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Group of Experts on Benchmarking Transport Infrastructure Construction Costs

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Item 5 of the provisional agenda
Discussion on the structure of the final report of the Group of Experts

A Benchmarking literature review – definitions concepts and methodologies - Revised

Submitted by the Government of Turkey with contributions by Polish Railways

I. Introduction

1. As requested by the Group of Experts on Benchmarking of Transport Infrastructure Construction Costs at its twelfth session in November 2021, this document is submitted as Chapter II of the final report of the Group. It builds further on the information contained in ECE/TRANS/WP.5/2020/6 and is a further revision of ECE/TRANS/WP.5/GE.4/2022/3. It provides an overview of benchmarking definitions, concepts, and methodologies. As requested by the Group at its thirteenth session, additional information has been added by the representatives of Turkey and Poland on concepts surrounding the benchmarking of transport infrastructure maintenance and operation costs.

II. Benchmarking Concept and Description

2. Benchmarking as a Verb refers to a process of comparing agencies' operations and performance against recognized standards and improving those operations to enhance the effectiveness. According to Merriam Webster's Collegiate Dictionary, tenth edition, a benchmark as a Noun refers to the numerical target or reference point for taking measures against. This word has migrated into the business world, where it has come to mean: "A benchmark is a measured best-in-class achievement recognized as the standard of excellence for that business process".

3. According to Merriam Webster's Collegiate Dictionary (1994), the word benchmark defines as (1) mark on a permanent object indicating elevation and serving as a reference in topographical surveys and tidal observations, (2) point of reference from which measurements may be made. Its origin comes from geographic surveying. The International Clearinghouse for Benchmarking (1992) defined benchmarking as the "process of

continuously comparing and measuring an organization with business leaders anywhere in the world to gain information that will help the organization act to improve its performance".

4. In literature there are plenty of definitions and most of them describe benchmarking as the process of comparing something or someone with best practice. On the other hand, best practices are collections of activities within an organization that are done very well and ultimately, are recognized as such by others. It is referred to as a learning process, a performance process and a strategic activity.

5. Since benchmarking is referred to as a strategic activity, it requires a lot of research and analysis. To make it efficient, the company must be clear about the type of related strategy it must adapt to treat a specific problem area (Priya, 2018).

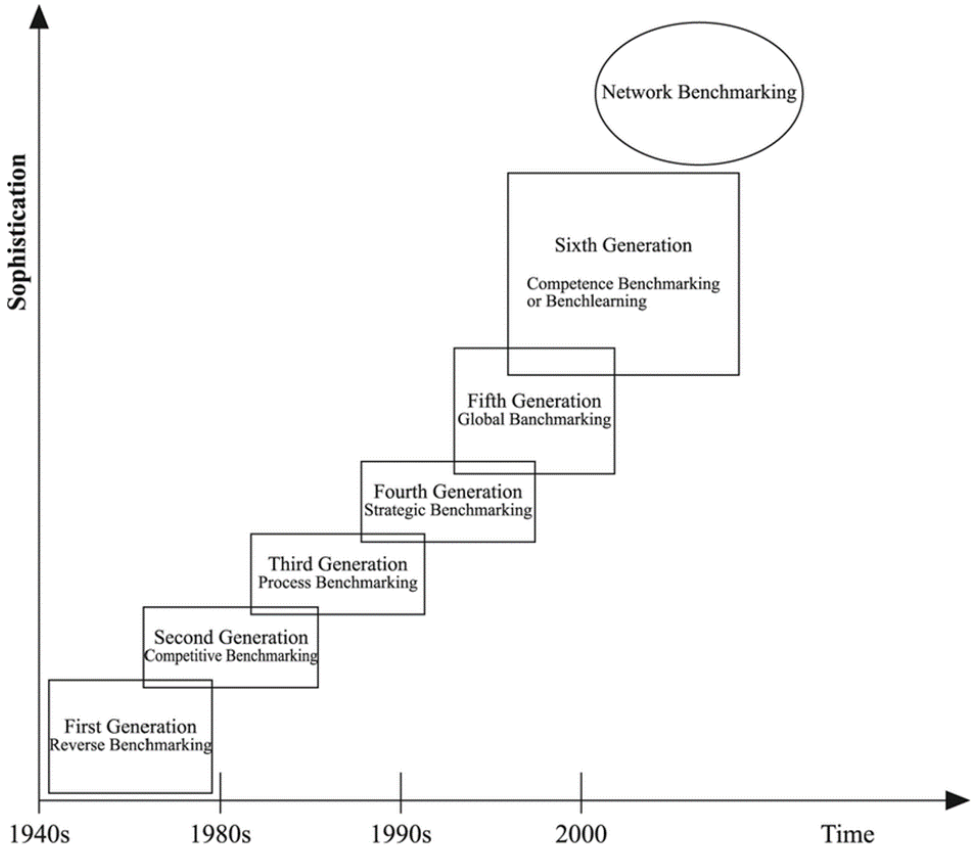
6. Benchmarking is the process of continuously improving business or organizational processes by evaluating the scope for improvement, comparing the current position with that of the previous one or with the business practices of relevant competitors, thereby establishing standards to be achieved (Priya, 2018). Typically, measured dimensions are quality, time and cost. Benchmarking is used to measure performance using a specific indicator (cost per unit of measure, productivity per unit of measure, cycle time of x per unit of measure or defects per unit of measure) resulting in a performance metric that is then compared to others.

7. It is an important continuous improvement tool which empowers companies and organizations to enhance their performance by identifying, adapting and implementing the best practice (Ryus, et al, 2010). Benchmarking is the process of systematically seeking out best practices to strive towards. It thus is a continuous learning and improvement process.

III. History of Benchmarking

8. Benchmarking is an evolving concept that has developed since the 1940's towards more sophisticated forms. The history of benchmarking as described by Watson (1993) has been categorized under five generations of benchmarking. The first generation was reverse engineering, which was an engineering-based approach to product comparisons that included teardown and analysis of technical product characteristics. The second generation was competitive benchmarking which Xerox refined starting in 1976. This type of benchmarking went beyond product-orientation comparisons to comparing processes with competitors. In the 1980s, the third generation of benchmarking was process benchmarking, which included searching for best practices across industry boundaries. The fourth-generation benchmarking was strategic benchmarking; where it was used to fundamentally change the business, not just alter the processes. Lastly, the fifth generation was global benchmarking, where international trade, cultural and business process distinctions among companies are abridged and their implications for business process improvement are understood. In the 1980s and 90s benchmarking became a popular management tool in organizations to achieve quality and to learn best practices. Later it has been used by several companies like General Motors, Hewlett Packard, Dupont, Motorola, Royal Mail and others.

Figure I
Five Generations of Benchmarking



IV. Scopes of Benchmarking

9. Benchmarking aims to improve an organization's performance and competitiveness by learning from and/or with others towards the best practices (Kyrö, 2003).

10. Scott cited Meade' (1998) benchmarking theory is formed by ten principles. These are:

(a) Improves practices, services or products;

(b) Involves learning about 'best practices' from others;

(c) Accelerates the rate of progress and improvements;

(d) Contributes to continuous quality management;

(e) Is an ongoing process;

(f) Promotes fresh and innovative thinking about problems;

(g) Provides hard data on performance;

(h) Focuses not only on what is achieved, but on how it is achieved;

(i) Involves the adaptation, not merely adoption, of best practices; and

(g) Results in the setting of specific targets.

11. Since the specifics of benchmarking relate to best practices, the starting point of benchmarking is either to learn from others' outstanding performances, or to create them with others.

12. While benchmarking and action research both aim to improve practices, but benchmarking also has its specifics:

(a) Focuses on best practices to identify next practices;

(b) Strives for continuous improvement;

(c) Partnering to share information;

(d) Needed to maintain a competitive edge;

(e) Adapting based on customer needs after examination of the best;

(f) Lead to competitor research.

V. Types of Benchmarking

13. Literature review shows that there are many types of benchmarking and many ways of categorizing these types. authors seem to capture different categories of benchmarking. Some terms are used by different authors with different meanings. Each type seems useful for a particular situation. The most important overarching principle however regardless of the benchmarking approach that is used is that the aim of the benchmarking exercise needs to be clear and achievable, and that the choice of partner organization needs to be aligned with the aims.

14. Lutfullayev, cited Alstete (1996) identifies five types: internal, external competitive, external collaborative, external trans-industry (best-in-class), and implicit benchmarking. He also cited Jackson and Helen (2000) classified benchmarking types according to referencing processes:

(a) Implicit or explicit benchmarking;

(b) Independent or collaborative benchmarking;

(c) Internal or external focused benchmarking;

(d) Vertical or horizontal benchmarking which is focused on the whole process;

(e) Quantitative and qualitative approach benchmarking;

(f) Input-process-output focused benchmarking.

15. Four types of benchmarking namely internal, competitive, non- competitive, and best practice/world class were identified by Cook (1995). On the other hand, Vlăsceanu, Grünberg, and Pârlea. (2004) identify the three prevalent benchmarking types as strategic benchmarking (focusing on what is done, on the strategies organizations use to compete), operational benchmarking (focusing on how things are done, on how well other organizations perform, and on how they achieve performance), and data-based benchmarking (statistical benchmarking that examines the comparison of data-based scores and conventional performance indicators). They mentioned also internal/external and external collaborative/trans-industry/ implicit benchmarking types. They say, within different types, benchmarking may be either vertical (aiming at quantifying the costs, workloads, and learning to improve productivity of a predefined program area) or horizontal (looking at the costs of outcomes of a single process that cuts across more than one program area).

