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Transport infrastructure data:
Benchmarking Transport Infrastructure Construction Costs

A Benchmarking literature review – definitions concepts and methodologies*

Submitted by the Government of Turkey

I. Introduction

1. This document is submitted as Chapter II of the final report of the Group of Experts on Benchmarking of Transport Infrastructure Construction Costs. It provides an overview of benchmarking definitions, concepts and methodologies.

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".

* The present document is submitted as received.

4. In literature there are plenty of definitions and most of them are 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 continually improving the business or the organization by evaluating the scope for improvement, comparing the current position with that of the previous one or with the business practices of the 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 metric of performance 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 is a continuous learning and improvement process.

III. History of Benchmarking

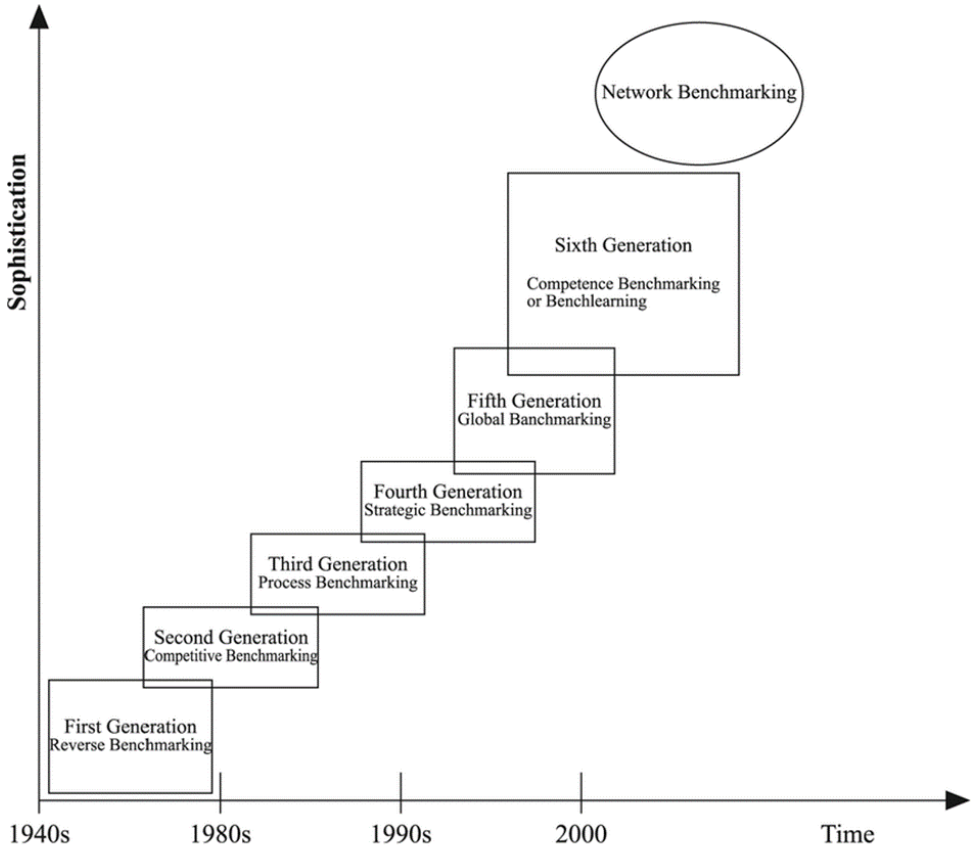
8. People have developed different methods and tools for setting, maintaining and improving their performance standards throughout history. In a real sense, benchmarking is a natural evolution from principles of Quality Measurement and Total Quality Management (TQM). The early benchmarking phase began in the late 1950s. The Japanese visited many thousands of companies around the world, mainly in the United States of America and Western Europe, specifically, to gather ideas that they could adopt and improve upon in their manufacturing processes. The Japanese investigated Western products and processes to understand their good and bad features and build superior alternatives at lower cost.

