DATA QUALITY AND KPIs: A LINK TO BE ESTABLISHED

(Research-in-Progress)

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ABSTRACT

Business organisations must achieve efficient and effective processes in order to attain competitive positions. The performance of these processes is measurable through key performance indicators (KPIs). KPIs are very important to management decision-making and are relied upon by all levels of an organisation to measure success in achieving outcomes. An organisation needs to be able to identify its high-value high-risk data quality (DQ) issues that support each KPI. Thus, it is thought that a rigorous framework that guides the mapping of DQ dimension to KPIs is needed to provide confidence in decision-making.

In order to develop a framework that maps DQ issues to KPIs, the current state of DQ in Australian organisations and the degree of DQ initiatives which are linked to organisational KPIs will be investigated. A proposed nation-wide survey and case study findings will be used together to develop the framework for mapping DQ efforts to organisational KPIs. This research will also address the question of how criteria which link DQ initiatives to organisational KPIs can be established.

KEYWORDS

Data Quality, Performance Measurement, Key Performance Indicators, Framework

INTRODUCTION

Process efficiency and effectiveness are two of the most important determinants of business success [5, 6, 14]. Thus, performance measurement becomes a critical business activity. Performance measurement often requires a reactive component capable of monitoring time-critical operational processes to allow decision-makers to focus their actions according to the organisation's strategy [13]. This component is usually supported by a computer-based information system. That system is exists to:

- help monitor and control specific activities;
- predict future internal and external states;
- monitor states and behaviours relative to organisational goals;

- support decision-making within required time frames; and
- alter the business's overall orientation and/or behaviour.

Such system can be found in many organisations. In addition, other forms of performance measurement include regular staff reviews, performance measurement based personal award systems and more. It is believed that performance measurement enables businesses to meet demands more successfully as it helps ensure that decision-making at every level is better informed, more focus and more effective.

There are many performance measurement approaches employed by organisations. The methodologies, methods and techniques [20, 28] of measurement are too many to list here, but in the main include the:

- balanced scorecard [21],
- performance measurement matrix [23],
- EFQM business excellence model [12],
- results-determinants framework [12],
- measures for time-based competition [4],
- performance pyramid [26],
- ICAS framework [18], and other related.

For performance measurement modelling, the business objective is translated into a KPI that enables the organisation to measure some aspect of the process against a target that they define. KPIs have been found to be useful in performance measurement [20], and the use of KPIs has been widely adopted in organisations [11, 20, 31]. These KPIs are compilations of data measures used to assess the performance of a business's operations. KPIs are created from a business's objectives. A business objective is an executive statement of direction in support of a corporate strategy. The business objective is a high-level goal that is quantifiable, measurable, and results-oriented [17].

Data processing is often regarded as one critical element in KPI evaluation [7, 9, 29]. KPIs which use data of poor quality may result in poor KPI outcomes, which in turn may lead to poor decision-making (e.g. wrong strategies). Inadequate data handling may also cause KPI-related problems. For example, disparate or interfaced software systems from different manufacturers may require organisations to undertake laborious data manipulation to compile KPIs; data transfer between different software systems could result in mistakes and inaccurate KPI calculations [16]. Organisations must be able to identify the DQ elements which are necessary to support the KPIs. However, in practice, organisations may be unable to identify high-value, high-risk data quality dimensions that support each KPI [15]. This raises the need to develop a DQ and KPI framework which can provide guidance to improve KPI accuracy and effectiveness.

KPI Literature

A brief summary of KPI literature is provided here to give the reader an understanding of what KPIs are, the process for creating them, and known problems with using and creating KPIs.

KPI Definition

The CobiT framework [19] defines KPIs as measures that determine how well business processes are performing in terms of their potential to enable a particular goal to be reached. They are lead indicators of whether a goal is likely to be reached, or not, and are good indicators of capabilities, practices and skills. They measure the activity goals, which are the actions the process owner must take to achieve effective process performance.