16. Achtemeier and Simpson (2005) mention process benchmarking, metric benchmarking and goals and milestones. Process benchmarking involves identifying a problem area within one's own institution, identifying another not necessarily similar institution with exemplary performance in this area, and sending a team of people who work in this area to the exemplary institution to learn how it achieves its outstanding results. The team then adapts these best practices to improve the home institution. Metric benchmarking means the comparison, among several institutions, of data for selected indicators in order to determine an institution's relative performance (Smith, Armstrong, & Brown, 1999). Goals and milestones represent another way to understand benchmarking. One identifies internal targets to indicate an institution's process, and these may be chosen without any external reference by which to measure (Zairi, 1996).

17. Alstete (1996) gives two types of benchmarking approaches, which is strategic benchmarking and operational-level benchmarking. With strategic approach, the

organization looks at its overall competitive products and services to understand and develop competitive products and strategies (Camp, 1995). Operational benchmarking is used to understand specific customer requirements and the best practices to achieve customer satisfaction by improving internal organizational processes.

18. Yarrow and Prabhu (1999) differentiate three forms of benchmarking: metric, process, and diagnostic. Metric benchmarking seems to be the simplest and most straightforward in that it compares the performance data of businesses. Though efficient and simple, the metric process requires that the businesses are comparable, and it focuses only on superficial manifestations of business practices. Process benchmarking refers to an expensive, time consuming endeavor in which two or more organizations complete an in-depth comparison of specific business practices in order to achieve better results. Diagnostic benchmarking, on the other hand, is more akin to a 'health check' for the company, helping to identify which practices need to be changed and the nature and extent of performance improvements to be followed (Yarrow and Prabhu, 1999).

19. At an overarching level, there are two types of benchmarking. These are internal and external benchmarking as given in the following Figure-3.

Figure II
Types of Benchmarking in General

A. Internal Benchmarking

20. Internal benchmarking refers to efforts aimed at comparing organizational performance over time. The performance of the organization is compared either to its previous performance or to the performance of its competitors, i.e., companies belonging to the same industry (Priya, 2018).

21. As illustrated in Figure II SWOT[1], 'Best Practice Benchmarking', 'Performance Metrics', 'Financial Benchmarking' and 'Functional Benchmarking' are various strategies falling under this category.

22. SWOT: In this benchmarking strategy, the strengths, weaknesses, opportunities and threats of the company are listed and analyzed by the management.

23. Best Practice Benchmarking: The management itself studies and identifies the strategies and practices of the other companies who are the market leaders, to plan the desired course of action.

24. Performance Metrics: This strategy is based on statistical metrics derived through the analysis of the client's preference and the comparison made with competitors. The company can find out the loopholes in its performance and come up with a strategy to address those.

[1] Strengths, Weaknesses, Opportunities and Threats

25. Financial Benchmarking: The management compares the financial forecast of the organization with the actual results or financial reports in an attempt to identify areas of shortcomings and take corrective actions.

26. Functional Benchmarking: The company compares its performance and products with those of other related industries to innovatively improve its functioning.

B. External Benchmarking

27. In external benchmarking, the company compares its performance with that of its competitors in the industry or across the globe (Priya, 2018). Typically, this is done by comparing data collected through sectoral or industrial associations or third parties.

28. As illustrated in Figure II 'Collaborative Benchmarking', 'Process Benchmarking', 'Product Benchmarking', 'Corporate Benchmarking', 'Strategic Benchmarking' and 'Global Benchmarking' are various strategies falling under this category.

29. Collaborative Benchmarking: To improve the performance standards, the companies belonging to a particular industry collaborate in the framework of industrial associations. These associations provide the benchmarking data on best practices and a comparative analysis of all the companies, which in turn facilitates the improvement of the underperforming companies.

30. Process Benchmarking: In process benchmarking, the company analyzes the competitor's methods, tasks, techniques of production, means of distribution, etc. It also studies the standard mechanisms of performing specific functions, to modify its ways accordingly.

31. Product Benchmarking: This strategy focuses on the in-depth analysis of the competitor's product to know its features and composition. The company uses this strategy to improve and redesign its own products.

32. Corporate Benchmarking: The company compares its various departments like finance, production, distribution, marketing, human resources, etc. with those of its competitors to enhance the efficiency of each division.

33. Strategic Benchmarking: This strategy is usually adopted when the company plans to implement a new policy or idea or modify the existing one. The team compares the company's approach with that of the other successful companies in the industry before bringing it into practice.

34. Global Benchmarking: It is similar to strategic benchmarking, the only difference is that here the company compares its strategies with those of its other branches or the various competitors spread across the globe, to take corrective actions.

35. In the following figure types of benchmarking are given.

Figure III
Types of Benchmarking

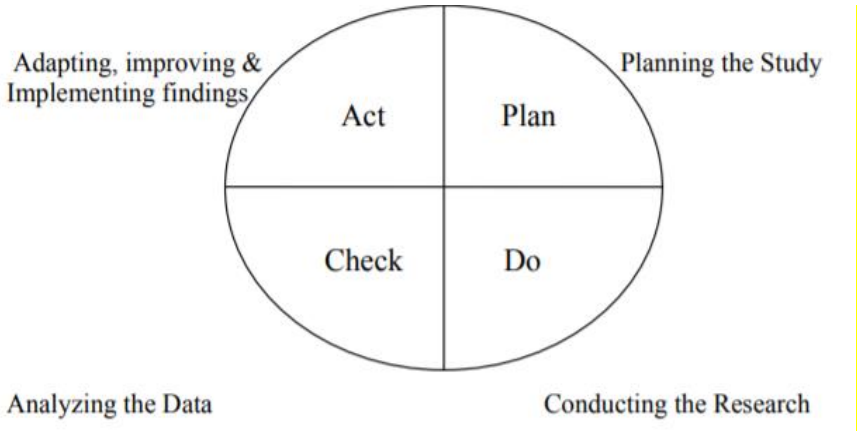
VI. Models and Methodologies of Benchmarking

36. There is no single benchmarking process that has been universally adopted, instead. numerous benchmarking models co-exist and are used in parallel. In general terms, benchmarking can be defined as a continuous and systematic process of comparing products, services, processes and outcomes with other organizations or exemplars, for the purpose of improving outcomes by identifying, adapting, and implementing best practice approaches. Since benchmarking is the practice of comparing business processes and performance metrics to industry leaders and best practices from other companies, the most often measured performance dimensions are quality, time and costs.

37. Benchmarking is used to measure performance using a specific indicator (cost per unit of measure, productivity per unit of measure, cycle time of x per unit of measure or defects per unit of measure) resulting in a metric of performance that is then compared to others.

38. There is no single benchmarking process that has been universally adopted. The wide appeal and acceptance of benchmarking has led to the emergence of a variety of benchmarking methodologies. Benchmarking process models and methodologies can vary from four steps to up to 30 steps. The four-step approach which is suggested by Alstete (1996) consists of: "Plan, Do, Check and Act" (PDCA) as illustrated below in Figure 4.

Figure IV
Alstete's Benchmarking process



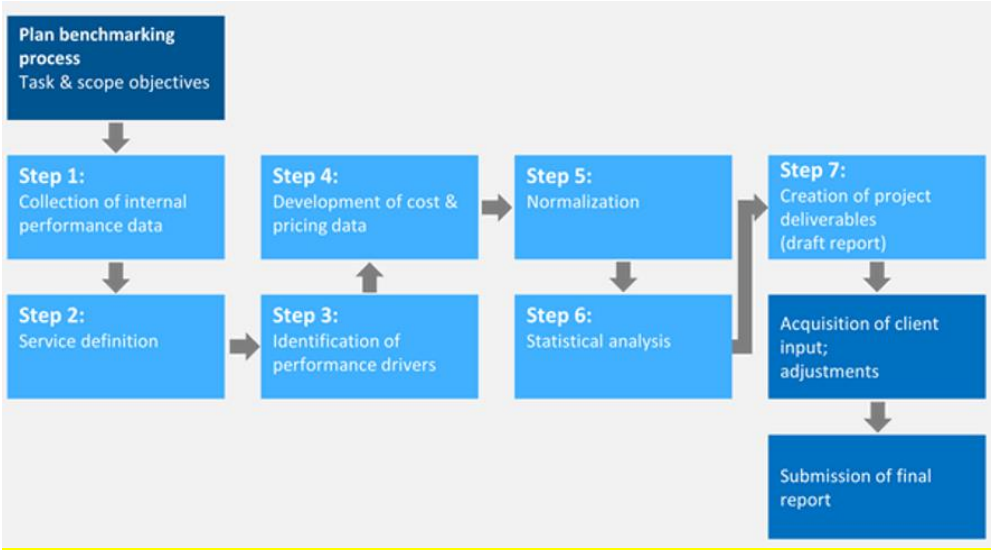
39. Robert Camp developed a 12-stage approach to benchmarking.

40. The 12-stage methodology consists of:

- Selecting a subject
- Defining the process
- Identifying potential partners
- Identifying data sources
- Collecting data and selecting all partners
- Determining the gap
- Establishing process differences
- Targeting future performance
- Communicating
- Adjusting goals
- Implementing
- Reviewing and recalibrating

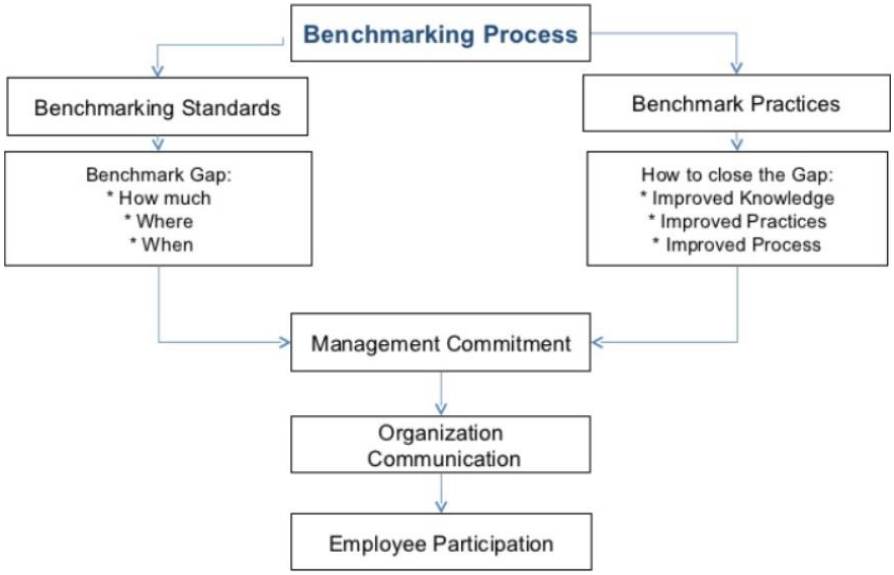
41. On the other hand, the Figure below identifies seven steps of effective benchmarking.

