THE IMPLEMENTATION OF INFORMATION QUALITY FOR THE AUTOMATED INFORMATION SYSTEMS IN THE TDQM PROCESS: A CASE STUDY IN TEXTILE AND GARMENT COMPANY IN THAILAND

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Abstract: Nowadays, industries are looking forward to obtain a precise data in both internal database and external database across their organisations. This paper attempts to clarify and recommend a way to share precise data environment. The contribution of this paper is to propose a framework to improve components of Information Quality (IQ) for Automated Information Systems (AIS) in a practical way via a case study firm in Thailand. The core set of information quality and Benefits/Costs/Risks (BCR) analysis of IQ have been presented through a case study which is a medium size textile and garment industry in Thailand. Several designed procedures in AIS have been upgraded to minimise its mismatched data. The major result indicates that, with the enhancement of IQ project, the projected risk cost of losing current customer has been dramatically reduced compared with the projected risk cost of losing potential new customer. The other results, limitations and recommendations are also presented.

Keywords: Information Quality, Automated Information Systems, BCR Analysis

1. Introduction

As information is one of the most powerful tools in business nowadays, in particular Automated Information Systems (AIS), which formally did not communicate, are increasingly required to share the information environment. Focused on achieving the sharing environment are often categorised as playing a pivotal role in facilitating and/or inhibiting system integration.

The contribution of this paper is to propose a way to improve AIS and information quality in practice through a case study. As known that textile and garment is a foundation industry in Thailand and it is even stronger during the devaluation of the currency due to lower wages and more choices of company. A number of information regarding to designed requirements and specifications from abroad are quickly coming simultaneously with orders. The textile and garment industry is in needs to implement Database Management System (DBMS) to cope with a high demand and requirements for further development. The main hurdle in implementing of DBMS in this industry is how to achieve the precise information between transaction of DBMS and users. That is the reason that this paper aim to apply the AIS to improve Information Quality (IQ).

The company in this case is a medium scale textile & garment company who previously used manual but currently using AIS in management information systems. As the cost of AIS have become reachable if the economy of scale is achievable, the management of this firm targets to improve AIS whilst the level of Information Quality (IQ) must be high for every user. It is

because different data users impose different quality requirements and that was of acceptable quality for one system might not be so in another. In addition, data that was sufficient accuracy and timeliness for local users may not be acceptable at another site, particularly other continents. Cost of inaccurate or inadequate data can become sky high. Problems with information quality can result in tangible and intangible damage varying from loss of customers/users confidence to loss of orders. This company found that there are several current customers turn down the order because they found many mismatched data between their DBMS and company's DBMS.

In the following sections, it clearly explains series of step beginning from background of TDQM such as requirements and evaluation of IQ. Then management process of IQ which has 4 major steps in detail, for example, eestablishing the TDQM eenvironment, identification of IQ projects, implementation of IQ projects and benefits/costs/risks (BCR) Analysis. After that the next section will explore a developed model within a case study textile and garment firm which will explain how to improve AIS and TDQM in a practical way.

2. Requirements and Evaluating of IQ

It has been known that Information Quality (IQ) is not a binary attribute [12]. We should not declare that a set of information is (or is not) of high quality but we should evaluate information in the context of each specific intended to use [13]. Then we should also feed the result of the evaluation back to improve the IQ. This implies that multiple evaluations must be applied and the results must be recorded for using in the future.

Table 1: Core Set of IQ Requirements (Adapted from DoD Guidelines [2])

Data Quality	Characteristics Description	Conformance Measures
Accuracy	A quality of that which is free of error. A qualitative assessment of freedom from error, with a high assessment corresponding to a small error [3].	Percent of values that are correct when compared to the actual value. For example, M=Male when the subject is Male.
Completeness	Completeness is the degree to which values are presented in the attributes that require them. [1].	Percent of data fields having values entered into them.
Consistency	Consistency is a measure of the degree to which a set of data satisfies a set of constraints. [11].	Percent of matching values across tables/files/records.
Timeliness	As a synonym for currency, timeliness represents the degree to which specified data values are up to date [11].	Percent of data available within a specified threshold time frame (e.g., days, hours, minutes).
Uniqueness	The state of being the only one of its kind. Being without an equal or equivalent.	Percent of records having a unique primary key.

Remark: DoD represents Department of Defense of USA.

Requirements and Evaluating of IQ have two distinct aspects one involving the "correctness" objective such as in Table 1 at IQ Characteristics Description column. The another one concerns the "appropriateness" of data for some specific purpose [9,11,13]. The data users usually assure that the purpose of IQ assurance (for the Total Quality Management or TQM purpose) is to provide the best data possible [7,8].

