

## Cost, Time, And Quality factors: A case Study of The Rivers monorail Construction Project

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**Abstract:** Over time, several parameters have been employed to measure the success/failure of construction projects. However, the most common factors employed are Cost, Time and Quality. This research is a case study of the Rivers Monorail Construction Project. It gives a detailed overview of the project, and outlines its challenges and opportunities regarding Cost, Time, and Quality. Questionnaires were distributed to selected stakeholders of the project, and it was found that 10% believe that the project's failure was as a result of political reasons; 5% believe the failure was as a result of social/community reasons; 10% believe the failure was the contractor's fault; while 75% believe that the project failed because of the lack of funding from the client and present economic issues. The cost of the project, became unbearable, bringing about a major failure in the delivery period (time). Some argue that the purpose, coverage areas, route, and scope were not worth the cost of one of the first Monorail construction projects in Africa. However, the study also shows that high quality was maintained during the execution of the project. The two most important factors that brought about the failure of the project were Cost and Time (duration), while the Quality was an advantage and would have brought about success if not for its minor effect on the project, given the prevailing circumstances.

**Keywords:** Cost, Time, Quality, Rivers Monorail, Iron Project Triangle, success/failure of construction projects, Rivers State.

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### I. Background

The Rivers Monorail project is one of the first monorail construction projects ever embarked upon in Africa (Konkwo, 2014). The 6.5Km monorail project was initiated by the Rivers State Government in Nigeria, through the Rivers State Ministry of Transport in July 2010. The then Governor of the State described the project as a vision for the future, and also said it was initiated to be completed in 2015. When completed, the project would ease the highly congested traffic situation in the state capital city of Port Harcourt (Utang and Peterside, 2011). However, in addition to decongesting the high traffic volume on the highways of Port Harcourt and its environs, authors such as Konkwo (2014) maintained that the Rivers Monorail would also attract tourism to Port Harcourt metropolis. The ₦150 Billion mega project (Konkwo, 2014) was awarded to Megastar Technical and Construction Company (MTCC), Mercury Engineering and Construction (MEC), and Intamin, while Arcus Gibb was appointed as the Technical Partner/Client's Representative. It was to be funded through a Public-Private Partnership (PPP), but was finally funded solely by the Rivers State Government. However, the project has attracted lots of criticism as many have argued that it is of no economic benefit, as only 2.6Km of the total length is currently being embarked upon through an insignificant route, and has been highly over-priced. The route (rail track) is connected with three stations (UTC, Azikiwe, and Sharks Park), and terminates at a "Depot station" where maintenance of the coaches would be regularly carried out. This means that the project is a portfolio with five sub-projects (four stations and a rail track or linear works).



Figure 1: Map of Rivers State (Nigerian Muse, 2010)

Port Harcourt being the capital city of Rivers State is made of two, out of the twenty-three Local Government Areas (LGA): Port Harcourt City LGA and Obio/Akpor LGA. Port Harcourt City LGA is the most populated LGA in Rivers State with a population of about 606,512 persons, followed by Obio/Akpor LGA with a population of about 520,378 persons (Otto and Ukpere, 2014; National Population Commission, 2010). This means the capital city has a total of about 1,126,890. In fig. 1 above, it is also clear that there are other LGAs bordering Port Harcourt. This means a large number of persons residing and working within these LGAs have the tendency of travelling to and from Port Harcourt on a daily, weekly, or monthly basis, but not accounted for in this study. According to Konkwo, (2014) however, about 40,000 passengers are estimated to be conveyed weekly with six seventy-seat capacity coaches.

#### Tracking the Project's Performance using Cost, Time and Quality indices:

Performance is usually of key interest to all stakeholders of a project. It determines whether a project will succeed or fail. Several authors have described the success or failure of construction projects with various performance factors. Some, such as Wright (1997) and Guo-li (2010) described it with budget and time. Ugwu, et. al. (2005) described it with durability and life-cycle cost, while others such as Razaket. al. (2009) described it with time and client satisfaction. However, most authors, (Shankah et. al., 2011) especially those in (Atkinson, 1999) described it with cost, time and quality. These (cost, time and quality) have turned out to be the most widely used factors for determination or measurement of performance in a construction project. The combination of cost, time and quality factors have been referred to as the Iron Project Triangle (Atkinson, 1999). However, when any of these factors does not fulfill the original limits of the project, it is generally believed that the project has not achieved total success or may have failed. Such project failures according to Guo-li (2010) mostly arise from cost and time overruns which could have resulted from many un-foreseen circumstances. In Nigeria for instance, (Ayodele and Alabi, 2014) most government construction projects are not completed at the agreed time and costs but at considerably good quality, which are as a result of variations and poor cost control techniques. Ugwu, et. al. (2005) also emphasized that durability with respect to construction