Figure V
Seven Steps of Effective Benchmarking



42. As illustrated in the below figure, any benchmarking process is mainly dived into two branches: standards and practices.

Figure VI
Benchmarking Process



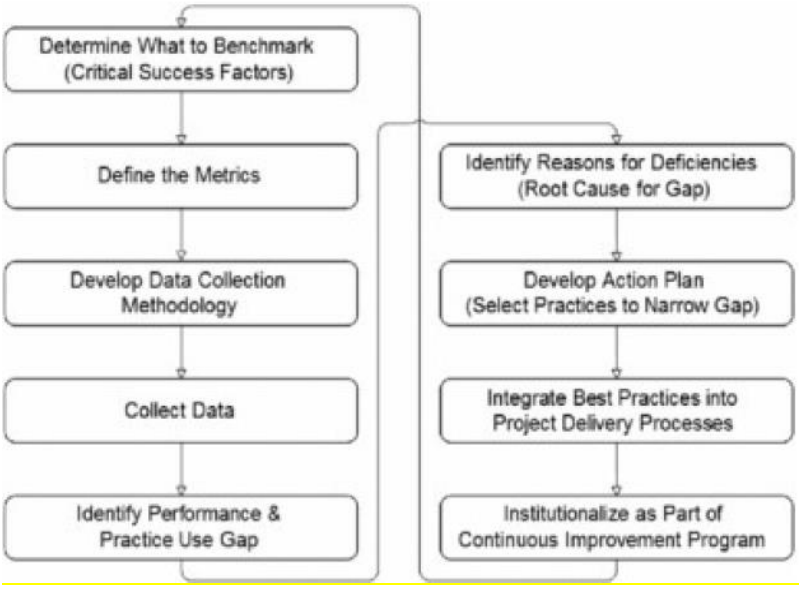
43. A typical benchmarking methodology is given as an example in the following paragraphs:

- Identify problem areas: Because benchmarking can be applied to any business process or function, a range of research techniques may be required. These include informal conversations with customers, employees, or suppliers; Exploratory research techniques such as focus groups; or in-depth marketing research, quantitative research, surveys, questionnaires, re-engineering analysis, process mapping, quality control variance reports, financial ratio analysis, or simply reviewing cycle times or other performance indicators. Before embarking on comparison with other organizations it is essential to know the organization's functions and processes; base lining performance provides a point against which improvement efforts can be measured.

- Identify other industries that have similar processes: For instance, if one were interested in improving hand-over in addiction treatment one would identify other fields that also have hand-over challenges. These could include air traffic control, cell phone switching between towers, transfer of patients from surgery to recovery rooms.
- Identify organizations that are leaders in these areas: Look for the very best in any industry and in any country. Consult customers, suppliers, financial analysts, trade associations, and professional magazines to determine which companies are worthy of study.
- Survey companies for measures and practices: this involves the deployment of detailed surveys of measures and practices used to identify business process alternatives and leading companies. Surveys are typically masked to protect confidential data by neutral associations and consultants.
- Visit the "best practice" companies to identify leading edge practices: Companies typically agree to mutually exchange information beneficial to all parties in a benchmarking group and share the results within the group.
- Implement new and improved business practices: Take the leading-edge practices and develop implementation plans which include identification of specific opportunities, funding the project and selling the ideas to the organization for the purpose of gaining demonstrated value from the process.

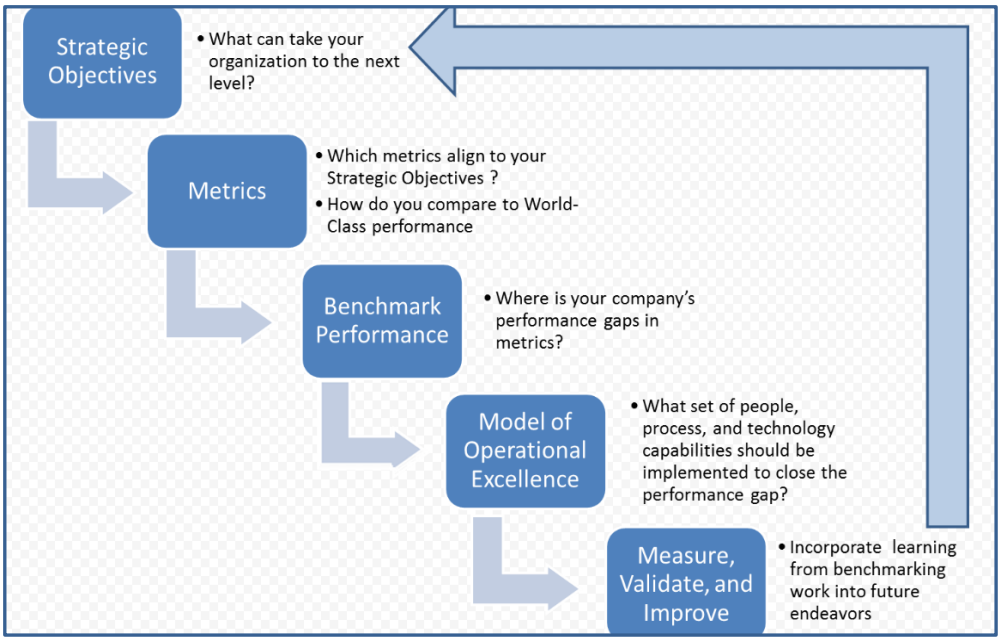
44. A benchmarking roadmap is shown in the following figure.

Figure VII
Benchmarking Roadmap



45. To benchmark anything, first of all quantitative data availability is the most important issue to study. This implies breaking down internal processes to calculate performance metrics. Quantify everything, because only quantifiable information can be accurately compared.

Figure VIII
Step by Step Benchmarking



VII. Benchmarking in Construction Industry

46. Benchmarking is a new tool to be used in the construction industry. The database created by the Houston Business Roundtable (HBR), one of the first attempts to develop a plan of benchmarking in construction, only contains information on global results of the projects allowing the parties to compare their performance with that of the other projects in this database (Alarcon and Serpeli). The data in this study was developed following a questionnaire that was submitted to company representatives to determine if there was any interest in benchmarking, and if so, what parameters should be used. According to Alarcon and Serpeli the following were the parameters proposed by the participating construction companies:

- Authorized vs. actual costs
- Authorized vs. actual time schedule
- Actual labor vs. estimated
- Scope change vs. original scope

47. The proposed parameters reflect an interest in comparing measured results rather than identifying the deficiencies in practices which affect the results. Actually, such an approach is more of a competitiveness than a benchmarking analysis (Muniz, 1995).

48. Benchmarking project results (cost, schedule, etc.) has a limited value since, at most, it identifies high-level problem areas but does not help to define a possible improvement strategy. With such an approach a company can understand if its planned schedule or cost performance is met, but it cannot know the source of the problems that exist, nor can it know why its competitors are more successful in achieving its results. This can only be achieved analyzing the factors which lead to a successful performance.

49. Benchmarking the results of a project leaves a company part way in the utilization of this improvement tool, since it arrives only at the first stage (Watson 1994) "To understand own processes and to detect its weaknesses and strengths. It however does not accomplish the following stages:

(a) To understand the leaders of industry or competitors; to identify, to understand and to compare the better practices.

(b) To incorporate the best; to copy, to modify or to incorporate the better practices in its own processes.

(c) To gain superiority by combining its own strengths with better existing practices.

50. These last three stages constitute the basis of benchmarking as an improvement tool.

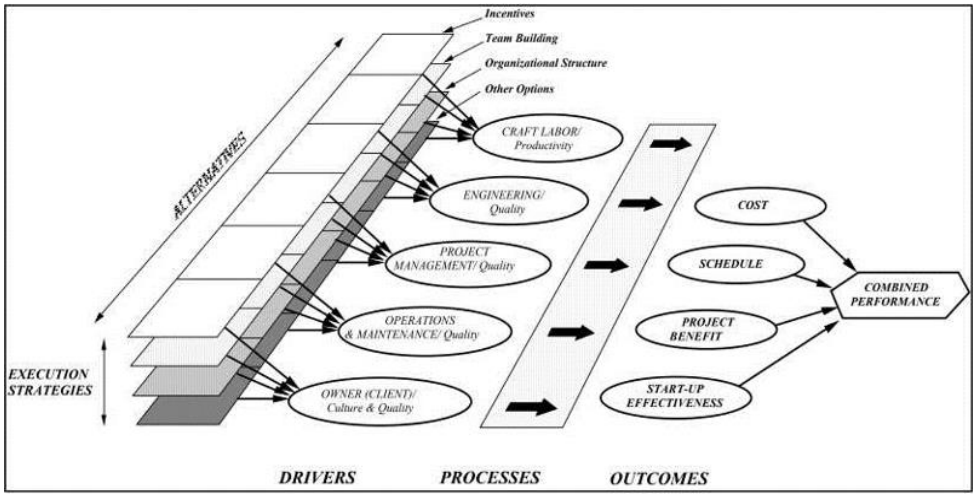
Modeling in Construction Industry

51. Statistical analysis serves as a traditional tool for developing models from empirical information. However, other options exist and may be even more attractive (Alarcon & Ashley 1992, 1996). Alarcon has recently developed a methodology to evaluate project management strategies whose principal components are indicated below:

- A general methodology for the acquisition and modeling of expert knowledge for evaluating decisions in projects.
- A mathematical model based on concepts of cross-impact analysis and statistical inference.
- A representation scheme to support communication and problem structuring during the modeling process.
- A prototype Computer implementation to automatize capturing and processing of information to analyze a model.