KPIs are focussed either on the critical aspects of organisational performance that require improvement, or on the aspects that must be kept within a specified level to ensure the continued success of the organisation [3, 30]. These aspects usually include customer satisfaction, financial, process and human factors. In a complex and challenging economy, companies need forward-looking or "leading" metrics that are tied to the company's value drivers. Leading metrics (for example, customer satisfaction), based on cause-and-effect relationships, can alert companies to problems before they adversely affect the bottom line [27]. For example, declining customer satisfaction can point to an eventual drop in overall revenue or a loss of market share.

KPI Critical Factors

Neely [29] points out that 70 per cent of balanced scorecard implementation fail. The author goes on to argue that there two main reasons why measurement initiatives fail. The first is that measurement systems are often poorly designed. The second is that they are difficult to implement due perhaps to (politics, infrastructural issues, and loss of focus). KPI implementations can also suffer from the same issues. The KPI literature suggests that successful performance measurement depends on how well these KPIs are designed [11, 30, 35]. Key performance indicators can be:

- Process-based (e.g. compliance with guidelines),
- Activity-based (e.g. dollars spent, numbers employed)
- Outcome-based indicators (e.g. goals achieved, success of services)

KPIs are particularly beneficial when they are linked to policy concerns or outcomes. KPIs can be categorised in a number of ways [35], some of which are:

- *Quantitative KPIs*: The amount of a product or service
- *Qualitative KPIs*: Structured perceptions or structured feedback
- *Cost efficiency KPIs*: The unit cost of achieving a specified amount of service
- *Cost effectiveness of KPIs*: The unit cost of achieving a specified amount of service to a designated level of quality
- *Timeliness / Responsiveness KPIs*: The time taken to perform a service, or the number of transactions or products within a time cycle
- *Work team productivity KPIs*: The amount of output of a workforce unit or group

KPI Creation Process

Implementation of the KPI creation process is complicated. For example, the European air traffic management programme [31] has summarised its KPI process from design to implementation as:

- KPIs definition, including
  - define KPIs
  - identify production process
  - brainstorm on KPIs
  - and develop data collection plan
- Monitoring and analysing data, including
  - monitor KPI compliance
  - gather and analyse data
- Improving components
- Refining KPIs

This above process is complicated by the number of activities and people involved. For example, during the defining of KPIs [31] might be included:

- Create the list of products produced and/or services provided by your organisation
- Identify your major (segments of) customers and their profiles (i.e., services, products, delivery methods and requirements)

- Identify list of principal processes used in production and service provision via the activity identify production Process
- Create possible list of KPIs for the following categories: financial, customer satisfaction, human factors and business processes via the activity brainstorming on KPIs
- Formulate each KPI by using the KPI design form as a result of brainstorming meeting
- Apply KPI checklist on the list of possible KPIs (result of the activity brainstorming on KPIs) in order to select your initial set of KPIs
- Refine data collection methods for each KPI via the activity develop data collection plan
- Set an objective for each selected KPI (if you have historical data)

Moreover, in an effort to lessen the complications associated with KPI selection, the organisation should consider the following principles while selecting or defining new indicators:

- An indicator must motivate the right behaviour
- A KPI must be measurable
- A KPI must be affordable
- The objective set for a KPI must be attainable
- Factors affecting the indicator must be controllable by the service provider
- A KPI must be meaningful to all the parties.

Table 1 provides an example of how KPIs may be determined and applied.

KPI Name	**Profit per Employee**
Description	It represents the annualised amount of profit that each employee is generating.
Objective	To check whether the organisation is hiring effectively.
Type	☑ Quantitative ☐ Qualitative
Effort	☑ Low ☐ Medium ☐ High
Unit	Euro
Assessment Method	It is calculated as "Net Profit before Taxes/Total Employees".
Possible Tools	None
Analysis Frequency	☐ Day ☐ Week ☐ Month ☐ Quarter ☑ Year ☐ Year+
Comments	A similar indicator, *return on labour,* can also be used. *Return on labour* represents the percentage of profit generated from each euro invested in employee compensation. It is calculated as "Net Profit before Taxes/Salary Expense".