9. As it is given in above paragraph, benchmarking in USA was first used in the private sector in 1979 and has subsequently been embraced by business leaders and become the basis for many of the Malcolm Baldrige National Quality Award's performance criteria. It has been used in the United States of America public sector since the mid-1990s, particularly in municipal applications (Ryus, at all, 2010).

10. 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.

11. 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.

Figure I
Five Generations of Benchmarking



IV. Scopes of Benchmarking

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

13. 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.

14. 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.

15. As a result, we can conclude that both, benchmarking and action research aim to improve practices, but benchmarking might consider adopting learning empowerment from

action research, while action research might ponder what benchmarking can offer, as far as outside possibilities for learning from and with others are concerned. Thus, similarities are evident, 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

16. In literature review it is seen that there are many types of benchmarking and many ways of categorizing these types. It shows there is not consensus on the types of benchmarking. Several 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. However, the type of benchmarking used is not as important as that the aim of the benchmarking exercise is clear and achievable, and that the choice of partner organization is aligned with the aims.

17. 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.

18. 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).

19. 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).

20. 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.

21. 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).

22. In general, 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

23. Internal benchmarking refers to the comparison of the organizational performance internally. Either with its previous performances or with that of its competitors, i.e., companies belonging to the same industry (Priya, 2018).

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

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

26. 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.

[1] Strengths, Weaknesses, Opportunities and Threats

27. Performance Metrics: This strategy is based on the 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 address those.

28. Financial Benchmarking: The management conducts a comparative study of the financial forecast with the actual results or financial reports to find out the areas of shortcomings and take corrective actions.

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

B. External Benchmarking

30. In external benchmarking, the company compares its performance with that of its competitors in the industry or across the globe (Priya, 2018). Usually, by data collected through associations or third parties.

31. 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.

32. 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.

33. 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 a function, to modify its ways accordingly.

34. 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 products.

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

36. 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.

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

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

Figure III
Types of Benchmarking

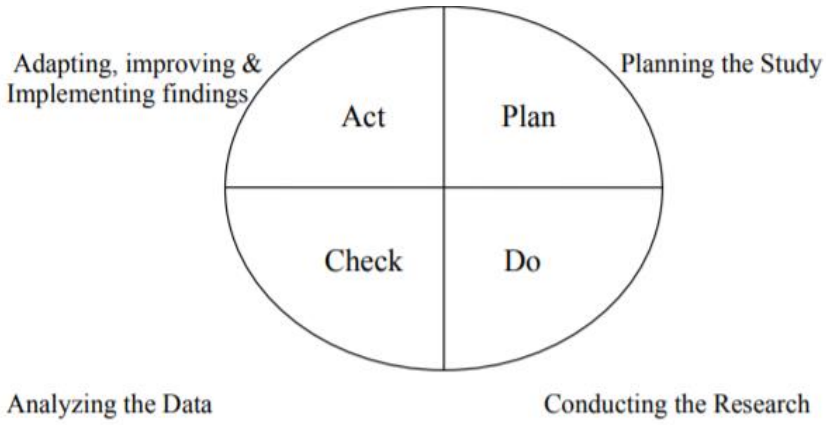
VI. Models and Methodologies of Benchmarking

39. There is no single benchmarking process that has been universally adopted. While reviewing literature it is seen that numerous models of benchmarking are discussed in the literature. Benchmarking is 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 bests and best practices from other companies, typically measured dimensions are quality, time and cost.

40. 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.

41. There is no single benchmarking process that has been universally adopted. The wide appeal and acceptance of benchmarking has led to the emergence of benchmarking methodologies. Benchmarking process models and methodologies can vary from four steps up to30 steps. The four step approach which is suggested by Alstete (1996) consists of: plan, do, check and act (PDCA) as shown in below Figure 4.