52. The methodology consists of a conceptual, qualitative model structure and a mathematical model structure. The conceptual model structure, called the General Performance Model (GPM), is a simplified model of the variables and interactions that influence project performance. The mathematical model uses concepts of cross-impact analysis and probabilistic inference to capture the uncertainties and interactions among project variables. The structure of the GPM is summarized in the following Figure.

Figure IX
General Performance Model (Alarcon and Serpeli)



53. The computational scheme utilized within the model allows for different execution strategies to be compared on a relative basis. Preferred strategies are ranked either based on combined performance or on any single chosen criterion. Sensitivity analyses help determine the robustness of any highly ranked strategy, as well as which drivers or processes have greater impacts on outcomes.

54. This work provides a conceptual and theoretical framework for modeling decision situations that will serve as a basis for the development of the proposed models.

55. In the following table proposed project performance parameters are listed.

Table 1
Proposed Project Performance Parameters (Alarcon and Serpeli)

Results	*Parameters*	*Units*
Cost	Cost Variation	Actual Cost/Budgeted Cost
Scheduled Duration	Schedule Variation	Actual Duration/Planned Duration
Quality	Rejection of Work	% Sample Rejections
Scope of Work	Change in Scope of Work	Change Orders/Budgeted Cost
Process	*Parameters*	*Units*
Procurement	Delivery Time	Delivery Cycle Time
	Compliance W/Specs	% Compliance W/Specs
Construction	Labour (MH)	Actual Labour MH vs. Planned MH
	Productivity	Actual vs Planned
	Rework	Rework MH/Total MH
	Material Waste	% Material Waste
	Equipment	% Stand by Hours.
	Activities at Planned Rate	% Activities Working at Planned Rate
Planning	Planning Effectiveness	% Planned Activities Completed
Engineering Design	Design Changes	Number of Changes/ Total Number of Drawings
	Errors /Omissions	Number of Errors/ Total Number of Drawings
Other variables	*Parameters*	*Units*
OH&S	Accident Frequency	Number of Accidents* 100/ Total Number of Workers
	Risk Rate	Number of Days Lost* 100/ Annual Average of Workers
Subcontracts	Subcontracted MH	% MH Subcontracted
	Subcontracted $	% of Cost Subcontracted
Others		

56. The collection of information on these performance parameters will allow, as the database grows, to statistically study the existing correlations among results, characteristics and intermediate processes of projects and to develop models to explain the existing causalities, all of which will help to identify the sources of success and failure in construction projects. In this way it will be possible to focus on more accurate studies of operational benchmarking to identify best practices for the industry to improve as a whole.

57. In Table-2 performance indicators for another study are given. The median of these indicators was used.

Table 2
Performance Indicators (Alarcon and Serpeli)

Area	*Indicator*	*Units*
Cost	Deviation of Cost by Project	(Real Cost - Budgeted Cost) / Budgeted Cost
Due Date	Deviation of Construction Due Date	(Real Due Date - Initial Due Date Budgeted) / Initial Due Date Budgeted
Scope of Project	Change in Amount Contracted	Sale Final Contract / Sale Initial Contract
Safety	Accident Rate	(Number of Accidents) * 100/ Total Number of Workers
	Risk Rate	(Number of Days Lost) * 100/ Yearly Average of Workers
Labour	Efficiency of Direct Labour	Direct Hours Budgeted / Direct Real Hours
		Budgeted Cost Direct Hours / Cost Real Direct Hours
Construction	Productivity - Performance	Sale Final Contract / Direct Real Hours Labour at Construction Site
		Sale Final Contract / Relevant Units Executed
Subcontracts	Rate of Subcontract	Amount Sub-Contracted / Sale Final Contract
Quality	Cost Client	Cost Client Complaints / Total Cost of Project
	Complaints	Cost Client Complaints /Number of Complaints Per Client
Procurement	Urgent Orders	Number of Urgent Orders / Total Number of Orders
Planning	Effectiveness of Planning	% Completed Activities (PCA) = Number of Activities Completed / Number of Activities Programmed

VIII. Application of Benchmarking in Transport Infrastructure

58. Transport infrastructure is a key most component of economic development and social well-being. It is indispensable for social and personal life. It supports, and also ensures personal well-being and national economic growth.

59. The transport sector is an important component of the economy and a common tool used for development. Transportation infrastructures are among essential public assets in many countries.

60. Transportation assets are vitally the most important public assets for the accessibility and mobility of the people and freight. Improvements of these assets are to ensure important benefits to the citizens, taxpayers or users through access to health centres, schools, works, markets, tourism centres by improved comfort, speed, safety and lower vehicle operating costs (in case of the road infrastructure) (WB, 2005). They also support overall economic development by ensuring access of freight transport to logistics centres.

61. To achieve these benefits, a well-planned and timely scheduled transport infrastructure system must be built, maintained and upgraded on a regular basis. A relation between the quantity and quality of transport infrastructure and the level of economic development is apparent. High-density transport infrastructure and highly connected networks are commonly associated with high levels of development.

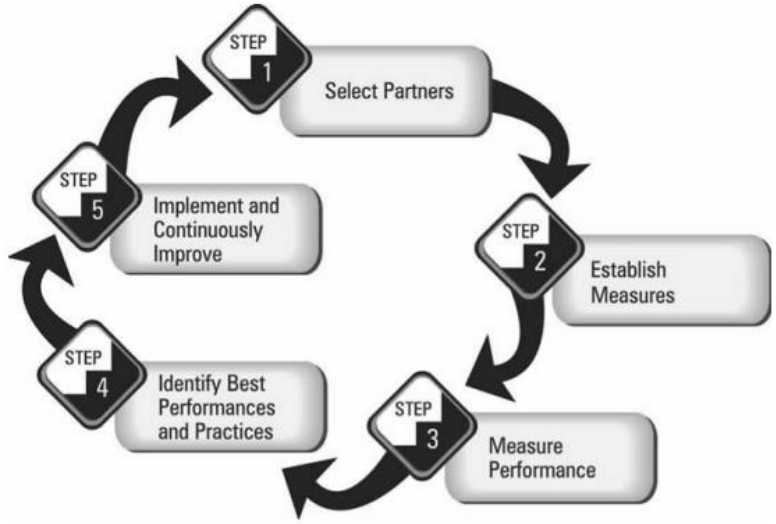
62. As important as developing the transportation infrastructure and constructing new lines, extending network, increasing capacity is, it is equally important to maintain and improving the system regularly

63. Maintenance processes are essential to sustain the capacity of transport infrastructures to provide multiple public services for the customers and stakeholders as defined above. To achieve this, it is necessary to carry out relevant treatments towards assets to keep their performance on the level as much as possible close to initially provided when originally constructed. Appropriate maintenance allows to protect adjacent resources and user safety, and to provide efficient, convenient, and safe travel along the route.

64. Unfortunately, maintenance is often neglected or improperly performed resulting in rapid deterioration of the assets and eventual failure from both climatic and vehicle use impacts. The aim of the maintenance is to preserve the asset not to upgrade. Maintenance activities should be done regularly and contains – for example in the road sub-sector - "activities to keep pavement, shoulders, slopes, drainage facilities and all other structures and property within the road margins as near as possible to their as-constructed or renewed condition" (PIARC, 1994).

65. Benchmarking is a strategic tool that helps users make decisions that improve the efficiency and effectiveness of transport assets. Benchmarking is closely associated with measuring costs and performance at the project level in the transportation sector as well as infrastructure sector (RICS, 2020). The most difficult part of benchmarking is data collecting and managing, data sharing, mutual understanding and defining benchmarking programme (What to benchmark, what levels to benchmark, what timescale to use, where). In a large body of literature on transport infrastructure, process of benchmarking is given as in the following figure.

Figure X
Steps in the benchmarking process (NCHRP, 2004)



66. There are five main process steps, as follows: selecting partners, establishing measures, measuring performance, identifying best performances and practices, and implementing and improving continuously.

67. In transport sectors partners are generally state/nation agencies, local agencies, cities, counties, turnpike/motorway authorities, private sector firms, organizations in different industries and organizations in other countries (NCHRP, 2004).

68. “A benchmarking partner and a benchmarking unit are not necessarily the same—for example, a state maintenance organization could be a benchmarking partner with benchmarking units consisting of districts, counties, areas, or garages. Private companies could be benchmarking partners, and their benchmarking units could consist of districts. County government or municipalities could both be partners, while having subunits that are benchmarking units” (NCHRP, 2004).

69. As a result of benchmarking to achieve good results the units to be benchmarked must have some expected characteristics and show this intention. These are: initial agreement what to benchmark, cooperation and willingness to share information, willingness to create common measures, commitment to data and measurement quality, commitment on time, effort, and resources.

70. A National Cooperative Highway Research Program (NCHRP) research cited as report identified two general approaches towards benchmarking in the infrastructure industry as independent (or internal) benchmarking and external benchmarking or benchmarking within a network of similar organisations (RICS, 2020).

71. To identify the levels of benchmarking once the context of benchmarking is established. The levels of benchmarking are identified as international, system, network, asset and project. Appropriate metrics should be developed to measure the performance. To achieve international benchmarking, international standards should also be adapted. The most common measures used to benchmark cost is spatial measures as $/m, $/m2, $/m3 (CabinetOffice, 2012).

72. Benchmarking is closely associated with measuring costs and performance in the infrastructure sector. ICMS (International Construction Measurement Standards) and ICMS Data Standards are good tolls to perform infrastructure benchmarking on international level. Cost benchmarking is used as a more reliable platform for predicting the cost of new projects, so benchmarking is also useful in improving cost estimation in the transport sector.