materials, construction methods, quality of construction, environmental exposure, and maintenance accessibility could also be key circumstances affecting the success or failure of a construction project. There have been tools and techniques such as Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT), Net Present Value (NPV), and Monte Carlo simulation, which are traditionally used to monitor and control cost, time, and quality of construction projects. In addition, several researchers have tried to further develop techniques to monitor and control the cost, time, and quality of construction projects. For instance Shankahet. al., (2011) developed a mathematical model to solve the problem of time, cost and quality trade-offs, assuming various renewable and non-renewable resource allocations. Ugwu, et. al. (2005) have done extensive work to develop several models and workflows to address quality and life-cycle costs on construction projects; while Issa and Eid (2013) have developed an optimization model which is based on generic algorithm to achieve minimum cost at various times and quality levels. El-kholy (2013) also applied PERT to develop a linear programming model to solve the problem of time-cost trade-off. In addition, Lambropoulos (2007) has also developed a mathematical model using a cost and time utility curve to determine the most economical tenders for the award of construction projects. However, Atkinson (1999), with his research has recommended a paradigm shift from the regular Iron Project Triangle to his developed square route approach given that the traditional Iron Triangle has really not been so successful. His square route method links the Iron Triangle with Information System, Organisational benefits, and Stakeholder community benefits.

## II. Methods

The research is targeted at a considerably small group of professionals working on the Rivers Monorail construction project. However, the research being a case study is predetermined on achieving factual statistics first hand from stakeholders of the project on the construction level, compared to previously established facts. Based on that, 31 questionnaires were distributed to top professionals from each of the companies working on the project sites. Closed-ended questions were asked the professionals relating to their perceived factors affecting the success or failure of the project, with emphasis on Cost, Time and Quality. The professionals were randomly sampled from the following stakeholders with their organisational descriptions with respect to the project: Rivers State Ministry of Transport -Client Amyforte Limited-Consultant (Project Management) Etteh Aro & Partners -Consultant (Civil/Structural Engineering) J.I. Sodiki & Associates-Consultant (Mechanical/Electrical Engineering) Megastar Technical & Constr. Co.-Contractor Mercury Engineering & Construction-Contractor Alcon Engineering-Sub-Contractor.

## III. Results and findings

Out of the 31 questionnaires distributed, 20 of them were completed and returned. The Statistical Package for Social Research (SPSS v16) was the software used in the statistical data processing and results generation. Figures 2 and 3 show the project stakeholders and respondents' designations respectively.

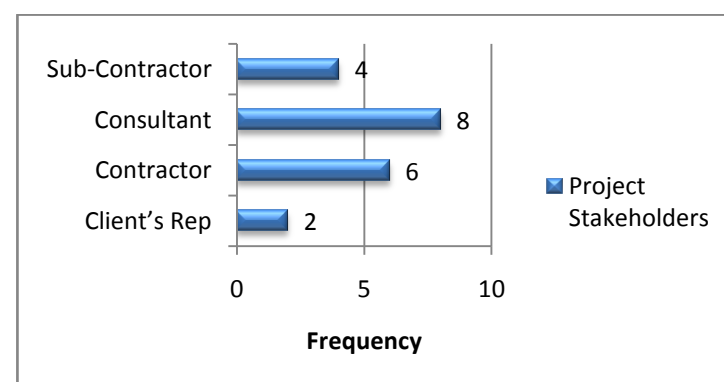


Figure 2

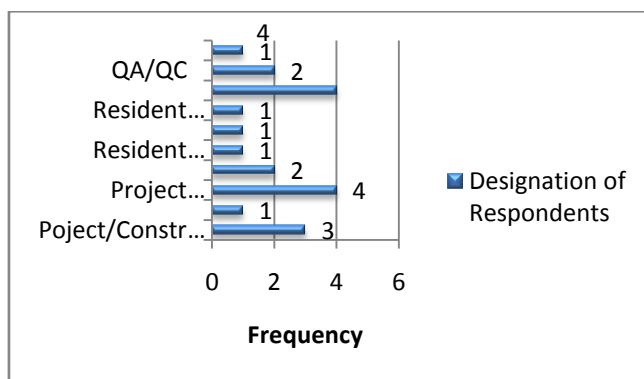


Figure3

The respondents also gave their perceived factors that have affected the success or failure of the project and reasons in Figures4 and 5 respectively.