Figure IV
Alstete's Benchmarking process



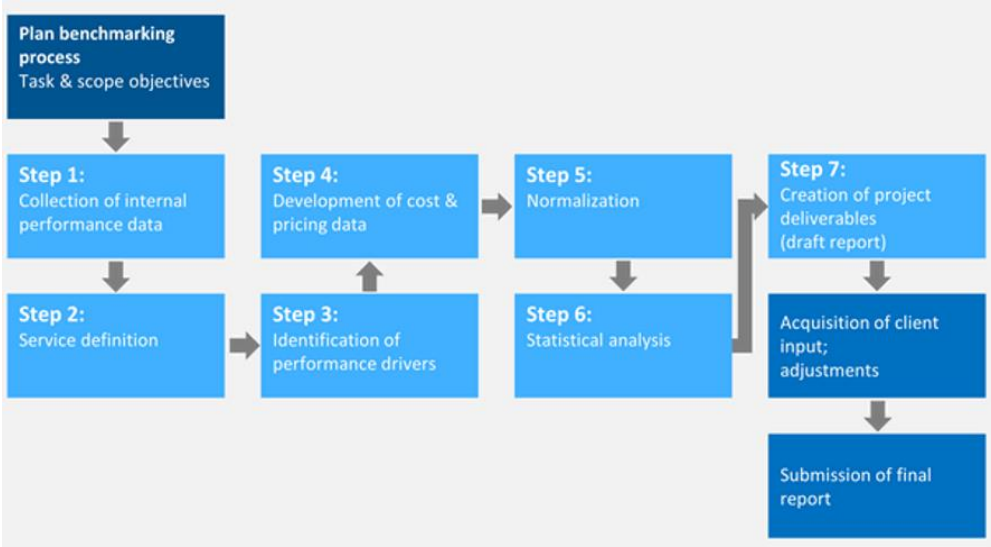
42. Robert Camp developed a 12-stage approach to benchmarking.

43. The 12-stage methodology consists of:

- Select subject
- Define the process
- Identify potential partners
- Identify data sources
- Collect data and select all partners
- Determine the gap
- Establish process differences
- Target future performance
- Communicate
- Adjust goal
- Implement
- Review and recalibrate

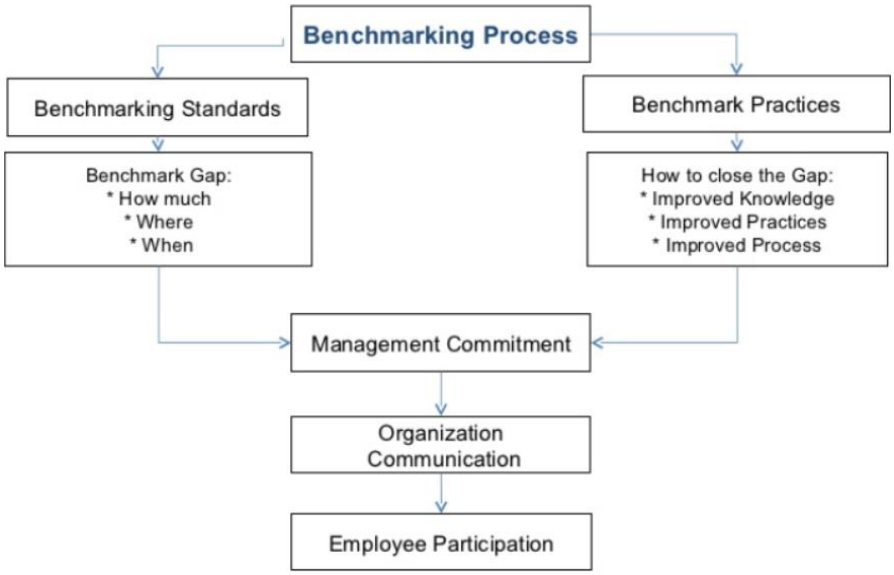
44. On the other hand, the following Figure shows seven steps of effective benchmarking.

