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Developing KPI for organizations with similar objective

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Abstract— It is a difficult task to attempt developing generic Key Performance Indicators for all the functions of Facilities Management services in all organization it serves. Nevertheless, the exercise is possible for organizations with similar objectives. For example, the objectives of Higher Education institutions revolve around teaching, learning and research that require functional infrastructure, technology and services. The client, end-users and service providers in these organizations can develop acceptable indicators for their operation of the support facilities and that will facilitate the creation of an effective benchmark. The modified classic Delphi technique was used in achieving the consensus of opinion from the participants. The findings revealed that there were convergence of opinion on the essential indicators that can enhance the provision, operation and management of the required support facilities for the effective performance of the core functions of Higher Education institutions. It was recommended that the research should be extended to cover all Higher Education institutions within and across regions for more comprehensive information

Keywords— Benchmark; Delphi technique; Facilities Management; Functional infrastructure; Higher Education institution; Key Performance Indicators

I. INTRODUCTION

Key Performance Indicators (KPIs) are specific standards of performance measures, significant and measurable, set by organizations or inter-relating organs of an organization. These specific indicators are sensitive to each institution depending on the effect the support facilities have on the performance of the core functions of the organization. Due to the uniqueness of each organization and the need to create a niche for competitive advantage, operational KPIs varies from one organization to the other. However, organizations with identical objectives can develop generic KPIs around which individual members can select and adapt to suit their operation. These generic KPIs provides suitable platform for effective benchmarking [1]. In the education industry, the three levels of primary, secondary and tertiary (commonly referred to as Higher Education (HE) institutions), have set objectives common to each level. Thus, the objectives of the HE institutions revolve around teaching, learning and research. Administrators of these institutions invest significant resources on the development, operation and maintenance of the support facilities to enhance the performance of the core function, achieve the strategic objectives of the institution and earn the competitive advantage within the industry. Therefore, stakeholders within this level of the industry can craft suitable KPIs for the measurement of the performance of the organ that provides the support facilities. This paper reports on a pilot effort aimed at developing KPIs for the operation of FM units in HE institution in South Africa. It is part of a larger research for a Doctorate degree in Engineering Management, in the University of Johannesburg, South Africa.

II Literature review

Literature review provides broad based but structured information, allowing the researcher to harness existing information, models and methodologies to support new endeavors. The literature reviewed here provides general information on the development of Key Performance Indicators (KPIs) and the essence of the active participation of relevant stake holders.

A. Performance assessment tools

The Balance Scorecard (BSC) has been judged to be one of the most popular performance measuring and management tool but rated second best to Key Performance Indicators (KPIs) in FM operations [2]. At the operational level, one of the four components of the BSC, “Customer Perspective”, and its accompanying question “How do customer see us?” [3, p. 72] is appropriate to measure the level of customers’ satisfaction in the provision, operation and management of support facilities. This has become useful because, customer concerns generally “fall into four categories: time, quality, performance and service, and cost [3, p. 73]. This Customer Perspective of the BSC requires a delicate balance of how the functions of FM are to create value for the customer and how the customer demands for this value to be satisfied. However, the complexities of

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data collection and management; translating general concept to concrete action has reduced the use of the BSC as performance measuring model in FM in preference for KPIs [4].

B. Key Performance Indicators as performance measurement tool

The term Key Performance Indicators (KPIs); "represents a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization" [5, p. 3]. They are specific standards of performance measures, significant and measurable, set by organizations or inter-relating organs of an organization. These specific indicators are sensitive to each institution depending on the effect the support facilities have on the performance of the core functions of the organization. One of the key significance of KPI is that the resulting set of interlocking indicators provides feedback that stares the individuals, groups and the entire organization directing the behavior of all towards a common goal [6]. These indicators (matrix) must be simple, realistic, and practical aimed to drive changes that will enable the achievement of the set goals; starting with few indicators and building on them [6]. The operational KPIs for any organization can be developed and handed down to the service provider to adopt or they are mutually developed by the customers and the services providers

i. Handed down Key Performance Indicators (KPIs)