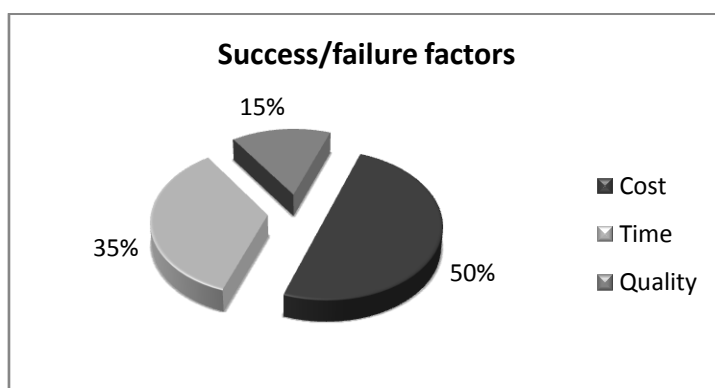


Figure4

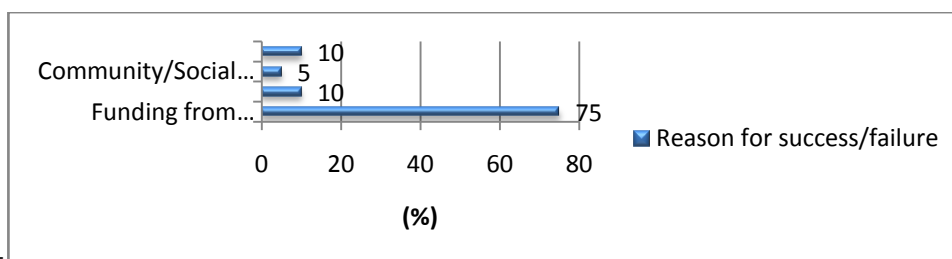


Figure5

Table 1 below shows the respondents' perceptions on the effects of cost, time, and quality on the project, while Figure 6 represents this information.

Table 1: Respondents' perceptions

	cost		time		quality	
	Count	Percentage	Count	Percentage	Count	Percentage
Positively	5	25%	6	30%	12	60%
Neither positively nor negatively	1	5%	6	30%	3	15%
Negatively	14	70%	8	40%	5	25%
Total	20	100%	20	100%	20	100%

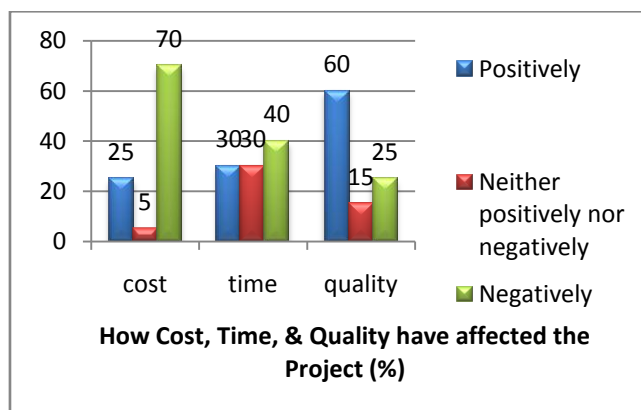


Figure 6: Respondents' perception

Table 2: Descriptive Statistics

	Mean	Std. Deviation	N
How has "COST" affected the performance of the project	2.4500	.88704	20
How has "TIME" affected the performance of the project	2.1000	.85224	20
How has "QUALITY" affected the performance of the project	1.6500	.87509	20

Table 3: Correlations

			How has "COST" affected the performance of the project	How has "TIME" affected the performance of the project	How has "QUALITY" affected the performance of the project
Spearman's rho	How has "COST" affected the performance of the project	Correlation Coefficient	1.000	-.299	-.705**
		Sig. (2-tailed)	.	.200	.001
		N	20	20	20
	How has "TIME" affected the performance of the project	Correlation Coefficient	-.299	1.000	.183
		Sig. (2-tailed)	.200	.	.441
		N	20	20	20
	How has "QUALITY" affected the performance of the project	Correlation Coefficient	-.705**	.183	1.000
		Sig. (2-tailed)	.001	.441	.
		N	20	20	20

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Out of the 20 respondents, 10 (50%) believed that the major failure of the project was in the aspect of the cost, while 7 (35%) and 3 (15%) believed it was in the aspect of the time and quality respectively (fig 4). Majority (75%) of them gave the reason for the failure as "funding from client/economic issues" while the minority (5%) said the reason was because of "community/social issues". However, 10% of the respondents believe that "political issues" is the cause of the failure, while the remaining 10% believe the project failure was caused by the contractors (see fig 5). In table 1 which was also represented in fig 6, 14 (70%) of the respondents believe that the cost of the project affected the project performance negatively. However, 12 (60%) said the quality of work affected the project performance positively, while 8 (40%) said the time (duration) affected the project performance negatively. A two-tail Spearman correlation test was carried out on the statistical data and it is found that the most significant at the 0.01 level for the COST against the QUALITY of work, which implies that the impact of the failure of performance on the project is mostly due to the cost.