Figure V
Seven Steps of Effective Benchmarking



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

Figure VI
Benchmarking Process

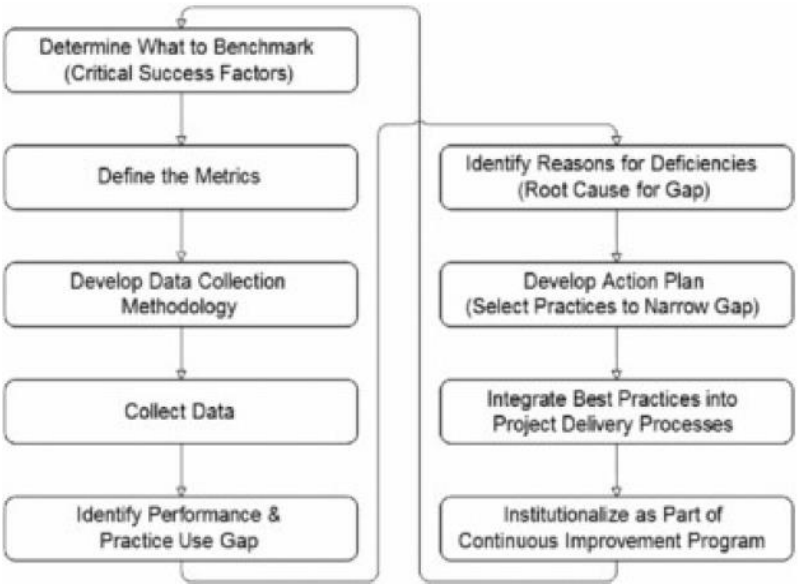


46. A typical benchmarking methodology is given as an example in the following paragraphs:

- Identify problem areas: Because benchmarking can be applied to any business process or function, a range of research techniques may be required. They 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 function and processes; base lining performance provides a point against which improvement effort can be measured.
- Identify other industries that have similar processes: For instance, if one were interested in improving hand-offs in addiction treatment one would identify other fields that also have hand-off 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 magazines to determine which companies are worthy of study.
- Survey companies for measures and practices: Companies target specific business processes using 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.

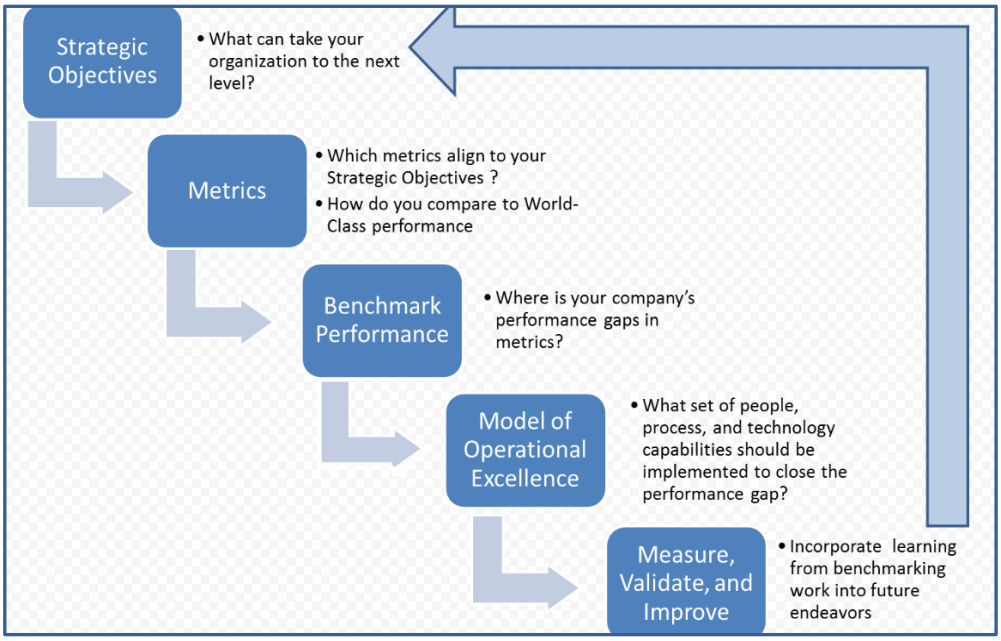
47. A benchmarking roadmap is shown in the following figure.