Table 1: Elements in KPIs [30]

Problems with KPIs

There are problems (e.g. poor DQ) emerging from the development and use of KPIs. Neely and Bourne [29] suggest that, when measurement initiatives fail, the major issue is simply the lack of infrastructure in an organisation. In most businesses the data to calculate particular performance measures exists in some form. The problem is that the data is spread throughout the entire organisation. It is held in unrelated, unlinked databases, often in inconsistent formats [29].

The literature is replete with learned when establishing performance measures. Theurer [33] writes about seven "pitfalls" of performance measurement systems:

- Data by themselves have no meaning

- There must be a strong commitment from leaders to move toward measuring performance and not just collecting data on effort
- Employees must have the capacity to develop measures, or they will use whatever 'measures' are already available
- If measurement focuses on negative accountability, managers and employees will seek to avoid accountability when things go wrong
- A performance measurement system should provide information to policymakers and managers so they can make better decisions
- For many governments, the ultimate aim of management based on performance measures is to integrate program performance and outcome information with the budget process
- Provide reliable and valid information on performance

LaBarge [2, 24] also considered these major pitfalls of performance measurement systems:

- *Measures not linked to strategy*: Critical to do initially, but also revisit when either the organisational strategy or structure changes
- *Measures not driven into all organisational levels*: Breaks the linkage with overall strategy. Should be driven into staff performance agreements at all appropriate levels.
- *Too many measures*: Creates a lack of focus on what is really critical to managing your business.
- *Not enough critical measures*: Organisations could be missing information vital to operations.
- *Focusing only on the short-term*: A cross-section of past (lagged), present and forward-looking measures is critical.
- *Conflicting measures*: Sub-optimises staff or organisational performance. For example, measuring reduction of office space per staff member while also measuring staff satisfaction with facilities.
- *Measuring progress too often*: Could result in unnecessary effort and excessive costs, resulting in little or no added value.
- *Not measuring progress often enough*: May not know about potential problems until it is too late to resolve easily.
- *Collecting too much data*: Could result in a mountain of data that really doesn't provide anything more than a lesser amount of the same data.
- *Collecting inconsistent, unrepresentative or unnecessary data*: Critical to understand what the data will look like, when it will be collected, at what frequency, by whom and what it means, up front.
- *"Dumbing the data" (i.e., Reducing the value of impactful data)*: Too much data roll-up (summary) can mask the impact of potentially significant events or trends
- *Driving the wrong performance*: Organisations must be careful that the selected measure(s) will result in the desired result.
- *Encouraging competition and discouraging teamwork*: Measuring vertically frequently pits one internal organisation against the others. Try to measure horizontally.
- *Failure to base business decisions on data*: Developing performance measures or collecting data only to comply with a requirement does nothing to improve the position of the company.

The Problems to be Addressed – The Data Quality & KPI Nexus

Data Quality Definition

Data quality (DQ)problems are widespread in practice and have significant economic

and social impacts [38]. For every hour the 'business spends hunting for missing data, correcting inaccurate data, working around data problems, scrambling to assemble information across disintegrated databases, resolving data-related customer complaints', and so on, the hourly costs are passed on to the customer through higher prices [10].

It is easy to understand the concept of poor data quality and it possible effects, but much harder to come up with a general definition of what it means for data to be "poor" or "good". Researchers have attempted to determine the attributes of "quality" data [37] as well as examined the various aspects of data and evaluated how those aspects affect quality [32]. It has also been said that the purpose of the data production process is to produce data for data consumers [25]., and that high quality data is defined as "data that are fit for use" by these data consumers.