The developed or handed down KPIs are list of measuring standards created by an organization as mold into which any service providers or operators relating with that organization should adopt. For example, in the early 1980s, a senior officer of the British Airways (BA) desired to make significant change in its operation so that each air plane will land and take off on schedule, within a "certain threshold" [5, p. 4]. The application of this KPI meant that the official was informed, wherever he is in the world, when a BA plane did not keep to its schedule within the allowed threshold. Immediately, the BA manager of the relevant airport will receive a personal phone call from the senior officer [5]. The short term benefit of implementing this KPI was that "BA planes had the reputation for leaving on time [5, p. 4]. Though the success stories of the BA organizations may have been exciting on the short term, there are no recorded evidence of the long term benefit. However, the research efforts of reference [6] revealed that there are productivity decline when using KPIs developed without the input from appropriate stakeholders.

ii. Mutually developed Key Performance Indicators (KPIs)

Reference [8] demonstrates the use of this concept and produced acceptable set of KPIs that were mutually agreed on by the costumer and the service provider. The focus of their exercise was to marry FM performance priorities with the customers' priorities and perception in order to "clarify and priorities the parameters (indicators) which correlated the views of the customer and the premises (FM) department" [8, p. 32] The exercise involved a team selected from both the customer and the FM leadership who examined a list of 172 related industry-wide KPIs that were successively and mutually iterated to 23 indicators [8, p. 36]. The resulting 23 KPIs were classified into suitable categories, for ease of operation and measurement. The categories are: "Business benefit, Equipment, Space, Environment, Change management, Maintenance/services and General" [8, p. 39]. These KPIs enabled the FM operators to execute their functions to the satisfaction of their customers.

Outside of the built environment industry, the concept of mutual development of KPIs has been experimented with successful results. The Charite University of Medicine Berlin, constituted a steering committee, to sieve a wide range of 'evidence-based Key Performance Indicators' to develop "a small set of practical key performance indicators that are related to the process of delivering intensive care medicine and to validate these indicators in terms of mortality rates and length of stay in ICU" [9, p.1268]. The committee members include the departmental head, representative of senior staff from the department, the doctors and nurses. Their responsibility was to sieve through a set of 11, 18 and 120 KPIs to identify the most relevant for clinical measures in the management of ICU that will reduce the patient's length of stay and mortality. Through the process of successive iteration, the committee identified six KPIs, namely: "measurement of sedation; pain; MAP; blood glucose level; and limitations of TV and PIP" [9, p.1282]. Since all the units connected with the operation and services in the ICU were involved in the selection of the KPIs, as against the idea of a 'handed down' script, all actors in the ICU operation accepted the KPIs and worked with them; the result was in the affirmative [8].

The lists of KPIs required by any organization are dynamic and elastic depending on the goals of the main or sub-organ of the organization. However, there is yet no comprehensive list of KPIs suitable for FM operation under the different organization and functions, but generic and functional KPIs can be developed for organizations with similar objectives by adopting the principle of inclusive participation of the relevant stakeholders; which is the focus of this paper.

III. RESEARCH METHOD

The objective of this research was to explore the possibility of developing acceptable set of KPIs for use by organization with similar objectives. In the education industry, the objectives of Higher Education (HE) institutions are similar and revolve around 'teaching, learning and research'. A pilot study was conducted in one HE institution and compared the results with the input from four other HE institutions within the same geographical zone. The data were collected using the 'modified classic' Delphi technique, which provided the generic list of items (KPIs) that were sent to participants to interact with and to select the set of suitable KPIs by following stipulated guidelines.

The Delphi technique can be described as "a method used to obtain the most reliable consensus of opinion of a group of experts by a series of intensive questionnaires interspersed with controlled feedbacks" [10, p. 1696]. The basic principles underpinning the Delphi technique include the identification and use of cognate experts or participants capable of addressing the issues raised in the research question [11]; the contribution of each member of the panel is treated in confidence and no participant will be traceable to its contribution; the group interacts with the issue at stake through a series of iteration of processes, where the information on previous iterations is communicated to all participants to see [11]; all submissions are processed through a central coordinator or facilitator, who recycles the feedback to participants after each iteration. The size of a Delphi panel may be as small as three members and as large as 80 [12], and reference [13] suggests between 8 and 16 participants. The method of selecting the participants follows closely to the 'purposive or criterion sampling' rather than random sampling [14], because the participants are selected for a purpose, to apply their knowledge or expertise to a certain problem situated within the confine of the area to be investigated. Adopting appropriate prequalification criteria for the selection of participants allows the coordinator to harness individuals with substantive knowledge in the area being investigated, commonly known as 'panel of informed individuals' [14, 15]. Concerted efforts should be made to manage the effects of high attrition rates by recruiting large number of participants at the initial phase, exceeding the set mark for 'preferred group size' [16]. These principles were adopted in selecting participants for this exercise.