Figure VII
Benchmarking Roadmap



48. In order to benchmark anything, first of all quantitative data availability is the most important issue to study. That means 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

49. 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 rest of the 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 propose by the participating construction companies:

- Authorized vs. actual cost
- Authorized vs. actual schedule
- Actual labor vs. estimate
- Scope change vs. original scope

50. The proposed parameters reflect an interest in comparing measures of results rather than identifying the deficiencies in practices which affected the results. Actually, this is more of a competitiveness analysis than a benchmarking (Muniz, 1995). Alarcon and Serpeli cited Salmona (1995) that it is important to note that the information of the HBR has been used in Chile recently by CODELCO, the world's largest copper producer, to compare the results of approximately twenty projects.

51. Benchmarking project results (cost, schedule, etc.) has a limited value since, at the most, it identifies high-level problem areas but does not help to select 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 competition is more successful in achieving its results. This can only be achieved analyzing the factors which lead to a successful performance.

52. 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):

(a) To understand own processes and to detect its weaknesses and strengths. But it does not accomplish the following stages:

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

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

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

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

Modeling in Construction Industry

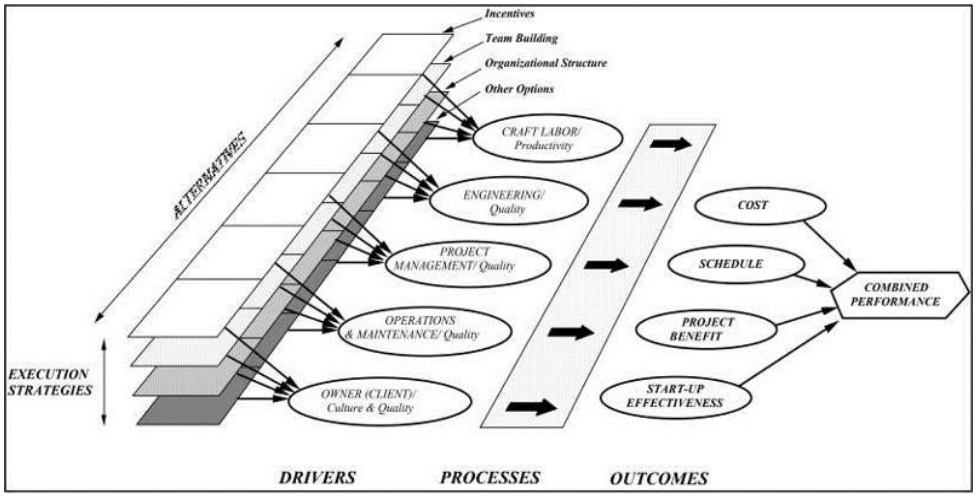
54. Statistical analysis serves as a traditional tool for developing models from empirical information. However, other options exist and may be even more attractive (Alarcon & Ashley 1992, 1996). Alarcon has recently developed a methodology to evaluate project management strategies whose principal components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

55. 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)



56. 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.

57. 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.

58. In the following table project performance parameter proposed to be used are given.

Table1
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.

Results	*Parameters*	*Units*
	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		

59. 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.

60. 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

Area	*Indicator*	*Units*
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 Transportation Infrastructure

61. The followings are samples from literature.

A. Infrastructure Benchmarking Report, Australia

62. 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.

63. 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

64. 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.

65. 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 3);

(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 X
Summary Cost Benchmarks – Project Cost Per Lane Kilometer, By Road Reference Class