If the data users obtain such IQ assurance data which they believe it is the best data possible [7,8], it means this obscures the need to evaluate data. In other words, if the information is the best available or as good as it can be produced, then there is no other alternatives but to use it, in this case there is no point to worry about how good it is. The flaw is that saying that the information is as good as it can be produced does not inform us *how* good it is. Therefore, we need an explicit evaluation as in Table 1 at Conformance Measures column. It describes how to perform an evaluation which those activities are done to ensure that data are correct and appropriate for their specific purpose. After we define requirements and evaluation of IQ which is the background of this paper, the next section describe four total data quality management process.

3. Management Process of Information Quality

The management process of IQ applies Total Data Quality Management (TDQM) approach to support database migration and improve database in conformance to business rule. The TDQM actually borrow the Total Quality Management (TQM) methodologies to apply human resources and quantitative method to improve products and/or services. The TDQM approach integrates functional management techniques and former improvement efforts to create or sustain of the continuous improvement process.

As illustrated in Figure 1, the TDQM consists of four major processes which has been described within the Defense Information Systems Agency (DISA) [2] and simultaneously enhanced by the author. Firstly, Establishing the TDQM environment by designing of management and infrastructure support. Secondly, Identification of information quality projects. Thirdly is the Implementation of IQ projects. Finally, are the Benefits, Costs and Risks Analysis of IQ projects.

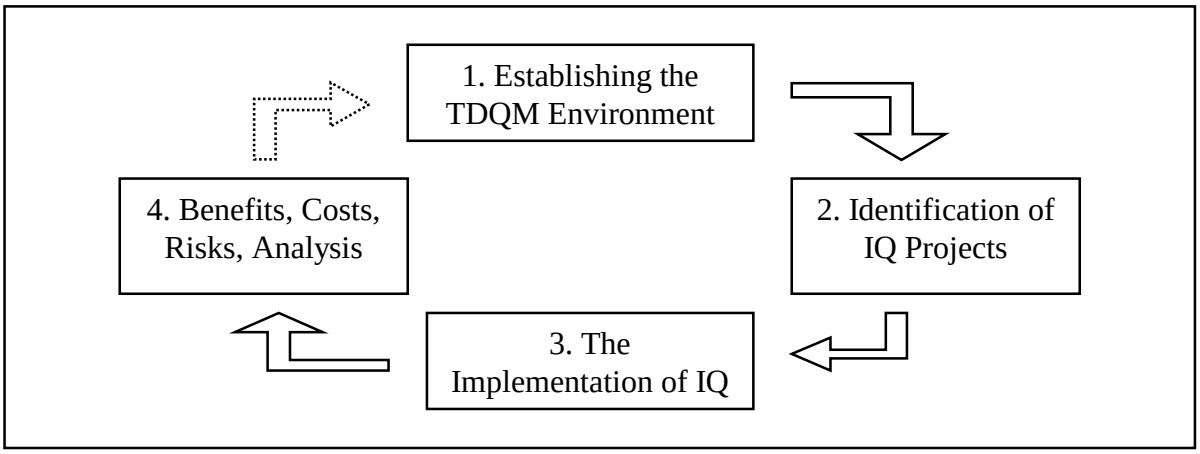

Figure 1: Total Data Quality Management Process
Adapted from the Defense Information Systems Agency (DISA) [2] and simultaneously enhanced by the author

3.1 Establishing the TDQM Environment

This is the first step in TDQM process and probably one of the most difficult step in the process, as similar to the introduction of Concurrent Engineering into the industry [4]. The existing culture which is characterised by an attitude, for example users know the IQ problems but do not want it to be fixed or AIS staff knows how to identify the IQ problems but do not want to say that they do not know how to change functional requirements that drives the data. It is because they worry about job cut. Given these existing barriers, one of the most important solutions is the involvement of the top management to support all obstacles as their pace of commitment is the only way to gradually change the existing culture in organisation. The action plan should be developed as following:

- Overall goals and objectives to the achievement of IQ.
- Strategies to obtain goals and objectives.
- Infrastructure needed such as responsibilities of members in the team, training programs etc.