The understanding of what constitutes high quality data may seem further confounded by the synonymous use of the terms "data" and "information" Wang states that the terms, "data" and "information", are often used synonymously [36], while in practice, managers differentiate information from data intuitively, and describe information as data which has been processed in some manner. Although "data" and "information" are two different concepts, it may be difficult to differentiate between them in practice [22]. Thus, in this study, the concept "data" will be used in a broad sense, which covers the concept of "information".

Quality Data for Quality KPIs

One of the biggest challenges organisations face has been consolidating performance data from disparate sources into a coherent system that people can trust [27]. Organisations usually rely on a raft of performance data drawn from many different systems: enterprise resource planning (ERP), customer relationship management (CRM), spreadsheets, flat data files, data marts, presentation software, legacy data and other sources. Each system provides important information about a particular aspect of the organisation's performance, but each collects, defines and displays the information in a different way. Due to the lack of enforced integrity and relationship, disparate data is usually of low quality as compared to data which has been properly integrated. Disparate data creates confusion and inefficiencies, and blurs accountability. KPIs based on this data are often incomplete, conflicting, or limited to a particular department/function within the organisation. Sometimes they are all three [27].

KPIs use data to support the KPI metrics [8]. Those metrics must of appropriate quality to support successful implementation of the KPIs. However, an organisation may find that it is unable to identify its high-value, high-risk DQ dimensions to support each KPI [15]. Take for example, KPI for inventory cost with these four metrics:

Metric 1: OEM total value of inventory
Metric 2: No. of stock outs per month
Metric 3: Inventory accuracy rate
Metric 4: Shipping cost by month

If data quality problems exist in these metrics, (for example, inaccurate stock count, shipping cost data entry error, etc) incorrect KPI results would occurs, as would incorrect decisions.

Linking DQ to KPIs

Existing / Previous studies: Very few and very limited

A literature search indicates that very little previous research has addressed the problem of data quality and its impact on KPIs. However, in practice, the data quality dimension has been addressed in several performance management frameworks [1, 30, 31, 34]. For example, the performance-based management framework [1] are considered data quality dimension in the step

of collecting and analysing data. The AIS AHEAD programme [30] has also tried to come up with data quality KPIs. Hey [15] proposed the data quality initiative framework that begin with determine data priority from organisational KPIs. However, knowledge of the link between data quality initiatives and organisational KPIs is still unclear at this time. That is, there is a perceived need to explore the ways in which data may be generated and stored, and also to examine ways of improving DQ so that KPIs better address the goals established for them.

The Proposed Research Model (Deriving from the KPI Activities)

Organisations do not generally coordinate DQ-based activities with KPI activities. In other words, organisations have not addressed the role of data as an essential element of KPI processes, particularly from the point of view of determining if data is of a suitable form and quality for the KPIs. This research project proposed in this paper enables the two distinct areas, key performance indicators and DQ initiatives to be brought more closely together so their interrelationship can be studied.

The preliminary model, which shows how organisational characteristics and DQ criteria provide a linkage between DQ initiatives and KPIs is shown in Figure 1. The model is classified into four categories, DQ initiative, KPIs, organisational environment, and external environment. The literature suggests that the following five DQ activities are particularly valuable to the KPIs:

- *define data set,*
- *define data source,*
- *define data owner/data stakeholder,*
- *define data prioritisation, and*
- *define DQ dimensions.*