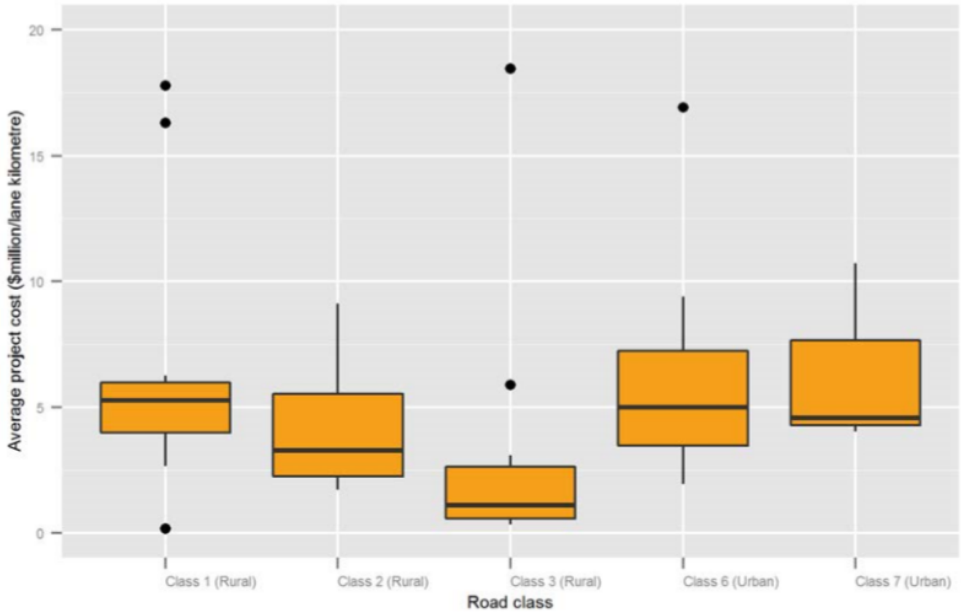
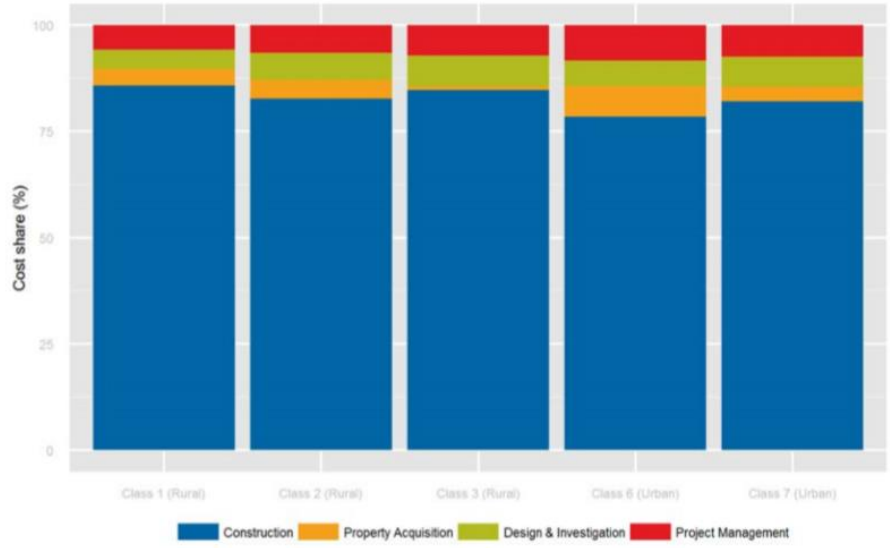


Table 3
Construction Cost Benchmarks, by Component and Road Reference Class

		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 XI
Average Project Costs Shares, By Road Class



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

66. 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.

67. 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.

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

68. 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.

69. 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

70. 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)

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

2. Average Works Costs per Km

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

73. 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

74. 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.