3.2 Identification of IQ Projects

How the TDQM project philosophy is promoted within the organisation will affect its success. If the TDQM is exaggerated, then under-delivery will result in a loss of creditability and hence slow down the introduction process. On the other hand, if the TDQM is under-publicised, then senior management may lose sight of the TDQM and therefore, it will not be fully exploited or supported its capabilities. Generally, either users or AIS administrators or both should select IQ projects. It is a critical to listen and understand in mutual. For example, users usually report complains with record errors. These inaccuracies happening in queries, reports and data correlation problems are good indicators of IQ issues. Alternatively, system administrators may suggest recommendations based upon problems with data collection, processing errors and procedures. Therefore, The recommendations for the selection of IQ projects are as follow:

- Choose the project that has a highly opportunity for project success. It is very important to make the project success as the first time that it is firstly implemented so that the organisation can adopt the idea more easily in the future. The steps are: (1) select the project that has a high chance of success, (2) that has the highest impact lost cost to the firm, (3) where the significant improvement can be made. Certainly, project that can be solved with minimum effort but results are obvious will increase the attractiveness of TDQM project to the top management.
- Doing a prototype project. If there is no support from the top management, performing a pilot project is another alternative. Choose the project with low risk but high visibility which is critical to the organisation success. Focus also on a project that has a huge chance of success. Importantly, choose the effort that is neither too large that is doomed for failure from the beginning, nor too small those improvements can be negligible.

3.3 The Implementation of IQ Projects

The implementation of IQ projects can be separated into two distinct steps: Developing the IQ Implementation Plan and Implementing the IQ Projects.

3.3.1 Developing the IQ Implementation Plan

As recommended by DoD [2], the project management will be applied in developing the IQ implementation plan in which it provides information on:

- Task Summary: list project goals, objectives, scope and synopsis of anticipated benefits.
- Task Description: describe data quality tasks.
- Project Approach: summarise tasks and tools to be used as a baseline in developing BCR Analysis.
- Report Analysis: List reports that conform to the BCR Analysis.

3.3.2 Implementing the IQ Projects

In implementing the IQ projects, based upon the TDQM process, it is defined into four activities:

1. Define: as in Table 1, to identify the IQ requirements.
2. Measure: to measure in conformance with the requirements as in Table 1.
3. Analyse: to verify, validate and assess the causes for poor IQ and seek for the improvement.
4. Improve: to improve the IQ, it may have to change data entry procedures, enhancement of data validation rules or using a uniform standard using throughout the organisation.

3.4 Benefits, Costs and Risks Analysis of IQ Projects

One of the most crucial tasks in IQ improvement is the identification of benefits, costs and risks which are connected to direct root causes of IQ problems and the indirect root causes that damage information.

Table 2: Major Types of Benefits, Costs and Risks of IQ

Benefits	**Costs**		**Risks**
	Direct IQ Costs	**Indirect IQ Costs**	
1. Customer Loyalty	1. Controllable Costs - Prevention Costs - Appraisal Costs - Correction Costs	1. Customer Incurred Costs	1. Correction Costs Too High
2. New Customer	2. Resultant Costs - Internal Error Costs -External Error Costs	2. Customer Dissatisfaction Costs	2. Schedule Too Long
3. Reputation Improvement	3. Equipment and Training Costs	3. Creditability Lost Costs	3. Costs of Buy-In Programmer for Correction

Source: DoD Guidelines [2] and Simultaneously Enhanced by the Author

The major types of Benefits, Costs and Risks of IQ are illustrated in Table 2. At Costs generally, Direct IQ Costs which consist of controllable costs, resultant costs and equipment and

training costs are quantitative by estimating based upon labour hour devoted to prevention, appraisal, correction activities, poor data quality cause internal&external error which need modifications, also equipment and training costs. In Indirect Costs are normally qualitative but it could be estimated whenever possible to adequately assess the impacts of poor IQ [2]. For example, inability to match payroll records with the initial employment records can become overpayment to employees.

In terms of Benefits and Risks, they are more difficult to quantify than costs. In particular, customer loyalty, reputation improvement (for Benefits) and too long schedule (for risks) are even harder quantifiable. If several alternative projects are available, it is advisable to apply a holistic decision making approach called "Analytic Network Process" or ANP which is a discrete multi-criteria decision making (MCDM) appropriate for complex model [5] or "Analytic Hierarchy Process" (AHP) [6] for simple case study. Alternative decision making models can be seen in [10]. The more detail and application of the approach will be discussed in the case study.

3.4 Summary

As recommended from the DoD guidance on data quality management [2], the goal is to ensure that:

(1) Users are involved in the IQ improvement process.
(2) Measurable data characterised are predetermined.
(3) The information acquired are conformed to the requirement in (2)

According to the Figure 1, the approach to achieve the goal comprises of four steps. Firstly, the TDQM environment must be established where from the top management to the users is responsible to seek for an action plan. Secondly, is the identification of IQ projects which should provide the high chance of success. Then the implementation of IQ projects which consist of two steps: developing of the IQ implementation plan and implementation of the IQ projects. Finally, the BCR Analysis of IQ projects. The case study in the next section will discuss deep into details of the application of the TDQM concept into a real IQ project.

