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BENEFITS OF SYSTEMS INTEGRATION: QUALITATIVE OR QUANTITATIVE?

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ABSTRACT

Systems integration has a slow rate of diffusion and adoption. This is partly due to users and practitioners scepticism on its actual benefits. This paper is based on the findings of a survey conducted in Malaysian public sector IT community. The paper starts with a definition of systems integration and a description on how the study was conducted. This is followed with a depiction on the state of systems integration in the Malaysian public sector, and a discussion on the benefits of systems integration as perceived by the respondents. Finally, a conclusion is drawn on the qualitative and quantitative benefits of systems integration.

Keywords: Systems integration; Qualitative benefits; Quantitative benefits

1.0 INTRODUCTION

Systems integration has been on the forefront of the IT sector in the past years. Researchers and practitioners differ in their definition of systems integration; they generally agree that systems integration is difficult and complicated, yet, **not** impossible. System integration means different things to different category of people. Khun in [1] defines systems integration as the practice of joining the functions of a set of subsystems, software or hardware, to result in a single unified system that supports the requirements of an organisation. Another definition of systems integration is given as: "*the assembling of various hardware (such as computers and telecommunication systems), software (such as accounting, desktop publishing and personnel management) and human interfaces to accomplish a specific goal"* [2]. However a simpler definition is given as: "*A service to make user's isolated computers link each other and make them much easier and more useful"* [3].

To researchers and practitioners, systems integration is a term that has been used and interpreted to mean different things. It is often confused and used interchangeably with terms like *client-server* and Electronic Data Interchange (EDI). EDI is the direct computer-to-computer communication of information between organisations in a standard format that permits the receiver to perform specific business functions [4]. Client-server is one of the two models for organising resources of a local area network (LAN). A client-server involves a server, which is actually a dedicated computer that controls all the programs and the peripherals in a network and offers access to all PCs or workstations that have a client program [5].

In the following section, the paper justifies reasons for the need of systems integration and this is followed by a description of the survey and how it was conducted. In Section 3.0, the data gathered was analysed and the qualitative and quantitative benefits of systems integration are presented. The paper then seeks to explain the findings of the survey in Section 4.0.

1.1 Why Systems Need To Be Integrated

Today there is a rich and diverse choice of software selection available for almost every business domain. These softwares have a huge amount of processing capabilities. However, these software applications are like 'islands of processing systems' even within an organisation and across business boundaries. In order to meet the challenges presented by today's competitive atmosphere, organisations need the ability to solve problems that cannot be solved on its own [6]. Businesses today need a global, an open and distributed computational capability. In other words, the demand is for a large scale, complex and integrated systems.

Developing large and complex systems is no trivial task. One way of looking at the challenges faced by the current software development industry is by viewing the problems encountered, from the engineering, management and technological aspects.

One of the challenges of modern software development is that the current methods are no longer able to fulfil the requirements for the development of compound systems with multiple and unstable system requirements. When there are more than one system, additional efforts are needed to integrate the systems. When there are more than one group of developers involved, the overall view of the system is bound to be neglected. More than one customer will lead to multiple requirements and the presence of a heterogeneous environment will inevitably require engineering solutions to bridge the technology gap. Lastly, systems that possess long life cycle will inevitably produce unstable requirements. All these problems can be grouped together as the problems of software development today, viewed from the engineering aspect.

From the management aspect, the problem faced is that there is no clear distinction between general and long-term objectives and also between local and temporal objectives. When there are multiple systems, the general objectives of the systems are easily overlooked. More than one system developer will lead to coordination problems on a large scale. The many end-users will contribute to the difference in priorities. The presence of heterogeneous environment will mean that there is no standardisation of tools. A long system life cycle will lead to the negligence of long-term objectives.

Finally, from the technological aspect, there is a need to bridge the various technologies and efficiently incorporate new emerging technologies as a unique solution. Multiple systems lead to the creation of a heterogeneous environment. More than one developer will make each development group struggle independently with heterogeneity and dynamic environments. When there are more than one user the situation will require customisation of an application to the users' environments. A long system life cycle will necessitate the incorporation of new technologies [7].

2.0 THE SURVEY

The literature review that was carried out could not trace any study that has quantified the actual benefits of systems integration. The quantitative benefits of systems integration include; increased efficiency reduced maintenance cost, shorter business process, and reduction in redundancy; and improvement of data integrity. While the qualitative benefits include: increased customer satisfaction; increased job satisfaction amongst IT and non-IT personnel involved; and improved image of the public services as a whole. It is postulated that the benefits of systems integration are more qualitative than quantitative. Hence, the following hypothesis was formulated:

HI. Benefits of systems integration are more qualitative than quantitative.