IV. FINDINGS AND DISCUSSION

The list of KPIs was developed in the pilot institution, following the rule that only items that score 3 and above will be escalated to the next round of the exercise. The participants from other institutions were to rate the circulated list between 3 and 5 in order to compare results. The generic list of KPIs was circulated to participants, adopting the stated criteria, the response was collated and consensus achieved by adopting the statistical mean. The process of developing the generic list is demonstrated in Tables 1 and 2. The outcome in the capital development process is shown in Table 1. In the first round, the "Capital Development: Process" had ten items. This was reduced to six in round 2. The items highlighted in red were the items that did not meet the benchmark of 3, and were deleted in subsequent rounds. The six items progressed to the third round. Although the six items in round two were retained in the third round, the score obviously suggests a rearrangement of some of the items, indicating the order of priority, as shown in the priority listing in Table 2.

Table 1 List of KPIs for the three rounds

S/No	Description	Score		
	Capital development: Process	**Round 1**	**Round 2**	**Round 3**
1	Effective representation of project briefing into developed asset	3.33	3.42	3.57
2	Reduced dispute and litigation	2.33		
3	Incorporate end-users into project execution team	3.4	3.48	3.71
4	Conduct end-users' orientation into new facilities	3.27	3.50	3.64
5	The new facility should increase the positive reputation of end-users	3.53	3.60	4.21
6	Produce effective 'as-built' documents of the completed facility on handover	2.8		
7	Prompt correction of faults	3.60	3.78	4.29
8	Enhance new technological capability	3.0	3.35	3.64
9	Contributing to the effectiveness of other projects of end-users	2.73		
10	Functional in operation to reduce dependence on outside source	2.60		

Table 2 List of KPIs – Priority listing

S/N	Category	Description	Score
	Capital development		
1	**a. Process**	Prompt correction of faults	4.29
2		The new facility should increase the positive reputation of end-users	4.21
3		Incorporate end-users into project execution team	3.71
4		Conduct end-users' orientation into new facilities	3.64
5		Enhance new technological capability	3.64
6		Effective representation of project briefing into developed asset	3.57

The principles described in tables 1 and 2 above was used to develop the generic KPIs in the pilot institution; they were arranged around the seven main and eight sub-divisions. Tables 3 below, is used as illustrations to show the comparison of result from other HE institutions, in the capital development process and result only. The results in other divisions are identical.

A. Comparative analysis from other institution

From table 3, the result indicates comparative closeness in the information from all HE institutions; evidence that it is possible to develop suitable KPIs for industries with similar objectives. One salient observation is what may be regarded as project success factors in the HE industry. The consensus opinion evident from this exercise clearly shows that critical project success factors (in capital development results) exceed the 'iron triangle' of 'cost, quality and time' [16] to include that capital developments should satisfy defined technical specifications, fit for purpose, economical in running, support teaching and research, flexible and adaptable to the changing needs of the end-user. To achieve these objectives require the use of the concept of flexible design and phase development. The principle allows for the development of facilities that are adaptable, convertible and expandable, with relative ease and minimum disruption, to effectively support the core function of the client any time within the life cycle of the facility [17, 18].