4. Information Quality Case Study

4.1 Introduction to the Problem at a Textile and Garment Company in Thailand

The firm is a SME textile and garment company who produces several textile and garment products for domestic and export market. Currently, the are using Local Area Network (LAN) system to connect five departments together e.g. Sales and Marketing, Finance and Accounting, Operations and Manufacturing, Human Resource, and Health and Safety. This firm has had a fully integrated system for a year, however, mismatched information from its Database Management System (DBMS) to each department is frequently occurred. This problem has been addressed and the management of the firm has fully supported to implement an improvement of their IQ in AIS. The example of problems are, there are frequently mismatched information of orders and specific requirements between (Sales and Marketing department) and (Operations and Manufacturing department) which almost cause lost of order and penalty charged. Another example is that there are some mismatched information between (Human Resource department) and (Finance and Accounting department) in regarding some unauthorised information can be accidentally shown at Finance and Accounting department in which they asked just only to know enrolment date etc. This company is in needs of improving in AIS by TDQM philosophy.

4.2 The AIS Improvement by IQ Project Using TDQM Philosophy

The TDQM philosophy does not appear on the scene unexpectedly, most is result of many years of development process. The patterns of appearance and arrival of TDQM have common themes. The senior management in this company should have initiated it but in fact, TDQM philosophy is firstly introduced to the company by a group of middle management. Such appearance makes some difficulties in making awareness to the organisation culture. According to the seniority culture in Asian countries, senior management needs to be considerably convinced and explained about the benefit of TDQM philosophy and IQ. Fortunately, senior management agrees that TDQM and IQ would able to enhance operations within the firm and since then fully commitment have been drawn. As illustrated in Figure 1 and based upon an endorsement from the management, the first step Establishing the TDQM Environment can be achieved.

4.3 The Identification of IQ Project

As this project is the first in its kind within this firm, the management decided that they should have done it in a small scale, therefore, there is only one project in which the goal is to minimise or eliminate the mismatched information between users and DBMS on the AIS. This is a critical hurdle to the company in regarding the creditability to its customer and reliability of management in-house.

4.4 The Implementation of IQ Project

To implement the IQ improvement of this project, there are two steps: developing the IQ implementation plan and implementing the IQ improvement project.

4.4.1 Developing the IQ Implementation Plan

The project goal is to minimise the mismatched data between users and DBMS in AIS. The objective of this project is to increase the accuracy and the consistency of data using on the AIS which will enhance the reputation of the firm ultimately. The scope of this project is in operation between DBMS and 5 departments namely Sales and Marketing, Finance and Accounting, Operations and Manufacturing, Human Resource, and Health and Safety department. The approach of the project will be done in both way: enhancement of the DBMS program and minimise the human error in process. The anticipated cost and benefits will be discussed in section 4.5.

4.4.2 Implementation of the IQ Project

After the core set of data quality have been identified, the IQ team, who consists of a project manager, programmers and department representatives, have come to develop an implementation plan and seek for hurdles, then try to overcome them. The requirements of the core set of data quality and developed procedures are illustrated in Table 3 which is an enhancement from Table 1. The difference between them are in Table 3, they add Validity analysis instead of Timeliness and Operations because the IQ team considers validity has much more important role than timeliness and uniqueness. The Developed Procedures or “Filter” has been developed based upon Accuracy, Completeness, Consistency and Validity Analysis.

The result from the analysis, causes and solution of mismatched data that conform to the analysis are illustrated in Table 4. At table 3; from the operations point of view, Filter does indeed

contribute to the success of the improvement of IQ project. Several designed programs and procedures, as far as concerned, eliminate the mismatched data of AIS. The Benefits/Costs/Risks Analysis of IQ is discussed next.

Table 3: Core Set of Data Quality and Developed Procedures for the Firm (Adapted from Table 1, [2] and simultaneously enhanced by the author)

Data Quality	Developed Procedures (Filter)	Conformance Measures
Accuracy Analysis	Computational verification data between sources and end users.	Percent of values that are correct when compared to the actual value. For example, there are frequently happen that, loading some data from a terminal, it shows mismatched data. In particular, obtained incorrect data bundle with the correct data is the most concerned.
Completeness Analysis	Computational verification between data.	Percent of data fields having values entered into them. For example, downloading data from its DB to column for analysis but some fields are missing or null.
Consistency Analysis	Computational verification flow between point to point comparison.	Percent of matching values across tables/files/records. This is the most concerned due to the credit of its business can become grim if the inconsistency occur frequent when they are communicating with its customer.
Validity Analysis	Valid integration of values within data set.	Percent of data available within a specified threshold time frame (e.g., days, hours, minutes, seconds). In this case, it means the original data are considered to be valid or not. If yes, for how many percent.