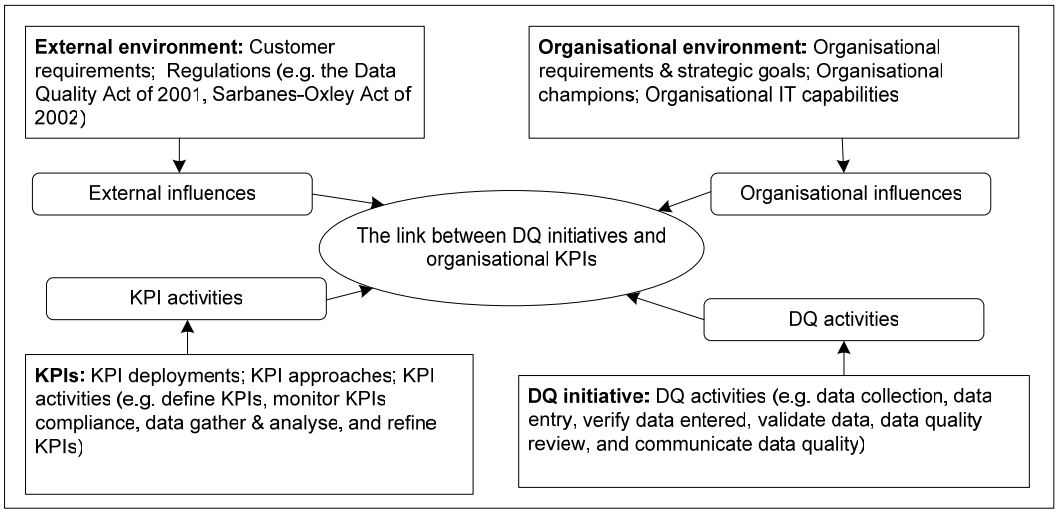

Figure 1: The preliminary model for criteria to establish the links between DQ initiatives and organisational KPIs

The category of KPIs deals with the KPI creation, the deployment approaches, and the KPI related activities. The literature suggests that while performing the following KPI activities, there is a strong need of DQ consideration.

- *define KPIs,*
- *monitor KPI compliance,*
- *data gather & analyse, and*
- *refine KPIs.*

In the organisational environment, there are some important influences for the link between DQ and KPIs. For example, *organisational requirement & strategic goals, top management commitment to DQ, organisational DQ champions, and organisational IT capability.* Finally, pressures from external environment such as *customer requirements, and regulations* also require organisations to make a strong link between their KPIs and DQ initiatives.

The focus is on improving DQ, in order for KPIs to be more relevant, better informed and more effective in supporting management objectives.

RESEARCH DESIGN

In this study, survey research will be used together with case study research. The survey research will be adopted to explore the current state of data quality in Australian organisations, and to provide a broad picture of data quality issues in Australian organisations. The survey research will also investigate some aspects of the criteria that create the links between data quality initiatives and organisational KPIs. Detailed case studies will be used as a research strategy for investigating the links between data quality initiatives and organisational KPIs.

The research design is based on modification of the case study research methodology devised by Yin [39]. The survey research will be used together with case study research. The research design (see Figure 2) is divided into five stages:

(1) A nation-wide survey
(2) Designing the case study protocol
(3) Conducting the case studies
(4) Analysing case study evidence
(5) Developing conclusions