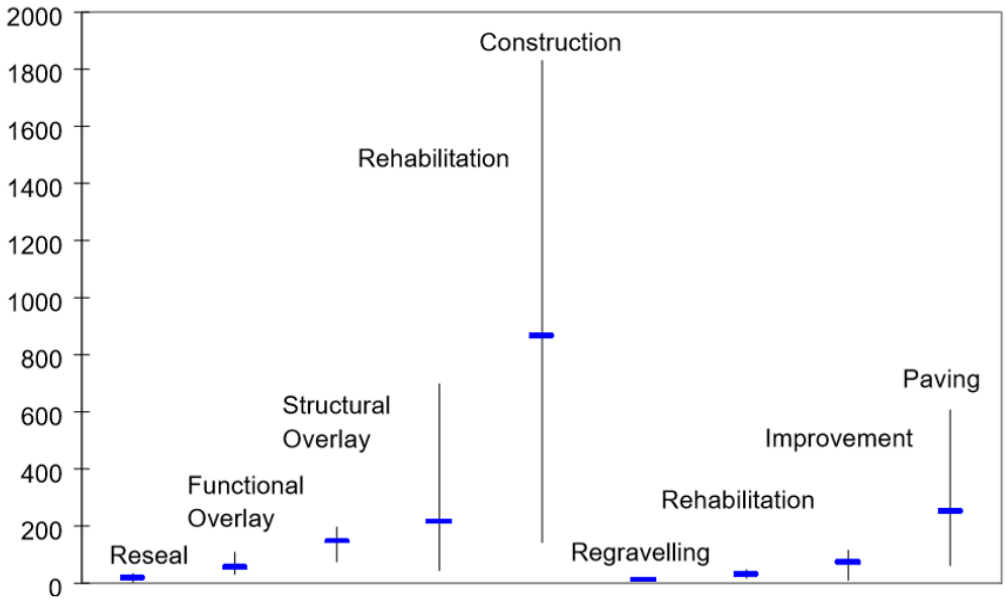
75. Unpaved Roads - Regravelling 9,000 - 13,000 $/km - Rehabilitation 17,000 - 47,000 $/km - Improvement 11,000 - 114,000 $/km - Paving 62,000 - 609,000 $/km.

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

76. 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.

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

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



IX. Advantages and Disadvantages of Benchmarking

A. Advantages of Benchmarking

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

79. Improves Learning Methodology: Benchmarking paves the way for idea generation and sharing of proven business practices which can be seen as a learning experience for the companies.

80. Initiates Technological Upgradation: Through this strategy, the companies get to know about the new technology and techniques which have been adopted by the market leaders. The companies can accordingly plan for up-gradation of its technology to sustain the competition.

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

82. 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.

83. Cope Up with Competition: Knowing about the competitors' business and their strategy, helps the company to design its strategies efficiently. It also facilitates the company to be updated with the recent developments and technology, hence beating the market competition.

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

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

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

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

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

89. Cost efficiency: Benchmarking provides organization with valuable data on the last technology, and processes followed in the business environment. 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 for five workers. This company might also adopt similar technology to lower its labour cost.

90. 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 standard and that of the industry is the largest. This helps organizations to prioritize the areas that they need to work on.

B. Disadvantages of Benchmarking

91. As we already know that benchmarking requires a lot of expertise and a vast collection of data. It, therefore, becomes difficult for some organization to execute its strategies in the desired manner.

92. 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.

93. Increases Dependency: The companies tend to depend on other companies' strategies to become successful. In this process of following the market leaders, they sacrifice their individuality and uniqueness and starts following the path shown by others.

94. Lack of Understanding: At times, companies adopt benchmarking for the sake of doing so, rather than finding out the necessity of it. It fails to understand its weaknesses while keeping an eye on the functioning of its competitors.

95. Copying Others: Some organizations don't understand the actual purpose of this strategy and start copying their competitors in every aspect. This may even lead to a downfall of the business.

96. Incorrect Comparison: It demands a comparison between two or more companies belonging to the same industry and competes with each other. But sometimes, the companies make irrelevant comparison resulting in poor benchmarks.

97. Costly Affair: It requires a team of experienced personnel who have excellent analytical skills and expertise in the area. Thus, increasing the administrative expenses of the company. Even the implementation of the changes involves capital expenditure at times.

X. Conclusion

98. 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.

99. 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 to benchmark in order to stay relevant and gain a competitive edge.

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

101. 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. It is not stealing, to the contrary, it is an open, honest, legal study of another organization's business practices. Benchmarking is a continuous process that requires constant calibration.

102. Benchmarking is not just looking for a better way to do things, it looks for the best.

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