Table 3 Capital development: Process and results Comparison of results with similar HE institutions

S/No	Description	Score	
		Pilot institution	**Others**
A	**Capital Development : a. Process**		
1	Prompt correction of faults	4.29	4.5
2	The new facility should increase the positive reputation of end-users	4.21	4.5
3	Incorporate end-users into project execution team	3.71	4.75
4	Conduct end-users' orientation into new facilities	3.64	4.5
5	Enhance new technological capability	3.64	4.5
6	Effective representation of project briefing into developed asset	3.57	4.25
	Capital Development : b. Results		
7	Meet technical specifications	4.64	4.75
8	Completed asset 'fit for purpose' of end-users	4.50	4.5
9	Complete project to desired quality	4.43	4.5
10	Complete project within budget	4.29	4.5
11	Complete project on time	4.21	4.5
12	Economic in running and maintenance cost	4.14	4.25
13	State of the art to support teaching and research	3.93	3.5
14	Flexible and suitable working space	3.79	4.0
15	Adaptable to modern teaching methodologies	3.71	4.25

V. CONCLUSION

The functions of FM unit within and across different organization are diverse, making it difficult to develop generic KPIs for its operation to ensure customer satisfaction. However, it is possible to develop functional KPIs for FM operations in organizations with similar objectives. FM in HE institutions performs identical functions aimed at providing adequate and functional support facilities that can enhance the performance of the core functions of the institution and achieve its strategic goals. As demonstrated in this research, the objectives of HE institutions revolve around teaching, learning and research which requires suitable academic environment [20, 21, 22, 23]. The response of the client (strategic leaders), end-users (tactical leaders) and service providers (FM unit) in the pilot institution compares favorably with the information gathered from FM operators from other HE institutions. Furthermore, operating with identical set of KPIs within same industry allows for effective benchmarking of operations for improvements [1].

This research report focused on few HE institutions, the result will be more refined if larger number of institution participates in the exercise. Instead of the adopting the 'modified' classic Delphi, they should use the 'classic' Delphi, where the participants will identify the functions performed by the different FM unit in their institution and then generate the suitable KPIs themselves in the first round of the exercise. These KPIs are then circulated to all participants for interaction. At the end of the exercise, the resulting KPIs will be useful for benchmarking exercises among the cooperating institutions

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REFERENCES

[1] Loosemore, M and Hsin, Y.Y. (2001), Customer-focused benchmarking for facilities management, *Facilities*, *19*,464-476. Available Online from: http://www.emeraldinsight.com/journals.htm?articleid=844312&show.html. Accessed 20/08/2010.

[2] Meng, X and Minogue, M (2011), Performance measurement models in facility management: a comparative study, *Facilities*, Vol. 29, pp. 472-484.

[3] Kaplan, R.S. and Norton, D.P. (1992), The balance scorecard-Measures that drive performance. *Harvard Business Review*. Jan- Feb, 71-79.

[4] Paranjape, B, Rossiter, M and Pantano, V. (2006), Insight from the Balance Scorecard performance measurement systems: successes, failures and future- a review, *Measuring Business Excellence*, *Vol.* 10, pp. 4-14.

[5] Parmenter, D (2007), *Key Performance Indicators: Developing, implementing, and using winning KPIs*. Hoboken, New Jersey: John Wiley and sons. Inc.

[6] McNeeney, Anthony, (2005), Selecting the right key performance indicators, *Meridium*, Friday 01 April, 2005. Available online from: www.mt-online.com:80/articles/0405meridium.cfm. Accessed, 18-08-10

[7] Beatham, S., Anumba, C and Thorpe, T. (2004), KPIs: a critical appraisal of their use in construction". *Benchmarking: An International Journal*, Vol. 11, pp. 93-117.

[8] Hinks, J. and McNay, P. (1999), The creation of a management-by-variance tool for facilities management performance assessment, *Facilities*, *Vol.* 17, pp. 31-53.

[9] Kastrup, M, Dossow, VV, Seeling, M, Ahlborn, R, Tamarkin, A, Conroy, P, Boemke, W, Wernecke, K-D and Spies, C. (2009), Key Performance Indicators in intensive care medicine: A retrospective matched cohort study, *The Journal of International Medical Research*, Vol. 23, pp. 1267- 1284.

[10] Hasson F and Keeney S (2011), Enhancing rigour in the Delphi technique research, *Technological Forecasting & Social Change*, Vol. 78, pp. 1695-1704.