73. “The benefits of benchmarking in the infrastructure sector have been documented by several global research studies, including the NCHRP in the US, and IPA, Centre for Transport Studies (CTS) at Imperial College London and benchmarking tunnelling costs and production rates in the UK” (RICS, 2020).

A. Transport Assets Maintenance Benchmarking

74. Transportation agencies have recognized that continuous improvement is essential to manage the maintenance organization effectively in the face of growing demand, tight budgets, and limited staff. There are different methods and techniques to improve the efficiency and effectiveness of the delivered maintenance products and services. All agencies look for the continuous improvement and best way of doing maintenance works cost effective, efficient, timely by identifying best practice. As defined early benchmarking is the process to identify the best performance, best way doing something and a learning process. It is also a kind of measurement technique.

75. For maintenance products and services one of the benchmarking in literature is customer-driven benchmarking. Four types of measures are used in customer driven benchmarking: Outcomes, outputs, resources, and hardship factors (NCHRP, 2004). These are defined as follows.

(a) Outcomes: Outcomes are the results of performing maintenance activities that are important to customers. Examples of outcomes are smooth roads, edge markings that are easy to see in poor weather, and traffic signals.

(b) Outputs: Outputs are measures of accomplishment or production. Examples of outputs are linear m of ditches cleaned, the number of bags of litter collected, and acres of grass mowed.

(c) Resources: Resources consist of labour, equipment, materials, and financial costs.

(d) Hardship factors: These are factors outside the control of the maintenance organization that make it more difficult to satisfy customer desires and needs. Examples of hardship factors are weather, terrain, and population density.

76. Customer-driven benchmarking combines all four measures to give analysts and managers a broad perspective on how well various organizations are achieving outcomes that matter to customers in a manner that uses the fewest possible resources while considering the level of production and uncontrollable factors such as weather (NCHRP, 2004). Organizations that do this the best, as determined through measurement, are sources of practices that agencies should consider adopting. It is recommended to further analyse the potential measures for benchmarking of the maintenance services in the railway sub-sector and in the inland waterways sub-sectors. Although some of the costs may be treated as internal or even confidential, perhaps it is possible to find a few of indicators which relates to the total costs of ownership of transportation infrastructure assets and to carry out benchmarking to feed the efficiency management in the country and/or particular road, rail, inland waterways managing organization.

B. Understanding the Importance of Maintenance

77. Many developed countries already established their transportation network. Trends in transport sector is not building new infrastructures but providing efficient transportation system. However, transportation professionals face important challenges: to provide efficient transportation with an aging infrastructure, to meet growing public and legislative demands for accountability, and to manage the rapid pace of change (TRB, 2006). The major trends affecting maintenance are:

- Infrastructure growth is slowing therefore maintenance, rehabilitation, improvement and preservation of transport assets are becoming more important.
- Traffic volumes continue to grow.
- Transport assets are getting aged and operators and managers of the organizations must respond this problem on time and in efficient manner.
- Technology is growing so rapidly also digital age is presenting solutions by also creating some problems.
- Climate is changing, that climate change makes maintenance and development of transport systems more important.
- Environmental concerns are becoming more and more important.
- Investing in maintenance at the right time saves significant future costs.
- Maintenance investment must be properly managed.

C. Road Transport

78. Without an emphasis on maintenance, highway and bridge infrastructure aged more rapidly than it could be reconstructed or rehabilitated (TRB, 2005). Currently, new attitudes toward maintenance prevail as understanding and awareness grow. Preservation of assets and mobility are high-priority challenges for a highway system that is essentially in place.

79. Categories of road maintenance costs should be aligned with the overall categories of maintenance, which in the case of the road sub-sector are as routine, periodic and urgent.

80. Routine maintenance, which comprises small-scale works conducted regularly, aims “to ensure the daily pass ability and safety of existing roads in the short-run and to prevent premature deterioration of the roads” (PIARC, 1994). Frequency of activities varies but is generally once or more a week or month. Typical activities include roadside verge clearing and grass cutting, cleaning of silted ditches and culverts, cleaning and repairing traffic signs and signals, patching, and pothole repair (WB, 2005). For gravel roads it may include regrading every six months. In addition, the purpose of winter maintenance is maintaining

the roads safe and passable during severe winter conditions by means of using all effective operation and management techniques and solutions to keep away snow and to prevent frost on the road surface. Roads are maintained regularly and their operability is ensured. Routine maintenance restores serviceability.

81. According to World Bank periodic maintenance covers activities on a section of road at regular and restively long intervals and aims to preserve the structural integrity of the road. These operations tend to be large scale, requiring specialized equipment and skilled personnel. They cost more than routine maintenance works and require specific identification and planning for implementation and sometimes even a design. Activities can be classified as preventive, resurfacing, overlay and pavement reconstruction.

82. Urgent maintenance is undertaken for repairs that cannot be foreseen but require immediate attention such as collapsed culverts or landslides that block a road.

83. Authorized agencies responsible for maintaining roads are local and national/state authorities and works are performed by these local i.e. municipalities and national agencies. Road agencies engage with Ministry of Finance and present their annual roads maintenance budget needs to get funds. If the roads are not constructed and operated by any techniques as PPP budget generally comes from central budget. Once maintenance needs have been estimated, the road agency finalizes and submits its annual budget for consideration to a funding source. At the central level that would be the Ministry of Finance or a road fund; at the regional or local level, it would be the funding authority at that level. Each country's institutional and financial systems affect how the budget submission is presented.

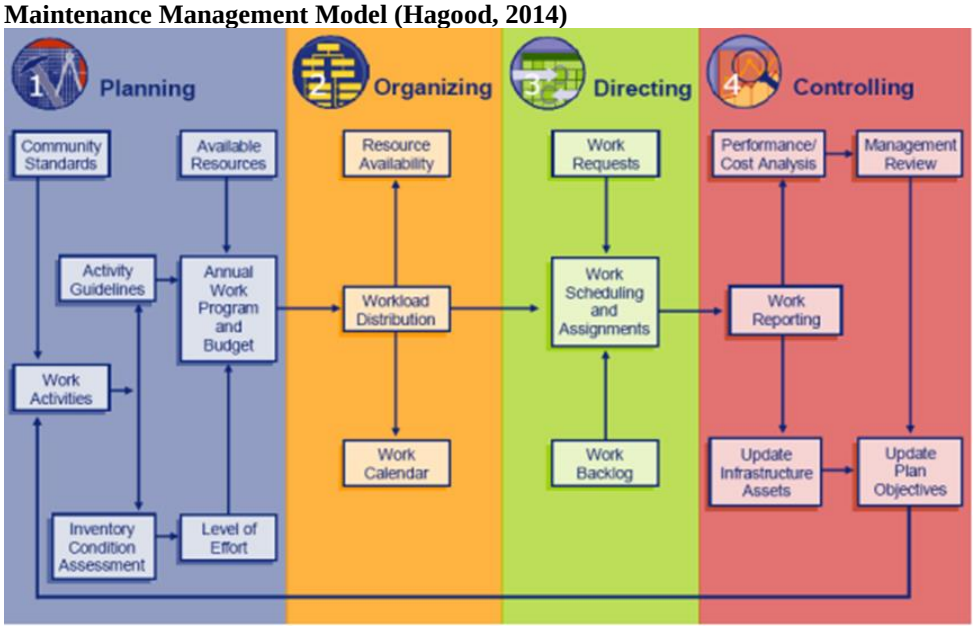
84. In the case of roads, maintenance and operations can be outsourced to private organizations or carried out using force accounts (inhouse units and equipment) or both as hybrid model. Responsible road agencies need competent maintenance program management, a good monitoring system, and clear and transparent procurement procedures. During last 10-20 years periodic maintenance done by in-house labour is being replaced by more contracts with the private sector worldwide.

85. There are several types of road maintenance contracts. Contracts can be classifying by size of contracts and type of work as length worker, community contractor, petty contractor, microenterprise, small scale contractor, medium- and large-scale contractors (TRL and DFID, 2003). Some contracts are short term (6-12 months or 1-2 years) and some of them are long-term (2-3 or 3-5 years) contracts. Some of the contracts are lump sum contract or depends on unit prices and some of them depends on performance-based or hybrid (mixture of performance contract and unit price contract). Generally routine maintenance contracts are often short-term contracts. Many countries use domestic although local contractors to implement maintenance works. Some contracts just compromise routine maintenance works but some of them include periodic maintenance also.

86. The cost of the maintenance depends on conditions of the region and country, conditions of the roads. Routine maintenance cost varies by climate, topography, used equipment and machines as sophisticated or conventional, market prices, labour costs, GDP of the country, traffic loads and other factors. In addition, type of the maintenance contracts changes unit costs. According to WB Transport Notes (WB, 2005), unit routine maintenance cost of two-lane bituminous highway is between 656-5,580 US$/km and the average is 2,199 US$/km with 2000-unit prices. According to study done in NZ in 2012 maintenance and operation cost of local roads is 2,870 NZ$/km and for state highway it is 29,318 NZ$/km (Hatcher, Hunter and Mitchel, 2012).

87. The maintenance management is an organized method that controls what work needs to be done, determines the timeframe of the work, labour, equipment, and material resources, and projects the cost of the work to be done. Proper maintenance management can reduce costs up to 20% per year (Hagood, 2014). In general maintenance management consists of four stages: planning, organizing, directing, and controlling. All these stages presented in the following figure.

