May 7th, 11:00 AM - 1:00 PM

An Assessment of the Decision Making Units' Efficiency in Service Systems (The Case of Cellular Telecom)

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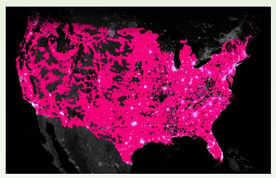
Abstract

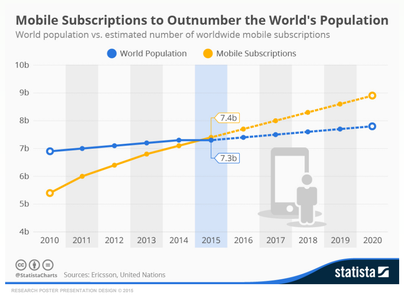
Most tools and models on performance and quality of service management are generic and do not solve the complex technical systems, which the most critical component on the network and where these tools should be applied. The objective of this research is to assess the cellular performance and Base Transceiver Station (BTS) efficiency by proposing a robust model that is derived from multiple Key Performance Indicators (KPIs) based on technical and financial aspects. The novelty of this research provides a comprehensive multidimensional model for tuning the BTS parameters, which can lead to developing a standard global mobile network KPI. The model measures the efficiency of BTSs and offers a reference set for inefficient BTSs. This creates guidelines for the network optimization engineers to improve inefficient BTSs by comparing their configurations with efficient BTSs to achieve a high level of network optimization. Thus, the analysis will help the decision makers focus on the right area and identify the most critical BTSs based on best practices.

Introduction

- Service science is the study of service systems, which creates a basis for systematic service innovation.
- The goal of service science is to increase the productivity and efficiency of the service industry and creates greater tools for assessing the value of investments in service systems.
- Customer satisfaction is directly related to performance and services quality
- It is very important to adopt a right tool to measure the productivity and efficiency of the new way of service delivery.



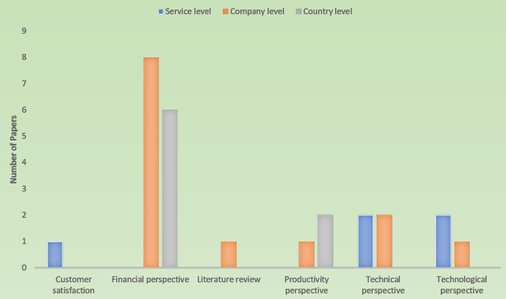
- Many daily life services are built on the availability and quality of telecommunication mobile service (Caylar and Ménard 2016; Wac et al. 2011).
- The mobile telecom industry has become one of the fastest growing sectors, and developing countries have been trying to keep up with the pace of these changes (Chavula 2013; Casey 2014).
- Mobile operators should adopt assessment of service quality approaches to respond to an increasingly competitive environment of customer satisfaction (Haider et al. 2009; Owusu and Duah 2018; Lee et al. 2001).



Literature Review

Prior BTS Research Focus Summary

Themes	Description	References
BTS Location	Position of the Mobile Base Station to study the performance evaluation of BTS	(Abasikeleş-Turgut 2016; Tohma et al. 2016 ; Mollanejad et al. 2010; Molina et al. 1999)
BTS Power Consumption	Address the power consumption of mobile radio networks to reduce the environmental impact	(Wu et al. 2015; Bianzino et al. 2012; Oh et al. 2011; Hasan et al. 2011; Zhang et al. 2010)
BTS Capacity	Evolution of cellular mobile communication networks to increase the capacity and to minimize the interference	(Karakayali et al. 2006; Everitt and Manfield 1989)
BTS Radiation	Focus on electromagnetic radiation and BTS efficiency analysis to ensure the human health and safety	(Singh and Gautam 2018; Buckus et al. 2017; Kim and Park 2010; Hutter et al)



Telecommunication Efficiency Research Summary Using DEA

Problem Statement

- Increased competition in the cellular telecom industry, which has brought a reduction in service cost
- The optimization and planning engineers are struggling to balance conflicting KPIs
- Challenge to make smart decisions on the BTSs and to deploy the efforts and adjustment to resources

Research Motivation

- Libya Cellular Competition Intensity Index was very low, at 34.3% in 2010 (Abbassi, 2011)
- Licensing a new foreign cellular operator is considered (Dabab, 2019)
- Research will have significant contributions and value in real life work implementation

Research Focus

- Identify the common KPIs to assess the BTSs and use them in a model of BTSs' assessment
- Determine the inefficient BTSs and provide recommendations to improve these BTSs
- Connect a real industry problem with technology management solutions

Research Gaps

- Most of the previous research was focused on individual factors in the BTS efficiency field
- There is a lack of robust tools in the telecom mobile industry for prioritizing the efficiency of BTSs
- Evaluating the cellular network performance is a complex process

Research Goal

- To develop a comprehensive model for:
  - BTS efficiency assessment based on best practices
  - Identifying the reference set of inefficient BTSs

Research Questions

- Which BTSs have potential improvements to create a better performance for:
  - Enhancing the network performance?
  - Increasing profit?
- What are the most important factors that are used to evaluate BTS efficiency?