Table 4: Results, Causes and Solutions of the Project

Result Occurred	Causes	Solutions for AIS

Mismatched Data	Input into the wrong field	Design program and procedure to element; design an authorisation level for the users.
	Input incorrect data	Design program and procedure to eliminate such as selected for string, number or others.
	No data but thought as it has had	Design a Data Map program and procedure to explain a perspective view of data in Database.

4.5 The Benefits, Costs and Risk (BCR) Analysis of IQ Project

The automated data quality, as recommended in Table 3 and 4, validates several principles of Benefits and Costs. However, evaluating Risks is one of the critical parts in the improvement process. Particularly, risks of losing current customer and potential new customer move to other more reliable business partners.

Table 5 illustrates projected savings by BCR analysis using current costs (both direct and indirect costs, as recommended is Table 2, are included) as a baseline. For example at Controllable Cost, Database (DB) Programmers Operations is the cost of employing programmer staffs to look after the DB. The DB Users Operations means cost of employing user staff to key inputs and draw output data. Both costs are major expenses on IT to the firm and after establishing of IQ project, the new improved cost become 4.5 MB or 30% savings (1.98MB) in total based upon current costs at 6.48 MB in replacing staffs by using new enhanced programs as in Table 3 at Development Procedures (Filter). In terms of Risks in particular, there are two possibilities estimated, lost of current customer and lost of potential new customer. The meaning of lost of current customer and potential customer have been clarified in Table 5. The comparison between both of them indicated that lost of current customer has more impact to the firm (before 20 MB compared with after 7 MB, therefore, save lost risks 13 MB) than lost of potential new customer (before 8 MB compared with 3 MB, therefore, save lost risks 5 MB).

Table 5: Projected Savings by BCR Analysis

Description of Benefits/Costs/Risks Estimated	**DB Programmers Operations**	**DB Users Operations**	**Total Operations**
Current Costs	3.6 MB	2.88 MB	6.48 MB
New Improved Costs	2.4 MB	2.10 MB	4.50 MB
Benefits	1.2 MB or 33 % Savings	0.78 MB or 27 % Savings	1.98 MB or 30 % Savings

Remarks: Savings are based upon replacing staffs by using new enhanced programs as in Table 3 at Development Procedures (Filter).

Risks	Before	After	Total Preventive Lost Risks
- Lost of Current Customer	20 MB	7 MB	13 MB
- Lost of Potential New Customer	8 MB	3 MB	5 MB

Remark: Lost of Current Customer is calculated based upon in-depth interviews current customer about reason for cancellation of order which can be converted to amount in currency.
Lost of Potential Customer is calculated based upon data from Marketing Department in contacting with potential new customer.
MB means Million Thai Baht.

5. Conclusions and Recommendations

The central contribution of this paper is in applying IQ concept to improve the accuracy, completeness, consistency and validity of AIS in order to minimise risks of current customer lost and potential customer lost. The concept of IQ has been described and applied through a case study of a Textile and Garment Company in Thailand.

The associated contribution is to present a Benefits, Costs and Risks analysis to identify trade-off between current costs and new improved costs through IQ concept. The BCR analysis helps to reveal a general theme that lost of current customer risks play more important role to the firm than lost of potential new customer. It is because major stake of incomes are from current customer, therefore, major cash flow of this firm are based upon the relationship between them. Running a business in Thailand, reputation usually has an equal important with market prices, therefore current customer deserve the first priority and also supported by data in Table 5. Moreover, if they lose orders from their current customer, it is not only financially but also reputation lose which they have been built up for years.

The data come from a textile&garment company, therefore, although the results are only appropriate for the textile&garment business, they provide a useful test of the methodology for improving IQ. Engineering firms or firms in other industries may implement this concept so that they can customise their data analysis in seeking for a new product strategy.

The Total Data Quality Management Process should be continuously reassessed in which either positive or negative feedback results should be recorded for further enhancements. The current and potential new customer will obtain the benefit and the firm will be better off ultimately.

The author hopes that findings from the research can benefit any firm in developed and developing countries to share their *precise* data. IQ are increasingly important across global industries, simultaneously with economic turmoil in countries in Asia. Therefore, a system of comprehensive improvement in new ways of IQ is desperately needed.

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