[11] Karthy, K. Franklin, J. and Hart, K. (2007), Idea generation and exploration: Benefits and limitations of the Policy Delphi research method. *Innov High Educ*, Vol. 31, pp. 237-246.
[12] Mullen PM (2003). Delphi: myths and reality, *Journal of Health Organization and Management*, Vol. 17**,** pp. 37-52
[13] Hallowell M.R and Gambatese J.A (2010), Qualitative research: Application of the Delphi method to CEM research. *Journal of Construction Engineering and Management*, Vol. 136, pp. 1-9.
[14] Hasson F, Keeney S and McKenna H (2000), Research guidelines for the Delphi survey, *Journal of Advance Nursing*, Vol. 32, pp. 1008-1015.
[15] Day J and Bobeva M (2005), A generis toolkit for the successful management of Delphi studies, *The Electronic Journal of Business Research Methodology*, Vol. 3, pp. 103-116.
[**16**] Donohoe HM and Needham RD (2009), Moving best practice forward: Delphi characteristics, advantages, potential problems, and solutions, *International Journal of Tourism Research*, Vol. 11, pp. 415-437

[17] Toor, Shamas-ur-Reman and Ogunlana SO (2010), Beyond the 'iron triangle': Stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects, *International Journal of Project Management*, Vol. 28, pp. 228-236.
[18] Hansen GK and Olsson NOE (2011), Layered project-layered process: Lean thinking and flexible solution, *Architectural Engineering and Design Management, Vol.* 7, pp. 70-84.
[19] Guma A, Pearson J, Wittels K, de Neufville R, and Geltner, D. (2009), Vertical phasing as a corporate real estate strategy and development option, *Journal of Corporate Real Estate*, Vol. 11, pp. 144-157.
[20] Uline C and Tschannen-Moran M (2008), The walls speak: the interplay of quality facilities, school climate and student achievement, *Journal of Educational Administration*, Vol. 46, pp. 56-73.

[21] Vidalakis C, Sun M and Papa A (2013), The quality and value of higher education facilities: a comparative study, *Facilities*, Vol. 31, pp. 489-5004.

[22] Odediran S J, Gbadegesin J T and Babalola M *O (*2015), Facilities management practices in the Nigerian public universities, *Journal of Facilities Management*, Vol. 13, pp. 5-26.

[23] Jarman D, Webb L, and Chan T C (2004), A beautiful school is a caring school, *School Business Affairs*, June 2004, pp. 37-38, available online at: www.sba_june_04_beautiful_school.pdf Accessed 4th Sept 2015

[24] Wan-Hamdan W.S.Z., Hamid M.Y and Mohd-Radzuan N.A. (2011). Contribution of facilities management processes in supporting Malaysia national higher education strategic plan. *Procedia Engineering.* Vol. 20, pp. 180-187.
[25] Yik F.W.H and Lee W.L. (2004). Partnership in building energy performance contracting. *Building Research and Information*. Vol.32, pp. 235-243.

[26] Kobes M., Helsloot I., De Vries B. and Post J. (2010). Exit choice, (pre-) movement and (pre-) evacuation behaviour in hotel fire evacuation – Behavioural analysis and validation of the use of serious gaming in experimental research. *Procedia Engineering*. Vol.3, pp.37-51.

[27] Liu M., Zheng X. and Cheng Y. (2011). Determining the effective distance of emergency evacuation signs. *Fire Safety Journal*. Vol.46, pp.364-369.

[28] Kobes M., Helsloot I., De Vries B. and Post J. (2010). Building safety and human behaviour in fire: A literature review. *Fire Safety Journal*. Vol.45, pp.1-11

[29] Notake H., Ebihara M and yashiro Y. (2001). Assessment of legibility of egress route in a building from the viewpoint of evacuation behaviour. *Safety Science*. Vol.38, p.127-138.

[30] Osman M.S. and Ram B. (2013). Two-phase evacuation route planning approach using combined path networks for buildings and roads. *Computers and Industrial Engineering*. Vol. 65, p.233-245

[31] Ko S, Spearpoint M and Teo A. (2007). Trial evacuation in an industrial premises and evacuation model comparison. *Fire Safety Journal*. Vol. 42, p. 91-105.

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