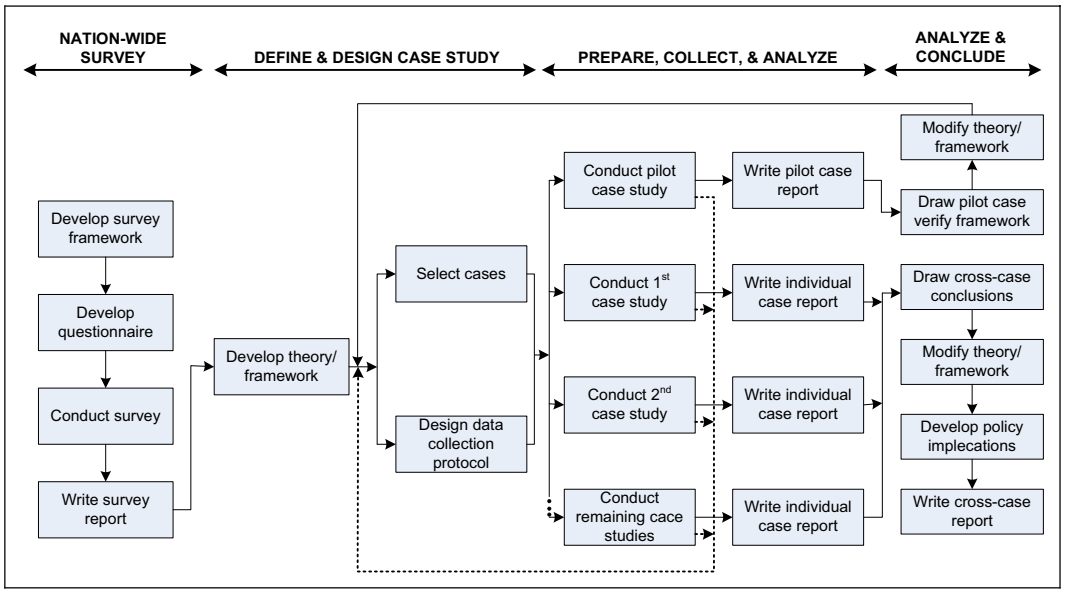

Figure 2: Research Design (Adapted from Case Study Method [40])

Nation-wide Survey

Following initial exploratory work, literature reviews will be used together with a conceptual study research method in order to develop the survey. Three thousand survey questionnaires will be sent, nation-wide, to Australian organisations. The questionnaires will be distributed to business stakeholders, including people at different levels. It is anticipated that the survey, by approaching many organisations in different sectors, will provide a broad picture of current

DQ/KPI practices across Australia. Specifically, it is hoped that a broad picture will emerge of the current approaches to data gathering and to methods employed to ensure greater DQ.

The survey results will establish an understanding of the current use of KPIs, including both positive and negative outcomes. It is hoped to also begin to establish an overview of the way is which organisation link data to KPIs, along with emerging problems related to the impact of DQ on KPIs. Moreover, the results will contribute to the development of theory and a framework in linking DQ efforts for organisational KPIs.

Follow-up case studies (interview-based)

Two or three pilot case studies will be conducted to verify the framework used in linking DQ efforts to organisational KPIs. Four to five Australian organisations will be employed as multiple case studies to validate results. This part of the study will use in-depth interviews and documentation as primary sources of evidence. Semi-structured and unstructured interviews with key stakeholders will be conducted. Data collection sources will include relevant documents, such as position description, policy manuals, organisational structure charts, and annual reports.

THE EXPECTED FINDINGS

The current state of DQ in Australian organisations, degree of DQ initiatives are linked to organisational KPIs, and the criteria influencing to establish the links between DQ initiatives and organisational KPIs are the research expected findings. These findings will make a contribution to the body of knowledge related to DQ initiatives that are linked to organisational KPIs. The body of knowledge can be contribute to better decision-making in regard to organisational investment in DQ efforts, though a better understanding of the criteria required to link DQ to KPIs. The research will provide a framework for linking DQ efforts to organisational KPIs. The framework will be including guidelines along how to use the framework to contribute to ensuring quality decision-making. This study will also present a detailed report of the state of DQ in Australian organisations as well as the degree to which DQ initiatives are linked to organisational KPIs. This is particularly important for management in order to investment in DQ effort.

CONCLUSION

The results from the proposed research should be of value to businesses and improve the performance measurement processes. As there has been little research conducted in this area, the proposed research will make both theoretical and practical contributions to the field of data quality and organisational KPIs in the following ways: (1) a framework for linking DQ efforts to organisational KPIs (2) guidelines for the framework and (3) research reports (current state and degree of DQ initiatives in Australian organisations).

Furthermore, the results of this research will be valuable to organisations in obtaining a better understanding of how to link DQ initiatives to organisational KPIs. Organisations should be better equipped to achieve efficient and effective decision-making based on their KPI outcomes.

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