Units lost) / (Total units))× 100	%								
Percentage of vehicle fill or Vehicle Management Efficiency	*This indicator shows how efficiently a company is using its truck load capacity. From the standpoint of weight or cage/pallet spaces, it may be computed. Just simply need to be aware of the weight or number of components that the vehicles are capable of transporting, as well as the weight or number of units that the company as a whole sent over a specific time frame.*		%								

Abbreviation

Pr	**Person**
D	**Daily**
W	**Weekly**
M	**Monthly**
Y	**Yearly**
RA	**Reporting Authority**