Research Methodology

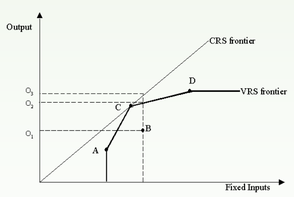
Data Envelopment Analysis is a nonparametric method that measures the efficiency of a series of Decision-Making Units (DMUs) using linear programming models (Charnes, Cooper, and Rhodes 1978).

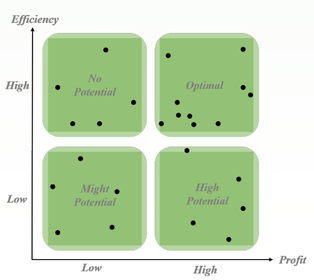
The BCG matrix was introduced in the late 1960s as a growth-share matrix to help corporations to analyze their business units, and then in the late 1970s and early 1980s was widely known and used by companies to decide which markets and business units to invest.

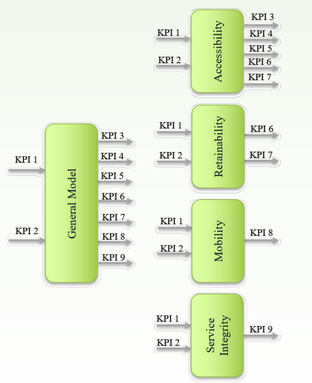
The performance matrix is adopted as a secondary step to present this decomposition graphically, which shows both efficiency and profit as an ellipse for each DMUs.

To provide a more complete recommendation, regression analysis is integrated as a third step in the model to:

- Explore the impact of the variables (inputs and outputs) which helps to clarify the driver KPIs in the model.
- Process data and determine the effectiveness of the BTS's parameters and setting based on its efficacy.

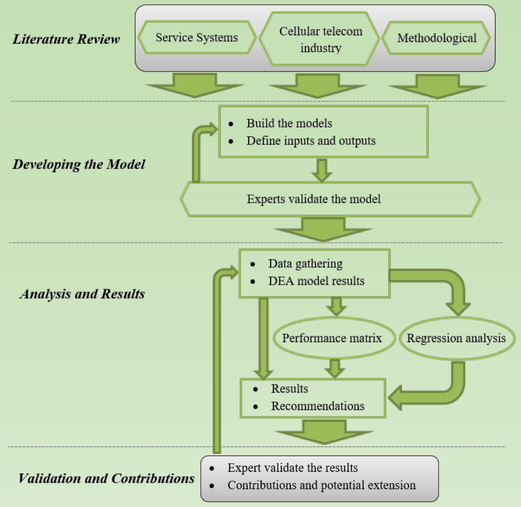






Inputs KPIs		*Outputs KPIs*	
KPI 1	TCH Time slots	**KPI 3**	Traffic (Erlang)
		KPI 4	SDCCH Traffic (Erlang)
		KPI 5	Random Access Success
		KPI 6	TCH Success
KPI 2	SDCCH Time slots	**KPI 7**	SDCCH Success
		KPI 8	Handover Success
		KPI 9	Speech Good Quality

Research Design



Research Contribution

- Create a better understanding of the dynamics surrounding mobile telecom infrastructure decision making in general and mobile base stations in particular.
- Suggest enhancements to increase cellular network efficiency by determining the inefficient BTSs based on related best practices BTSs.
- Provide guidance for the network optimization engineers who can improve the inefficient BTSs by comparing the configuration with peers to achieve a high level of network optimization.
- Assists decision makers to differentiate between the quality of equipment and vendors by defining BTS productivity and efficiency.
- Lead to developing an initial standard mobile network KPI that indicates a comprehensive BTS efficiency.

Conclusion and Future Work

- Due to the increase in competition, the importance of quality of service and performance evaluation to improve the provider's customer satisfaction should be taken into consideration more than ever.
- Mobile providers measure the BTS efficiency through a variety of KPIs, but the optimization and planning engineers are struggling to balance conflicting KPIs, to assess the priority of the BTS.
- The nature of the problem in this research requires a method that considers a variety of factors, and builds the evaluating model using multiple inputs and multiple outputs. Therefore, DEA is employed as the methodology because it meets this purpose and can be used to generate a composite of efficiency, productivity, performance, and benchmarking measures.
- This research aims to address how to improve the productivity and efficiency of the units in a chain and develop a decision model to enable better decision making within the operation stage by learning best practices from efficient units, and identifying the reference set to improve the efficiency of inefficient units.
- Real implementation in a real case of inefficient BTSs based on research results.
- Adopting weight restrictions for inputs and outputs to refine priorities.