Figure XI
Maintenance Management Model (Hagood, 2014)



D. Railway Transport

88. In the case of railway sub-sector costs may fall into two broad categories, which in the case of the Polish railway infrastructure manager are:

- Costs of maintenance and renewal of railway infrastructure
- Costs of operation of the train service

The first category is similar to the road sub-sector and contains, inter alia:

- Regular repairs
- Major repairs
- Winter services
- Operations
- Emergency interventions

89. These costs are directly incurred as a result of infrastructure maintenance and renewal were calculated using the so-called binary method which involves an assessment of the individual types of economic events in terms of their direct relation to train movements. The titles of economic events that are classified as direct costs and noneligible costs are specified and commented in the List of Controlling Items. The figure below shows an example of how economic events are divided into direct and noneligible costs for operations on mainline tracks, which generate 84% of direct costs.

Table 3
Examples of categories of costs in the case of the Polish railway infrastructure management

Mainline tracks							
costs directly incurred as a result of train movement				*non-eligible costs*			
Costs by nature only consumption of non-traction liquid fuel, consumption of materials, maintenance related services, renewal related services, remunerations, social insurance contributions							
Maintenance	*Regular repairs*	*Major repairs*	*Winter operations*	*Operation*	*Troubleshooting*	*Emergency repairs*	*Other, including e.g.: costs of safeguards against thefts and costs of recovery from damage due to thefts and acts of vandalism, and costs of maintenance, regular and major repairs, and preparations for winter operations, which are not direct costs*
• replacement of damaged connectors and installation of missing connectors, tightening screws and bolts • supplementing ballast • restoring rail profile by grinding	• horizontal and vertical adjustments of tracks • replacement of single components of the superstructure, final repairs of cracked rails, etc.	• ongoing rail replacement, • ongoing sleeper replacement, • ongoing cleaning, supplementing and thickening of ballast, etc.	• removal of snow and ice from tracks from November to March	• depreciation. • keeping the areas in good order. • lease payments.[2]	• plans, measurements and diagnostic analyses. • troubleshooting reports • visual inspections of infrastructure in accordance with instructions, etc.	ad-hoc protection or elimination of damage restoring unobstructed traffic flow or the required technical and operational parameters to enable safe rail traffic operations.	

[2] according to the agreement between PKP PLK S.A. and PKP S.A. for handing over the railway lines along with other immovable property required to manage these railway lines for paid use

90. The second category (of operation of the train service) are calculated to determine the unit rates for the minimum access to railway infrastructure are generated by:

- Train dispatchers, signallers, and points operators,
- Level-crossing attendants,
- Production planning dispatchers and line dispatchers,
- Staff needed for preparing train timetables.

91. The cost that is directly incurred because of train movement is the cost incurred during the active working time of the above staff members. The active working time is the time used for operations related to train movement and shunting.

92. The direct costs include the costs of salaries and social insurance contributions that are paid by the employer, which are the costs of the active working time of train dispatchers, signallers and points operators, level-crossing attendants, production planning dispatchers, line dispatchers, and the staff needed for preparing train timetables. The noneligible costs are the costs related to train movements, which, however, are not direct costs, in particular the costs of readiness to operate train service stations in the absence of train movements, annual, additional, training and sick leaves, time off work for renewal examinations and medical check-ups. The followings are samples on transportation infrastructure benchmarking from literature.

E. Infrastructure Benchmarking Report, Australia

93. The Transport Infrastructure Council published a booklet named “Infrastructure Benchmarking Report” in Australia. This report covers the findings of the initial benchmarking and outlines plans for continued and improved future monitoring of infrastructure procurement performance and construction costs (TIC, Australia). The analysis was undertaken by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) for the Infrastructure Working Group of the Transport and Infrastructure Council in Australia.

94. Analysis of the procurement processes found the majority of the projects in the pilot study sample met most timeliness targets and most qualitative and quantitative performance measures specified by Infrastructure Australia. The majority of projects also complied with planned quantitative and qualitative performance benchmarks, however, with two exceptions:

- Almost 80 per cent of sampled projects reported at least one addendum for project changes or missing information; and
- Approximately 57 per cent of sample projects reported at least one material change to terms or scope at the Request for Proposal phase.

Benchmarking Construction Costs

95. The infrastructure construction cost benchmarks presented are of a strategic nature, as recommended in the Productivity Commission’s Public Infrastructure inquiry report. The results cover a sample of 65 separate road construction projects undertaken since 2010, drawn from across all eight states and territories. Thirty of the projects in the sample have been completed, 26 are currently in delivery and nine projects are at pre-delivery phase. Only completed projects and projects currently in delivery have been included in the benchmarks. New South Wales and Queensland account for just over half of all projects in the sample.

96. The main findings of the cost benchmarking analysis are:

(a) road class is the most significant factor influencing average project costs – average costs of urban and rural freeways/highways are around $6.0 to $6.5 million per lane kilometer, while lower standard rural arterials average around $3.0 million per lane kilometer (Figure IX, Table 4);

(b) project management costs typically comprise around 7 per cent of total costs while design and investigation costs typically comprise around 5–6 per cent (Figure II); and

(c) the project sample provides no clear evidence of any time trend in average project costs over the last five years.

Figure XII
Summary Cost Benchmarks – Project Cost Per Lane Kilometer, By Road Reference Class

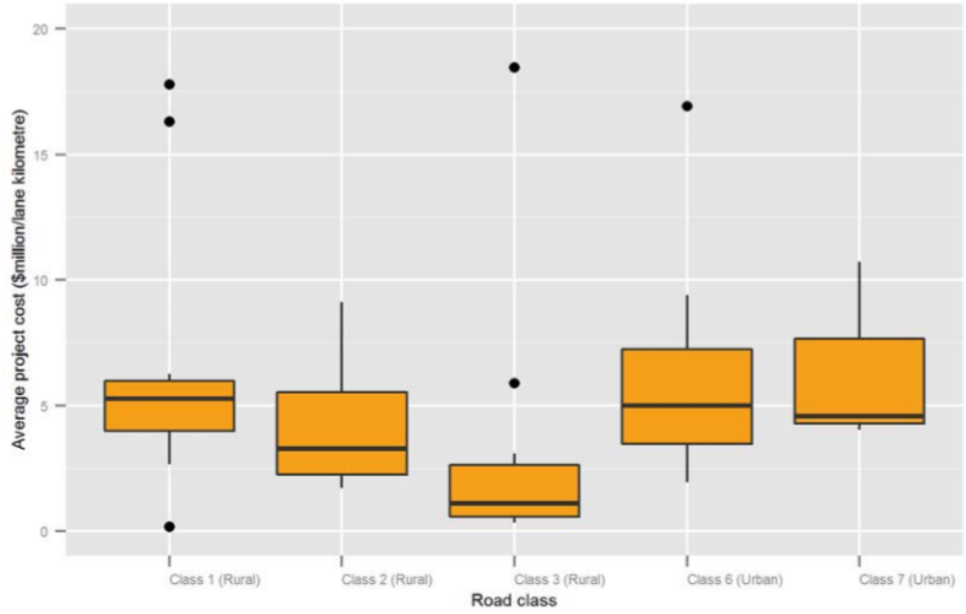


Table 4
Construction Cost Benchmarks, by Component and Road Reference Class

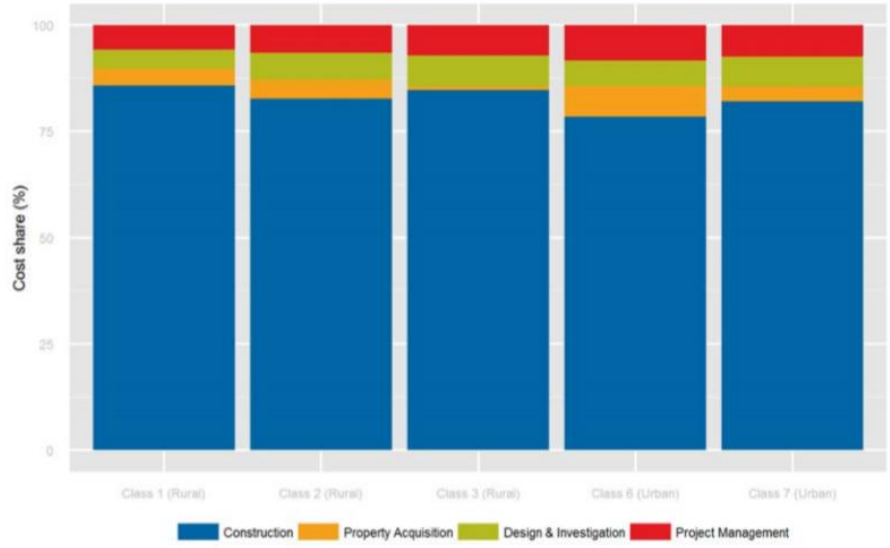
		Road reference class[b]				
Benchmark	**Unit**	**Class 1**	**Class 2**	**Class 3**	**Class 6**	**Class 7**
Average project cost	($m/lane km)	6.45	4.13	2.86	7.76	6.44
Average project cost (excl. land acquisition & supplementary items)	($m/lane km)	6.06	3.72	2.70	5.85	4.07
Average construction cost	($m/lane km)	5.46	3.40	2.47	5.06	5.11
Average pavement costs	($'000/lane km)	902.7	981.9	230.4	995.3	891.1
	($/sq. m)	159.1	158.5	79.1	201.8	164.3
Average bridge costs	($/sq. m)	5090	4150	3880	3610	3650
Average bulk earthworks costs	($/cu m)	35	48	49	76	55

a. The average cost benchmarks reported in the table are based on the sample mean. The data set included only three Class 7 (Urban) road projects, so the reported benchmarks may not be representative of broader selection of Class 7 road projects.

b. Austroads functional road classification definitions: Class 1 – Principal rural highways and freeways connecting major regions and capital cities; Class 2 – Principal rural arterial roads; Class 3 – Main rural arterial roads, not in Class 1 or Class 2; Class 6 – Urban motorways and freeways; Class 7 – Primary urban arterial roads.

Source: BITRE estimates based on state- and territory-supplied data.

Figure XIII
Average Project Costs Shares, By Road Class



Source: BITRE estimates based on state- and territory-supplied data.