#### IV. Conclusion

From the findings of the research, it is evident that the project was not completed at the stipulated time. In addition, it has gulped a huge cost but with a high quality, as there are numerous consultancy firms supervising the Civil/Structural, Mechanical & Electrical, Surveying, and Project Management aspects. This is an indication that the performance from the quality point of view is successful, whereas those from the cost and time points of view have been unsuccessful. It has also been found from this study that the cost has hugely affected the project negatively mostly as a result of inadequate funding from the client and inherent economic issues. It has also been found that the time has negatively affected the project as it failed its targeted completion date. However, the study also shows that the project maintained a high quality, as this has affected the project positively. According to Atkinson (1999), cost and time are factors that can be calculated even before the commencement of the project, whereas quality is a phenomenon that is determined by the attitudes and inputs of the individuals working on the project, throughout the project life-cycle. This case study research is aimed at contributing to knowledge in the areas of cost, time, and quality as performance control indices in the construction industry using the Rivers Monorail construction project. It also avails present and future researchers some basic facts and figures that might enhance their studies as well as contribute to future development of similar projects or same project from the lessons learnt.

#### References

- [1] Atkinson, R. (1999), "Project Management: Cost, time and quality, two best guesses and a phenomenon, a time to accept other success criteria", *International Journal of project Management*, Vol. 17, No. 6, pp. 337-342.
- [2] Ayodele, E. O. and Alabi, M. O. (2014), "Effect of cost control on Building Projects Delivery in Nigeria", *Civil and Environmental Research*, Vol. 6, No. 2, pp. 76-79.
- [3] El-kholy, A. M. (2013), "Time-Cost Tradeoff analysis Considering Funding Variability and Time Uncertainty", *Alexandria Engineering Journal*, Vol. 52, No. 1, pp. 113-121.
- [4] Guo-li, Y. (2010), "Project Time and Budget Monitor and Control", *Management Science and Engineering*, Vol. 4, No. 1, pp. 56-62.
- [5] Issa, U. H. and Eid, M. A. (2013), "An Application of Genetic Algorithms to Time-Cost-Quality Trade-off in Construction Industry", *Civil and Environmental Research*, Vol. 3, No. 12, pp. 11-19.
- [6] Konkwo, C. (2014), "SON Spots Danger on Amaechi's Monorail – Says it's a Death trap", *National Network Newspaper*, Jul 16-22, Vol. 11, No. 27, Available from: <http://www.nationalnetworkonline.com/vol11n27/deathtrap.html> [Accessed: March 24, 2015].
- [7] Lambropoulos, S. (2007), "Project management: The use of time and cost utility for construction contract award under European Union Legislation", *Building and Environment*, Vol. 42, No. 1, pp. 452-463.
- [8] National Population Commission (2010), *Various Years Report*, NPC, Abuja.
- [9] Nigerian Muse (2010), *Maps of Various States and their Local Governments in Nigeria*. Available from: <http://www.nigerianmuse.com/20100527092749zg/sections/pictures-maps-cartoons/maps-of-various-states-and-their-local-governments-in-nigeria/> [Accessed: March 24, 2015].
- [10] Otto, G. and Ukpere, W. I. (2014), "Democracy and Development in Rivers State of Nigeria", *Mediterranean Journal of Social Sciences*, Vol. 5, No. 1, pp. 243-248.
- [11] Razak, A. A., Jaafar, M. A., Abdullah, S., and Muhammad, S. (2009), "Work Environment Factors and Job Performance: The Construction Project Manager's Perspective", *International Conference on Construction Industry*, July 30 – August 1, Padang, Indonesia.
- [12] Shankar, N. R., Raju, M. M. K., Srikanth, G. and Bindu, P. H. (2011), "Time, Cost and Quality Trade-off Analysis in Construction Projects", *Contemporary Engineering Science*, Vol. 4, No. 6, pp. 289-299.
- [13] Ugwu, O. O., Kumaraswamy, M. M., Kung, F. and Ng, S. T. (2005), "Object-Oriented framework for durability assessment and life-cycle costing of Highway Bridges", *Automation in Construction*, Vol. 14, No. 1, pp. 611-632.
- [14] Utang, P. B. and Peterside, K. S. (2011), "Spacio-Temporal Variations in urban vehicular emission in Port Harcourt City, Nigeria", *Ethiopian Journal of Environmental Studies and Management*, Vol. 4, No. 2, pp. 38-51.
- [15] Wright, J. N. (1997), "Time and Budget: The twin imperatives of a Project Sponsor", *International Journal of project Management*, Vol. 15, No. 3, pp. 181-186.

oba, K.M "Cost, Time, And Quality factors: A case Study of The Rivers monorail Construction Project." IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) , vol. 15, no. 1, 2018, pp. 12-17.