97. The first national cost benchmarking was a significant step to inform efficient and effective project delivery and identify areas of best practice. Experience from this study initial benchmarking highlighted the need to collect additional information about projects (such as project type, construction methodologies, terrain, pavement type) to better understand the causes of cost variations, particularly for the small number of projects that had costs that differed significantly from averages for the class of road.

98. Preliminary international comparison provided mixed results – suggesting that average Australian road project costs were found below equivalent project costs in the United Kingdom, but above project costs in four continental European countries.

F. Study named “Road Works Cost per Km” Word Bank Report

99. This research prepared by Rodrigo Archondo-Callao in 2000 April. The objective of this report is to create a database of actual maintenance, rehabilitation and construction work costs per km. In this report information from World Bank completed highways projects, from 40 countries between 1995 to 1999, was reviewed. 93 work costs per km were found or estimated.

100. The descriptions given to the road works on World Bank reports are very general (for example: rehabilitation, strengthening, periodic maintenance, reconstruction, improvement, construction, etc.). Most of the time no detailed information was found, such as road width, terrain, traffic, overlay thickness, regravelling thickness, rehabilitation surface, improvement type, etc. It was only possible to estimate average costs and costs statistics for a series of road work classes based on the general descriptions.

1. Road Works Classes

101. Paved Roads - Seals (reseals, surface dressings) - Functional Overlays (thickness <= 5.0 cm) - Structural Overlays (thickness > 5.0 cm) - Rehabilitation (strengthening, reconstruction) - Construction (widening, new construction)

102. Unpaved Roads - Regravelling - Rehabilitation - Improvement - Paving

2. Average Works Costs per Km

103. Paved Roads - Seals 20,000 $/km - Functional Overlays 56,000 $/km - Structural Overlays 146,000 $/km - Rehabilitation 214,000 $/km - Construction 866,000 $/km.

104. Unpaved Roads - Regravelling 11,000 $/km - Rehabilitation 31,000 $/km - Improvement 72,000 $/km - Paving 254,000 $/km.

3. Range of Works Costs per Km

105. Paved Roads - Seals 5,000 - 32,000 $/km - Functional Overlays 30,000 - 107,000 $/km - Structural Overlays 74,000 - 198,000 $/km - Rehabilitation 45,000 - 700,000 $/km - Construction 142,000 - 1,832,000 $/km.

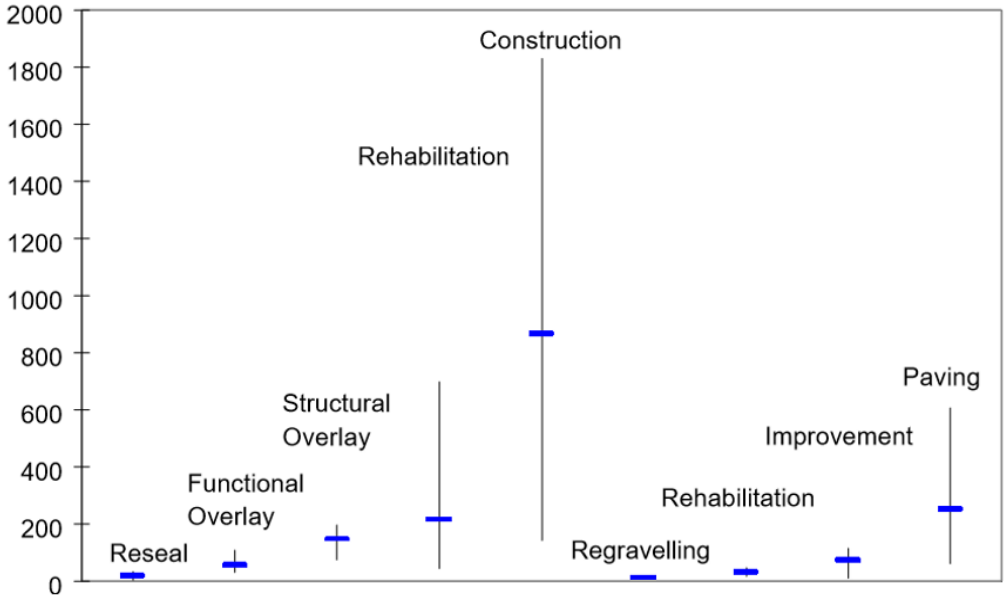
106. Unpaved Roads - Regravelling 9,000 - 13,000 $/km - Rehabilitation 17,000 - 47,000 $/km - Improvement 11,000 - 114,000 $/km - Paving 62,000 - 609,000 $/km.

4. Number of Observations and Standard Deviation of Works Costs per Km

107. Paved Roads - Seals (7) 10,000 $/km - Functional Overlays (12) 24,000 $/km - Structural Overlays (6) 42,000 $/km – Rehabilitation (33) 144,000 $/km - Construction (13) 567,000 $/km.

108. Unpaved Roads - Regravelling (4) 2,000 $/km – Rehabilitation (4) 17,000 $/km - Improvement (6) 37,000 $/km - Paving (10) 153,000 $/km.

Figure XIV
Average and Range of Roads Works Costs (1000) US $ per km (Archondo-Callao)



G. Routine Maintenance Benchmarking of Turkish Motorways, State and Provincial Roads

109. In Turkey motorways, state roads and provincial roads (excluding urban roads) which is about 68,526 km are under responsibility of General Directorate of Highways (KGM) as end of 2021. KGM is a national road transport authority and has 18 regional directorates. There is central office in Ankara which is dealing with mega projects and governance. All maintenance works are done at regional directorates by maintenance chief offices and maintenance houses. Except ring roads motorways are toll roads and toll roads maintenance are performed by maintenance and operation chief offices as same method as state and provincial roads but for assigned motorway sections as average 110 km. However, for special tunnels (i.e. Bolu Mountain's Tunnel) and special bridges (i.e. Bosphorus Bridges) maintenance and operation chiefs offices are just assigned for that special infrastructures. In addition, not all regional directorates have motorway network.

110. In Turkey there are also motorway sections and special transportation infrastructures constructed and operated under PPP method. Motorways and special road transport infrastructures which has been constructed under PPP method has also been managed,

operated and maintained by private firms. Routine maintenance benchmarking is only performed for publicly owned and operated roads under KGM (General Directorate of Turkish Highways) responsibility.

111. Under each regional directorate there are nearly 7 maintenance chief offices which is responsible from state and provincial roads covering almost one or at most two provinces. Each maintenance chief offices are responsible nearly 500 km state and provincial road network and each regional directorate is responsible nearly 3,500 km state and provincial road network (Motorways are not included). There are also regional directorates that does not have motorway network.

112. Routine maintenance works are performed using hybrid model in Turkey that is by force account and contracts together. Contracts are generally based on unit prices.

113. Routine maintenance expenditures and unit costs totally and by work types (TL (Turkish Lira)/Km) are benchmarked by central office in Ankara internally in terms of sub-divisions of each directorate and by different years and externally in terms of each regional directorate annually.

114. This benchmarking analysis is done in order to,

- Calculate realized cost and ranges
- Find out which parameters are important to specify maintenance cost
- Determine necessary budget for the following year for maintenance purpose
- Reduce the cost of delivering maintenance products and services or both
- Use for benefit-cost analysis
- Improve efficiency
- Increase customer satisfaction
- Ensure continuous improvement, etc.

115. The road maintenance benchmarking study is performed every year. There is a data base called KBOS (Organizational Information Automation System) where all inputs, outputs, outcomes, resources are recorded in this automation system. All data is uploaded on time and controlled and checked by system itself warning the person entering data and by central office in Ankara. Leader of this benchmarking is General Directorate. Data quality is the essential element of benchmarking. This benchmarking analysis is documented and published as a book and shared each year on KGM web page with all partners and customers, however some confidential data and outcomes is not shared. Measures are expenses (TL-Turkish Lira) and unit costs (TL/Km).

116. The results are mainly given as;

- Expenditures
    - Labor expenditures (TL)
    - Material expenditures (TL)
    - Invoiced expenditures (TL)
    - Expenditures under maintenance works contracts (TL)
- Unit Costs
    - Routine maintenance unit costs (TL/Km)
    - Winter maintenance unit costs (TL/Km)
    - Traffic safety issues unit costs (TL/Km)
    - Toll collection unit costs (Just for motorways) (TL/Km)

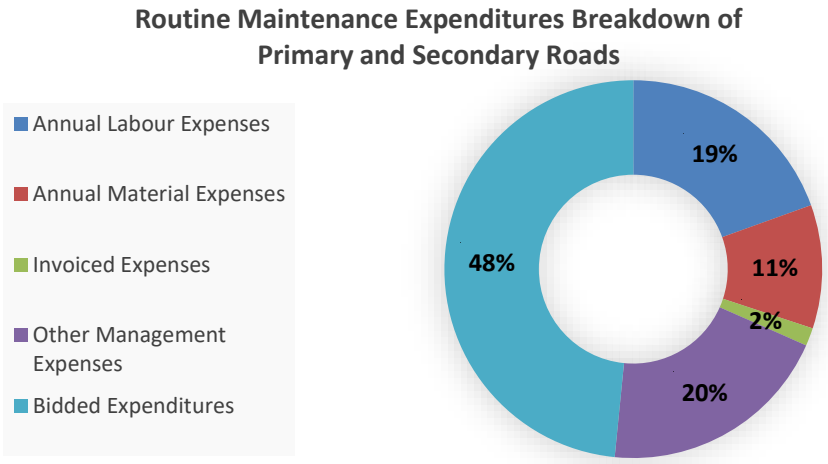
117. At the end of each year not only unit maintenance cost has been calculated and benchmarked, but also productivity analysis has been performed and productivity indicators has also been benchmarked. Cost overruns reasons for maintenance cost also have been

researched. Benchmarking is also performed every 5 years to benchmark different years performances and products.

118. Two different routine maintenance works benchmarking analyses are done every year, one is for state and provincial roads and the other one is for motorways. These benchmark analyses are done in detail however a very short summary of the result for 2020 is given below.

119. In 2020 62,140 km state and provincial roads were maintained. Total expenditures for this network are totally 972,770,200 US$ including winter maintenance expenditures. The breakdown of this expenditure is given in the following graph. As a short summary from this analysis, unit cost of routine maintenance works of state and provincial roads is 3,930 US$/LanexKm in 2020-year prices including winter maintenance.

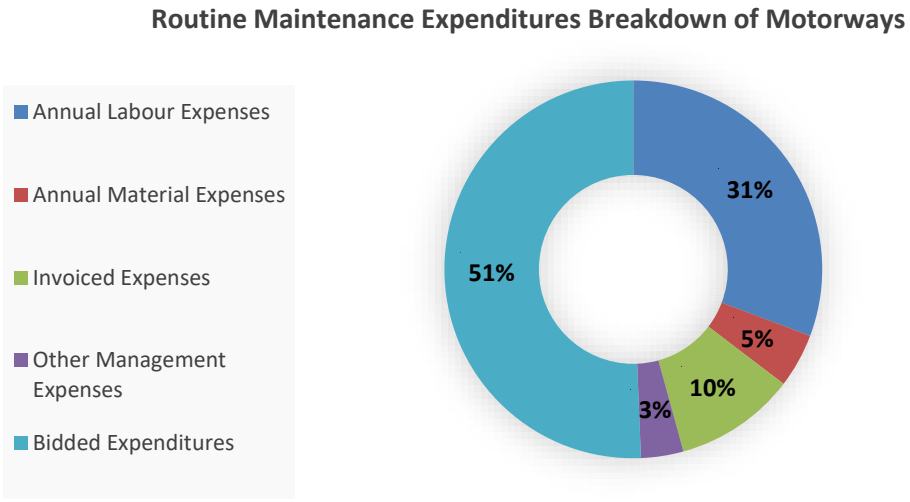
Figure XV
Routine Maintenance Expenditures Breakdown of Primary and Secondary Roads (%) (2020 Prices)



120. On the other hand, in 2020 2,610 km motorways, were maintained and operated. Total expenditures for this network 142,708,603 US$ including winter maintenance and toll expenditures. The breakdown of this expenditure is given in the following graph. As a short summary from this analysis, unit cost of routine maintenance works of toll roads is 12,633 US$/LanexKm in 2020-year prices including winter maintenance and toll collection.

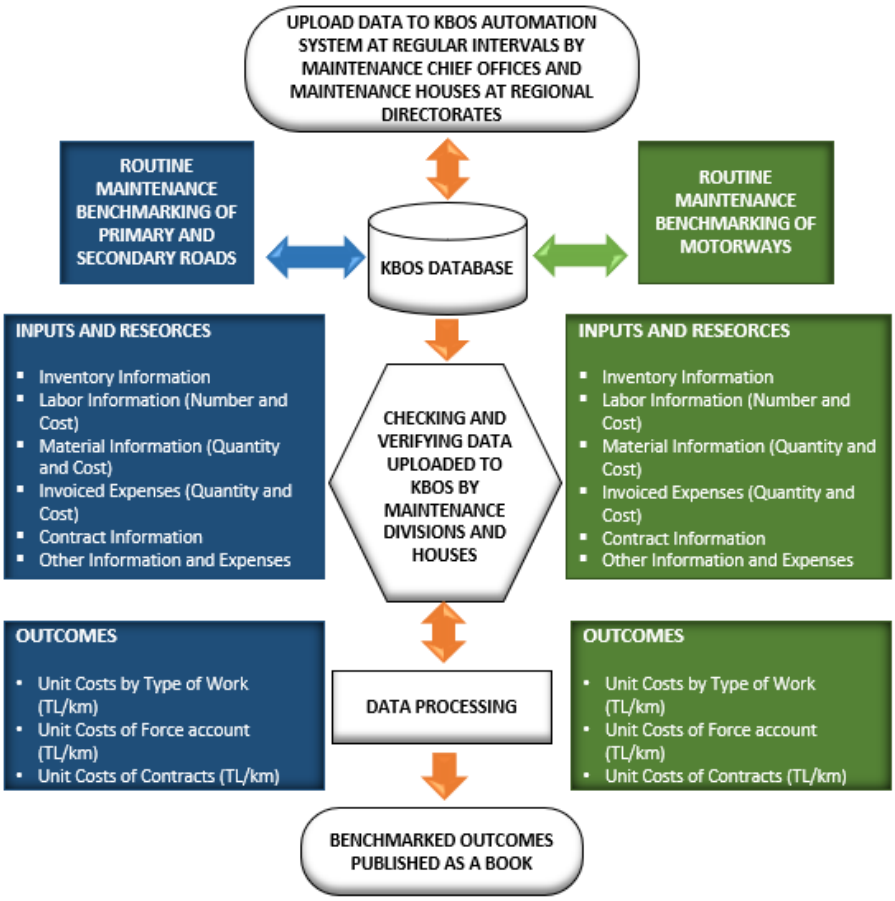
121. For motorways not only, costs and performance indicators are benchmarked but also ratio between Revenues to Expenditures are also benchmarked since motorways are tolled roads in Turkey.

Figure XVI
Routine Maintenance Expenditures Breakdown of Motorways (%) (2020 Prices)



122. Benchmarking steps as a simple flowchart for motorways, state and provincial roads is given in the following figure.

Figure XVII
Benchmarking Steps of Routine Maintenance of Roads Under KGM Responsibility



IX. Advantages and Disadvantages of Benchmarking

A. Advantages of Benchmarking

123. Benchmarking is essential for organizations to sustain high-level competition and to keep up with the customer's requirement and needs.

124. Benchmarking improves Learning Methodology: Benchmarking paves the way for generating new ideas and for sharing of proven business practices which can be seen as a learning experience for the companies.

125. Initiates Technological Upgrading: Through this strategy, the companies get to know about the new technologies and techniques which have been adopted by the market leaders. Companies can accordingly plan for up-grading their technologies to remain competitive.

126. Improve Company's Standards: The company analyses and studies the standards of the competitors. This facilitates the company to raise its own standard of production and products accordingly.

127. Enhances Work Quality: It leads to organizational growth since it improves the overall quality of the output and reduces the chances of errors due to the standardization of business operations.

128. Cope with Competition: Knowing about the competitors' business and their strategy, helps the company to design its strategies efficiently. It also facilitates the company to remain up-to-date with recent technological developments and trends and remain competitive.

129. Improves Efficiency: The overall efficiency of the employees increases with this practice since standardization of work motivates them to perform better without making mistakes.

130. Improved Quality: Benchmarking helps organizations to continuously improve the quality of their products and services. Organizations observe the current standard, and then try to surpass that.

131. Better performance: Benchmarking helps organizations overcome complacency. They continuously strive to improve their performance standards in order to stay relevant in the market.

132. Increases Customer Satisfaction: Through benchmarking, the company collects sufficient data on customer's needs and requirements. This information helps the company to enhance the customer experience and satisfaction level.

133. Help Overcome Weaknesses: These strategies help the company in finding out its shortcomings and overcome them to get the desired results.

134. Cost efficiency: Benchmarking provides organizations with valuable data on latest technologies, and business processes. These are aimed at increasing productivity while reducing cost. For example, a manufacturing company might learn about a certain machine used by its competitor, which can do the work of five workers. This company might then choose to adopt a similar technology to lower its labour cost.

135. Prioritizing areas of improvement: While organizations understand the importance to develop continuously, they might be unsure at times about where to start the improvement from. Benchmarking helps organizations to identify the areas where the gap between their own standard and that of the industry is the largest. This helps organizations to prioritize the areas they need to work on.

B. Disadvantages of Benchmarking

136. Benchmarking requires a lot of expertise and a vast collection of data that may not be readily available in any organization.

137. Lack of Information: Sometimes, the company is unable to gather adequate information for benchmarking. This leads to an improper or inadequate comparison of the company's performance with that of its competitors.

138. Increases Dependency: The companies tend to depend on other companies' strategies to become successful. In this process of following the market leaders, companies sacrifice their individuality and uniqueness by following the practices of others in the industry.

139. Lack of Understanding: At times, companies adopt benchmarking for the sake of doing so, rather than understanding the many benefits it can bring. Instead of using the benchmarking process to better identify and remedy its own weaknesses some businesses may only be interested in the functioning of their competitors.

140. Copying Others: Some organizations do not understand the actual purpose of this strategy and start copying their competitors in every aspect. This may even impede the very survival of the company.

141. Incorrect Comparison: comparing of organizational performances needs to be focused on relevant business process aspects, otherwise it may result in irrelevant or poor benchmarks.

142. Costly Affair: It requires a team of experienced personnel who have excellent analytical skills and expertise in the area. It may thus increase the administrative expenses of the company.

X. Conclusion

143. It is observed that companies at times might be reluctant to use benchmarks. One of the most popular reason for this is the belief that they are their own organization, and hence, do not need to emulate any other organization. This is where it is critical to underline the fact that benchmarking does not mean blindly 'copying' what competitors do.

144. Benchmarking is the simplest way to understand where an organization stands, and how far it needs to go before it reaches the top. While earlier benchmarking was a 'good to do' initiative, today it has become critical for organizations in order to stay relevant and gain a competitive edge.

145. Not only private sector but also public sector started to use benchmarking starting from 1990s.

146. Specific benchmarking approaches are not easily replicable, instead organizations must adapt the information to fit their needs, their culture, and their system. And, if organizations do simply reproduce a specific approach, they will only be as good as their competitor, not better. Benchmarking among companies or organizations is not about stealing ideas and approaches, on the contrary, it is an open, fair and transparent study of another organization's business practices. Benchmarking is a continuous process that requires constant calibration.

147. Benchmarking is not just looking for a better way to do things, it is about identifying the best approach.

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