Data gathering through a survey was chosen because it is a quick way to gather data from a large number of organisations. Pervan and Klasss in [8] recommended that surveys could provide a rich base of numerical data and are often used in association with other research approaches. Furthermore, surveys act as a standalone research methodology to test hypotheses via the information gathered in the questionnaire. In addition to the survey, telephone interviews were also conducted to seek clarification on the answers given by the respondents.

2.1 Participating Organisations

Questionnaires were sent out to EDP managers of all the 69 government agencies within the Klang valley. This exercise was closely monitored. A total of 40 government agencies responded and thus a response rate of 57.9% was achieved. Supporting data was obtained from the Manpower Administrative Modernisation Planning Unit (MAMPU), which they had gathered through an earlier survey, conducted during the conceptualisation of the electronic government project.

2.2 Methodology

The organisations selected are situated in the Klang valley and are utilising computers in their daily operations. The respondents were ensured of the confidentiality of the information given. The questionnaires were posted to all the 69 government agencies and after a grace period of three weeks, the answers started to come in. The results obtained were summarised using a statistical software package. Some of the data was collected using a Likert scale,

and then the mean, standard deviation and variance were computed. The Likert scale used was from 1 (weakest) to 5 (strongest) and therefore factors with mean value above 3 are considered important.

3.0 QUALITATIVE AND QUANTITATIVE BENEFITS OF SYSTEMS INTEGRATION

Whenever innovations are introduced to an organisation, the management is eager to find out the effects of these initiatives have on their productivity. Productivity is usually related to profits but in an information processing and service-oriented organisation, productivity may not be easily quantifiable. Strassman in [9] argued that whatever productivity gains may have been achieved through computerisation has been squandered off by the profligate waste of human and technological resources. To find out how the public sector will associate productivity with systems integration, the respondents were asked what is the best quantitative measure of the benefits of systems integration and the summary of their response is given in Table 1. Eight measurements have mean values of greater than 3 and the author elaborates only on the uppermost measurements.

Table 1: The best measurement of the quantitative benefits of systems integration

Measurements	Mean	Std. Dev.	Median
1. Shorter/reduced steps in business processes	4.297	.812	5
2. Time taken to process one application/record	4.282	.887	4
3. Less complaints from members of the public	4.077	.929	4
4. No. of applications/records processed over a period	4.0	.889	4
5. Less complaints from end- users	3.949	1.123	4
6. Reduced number of errors	3.947	.868	4
7. Reduced software development time/effort	3.297	1.024	3
8. Reduced maintenance	3.135	.976	3
9. Reduced no. of IT personnel	2.737	1.107	3

The results show that the best quantitative way of measuring the benefits of systems integration is in terms of:

1. Shorter/reduced steps in business processes
2. Time taken to process one application/record
3. Less complaints from members of the public
4. No. of applications/records processed over a period.

The CTG [10], revealed that from their study of 11 projects in the US public sector, the quantitative benefits of their systems integration effort have been characterised as:

1. Administrative and service delivery cost
2. Time required to process a transaction
3. Cost of processing, data entry and correction
4. Elimination of duplication and data entry errors.

The benefits of systems integration in both studies are similar except that reducing the number of complaints from the end-users is not cited as an advantage of systems integration in the CTG's study. One possible explanation is that there are not many serious complaints from end-users in the US due to the efficient present systems. In the Malaysian public sector, the case is different because members of the public are still generally unsatisfied by the service given by government departments. Almost everyday the local newspapers print letter/s from the public complaining of the poor service given by the town council or the National Electricity Board or the Immigration Department or Road Transport Department or the Inland Revenue Department and even the Education Ministry. Therefore, in the Malaysian context, the number of complaints from members of the public is a compelling reason to go forward with systems integration efforts.

3.1 Quantitative Benefits

1. Shorter/reduced steps in business processes

Inefficiency and too much bureaucracy have always been associated with government departments worldwide. Strassman in [9] pointed out that bureaucracy and the complexity of business process have increased tremendously. This in turn increased the demand for more information processing to get anything accomplished. Systems integration is an attempt at improving an organisation's business process.

This benefit of systems integration can be best described using diagrams as in Fig. 1 and Fig. 2. If an integration exercise involves three departments, which uses output of one system as an input to its own system, then a simple business process flow is typically shown as in Fig. 1. The steps *Fill in forms*, *feeding the output from departments A and B to departments B and C* respectively, and *Data entry and validation*, can now be omitted. This is assuming that the input data are similar. Even if they vary, at least the common data need to be captured only once and time is spent only on capturing and validating new data. There is absolutely no need to recapture the output of the previous system manually, since it can be done electronically. Ideally, the resulting situation will be as depicted in Fig. 2.

An example of this situation applicable to public sector is that the case of the National Registration Department, Road Transport Department, Election Commission and Police Department.

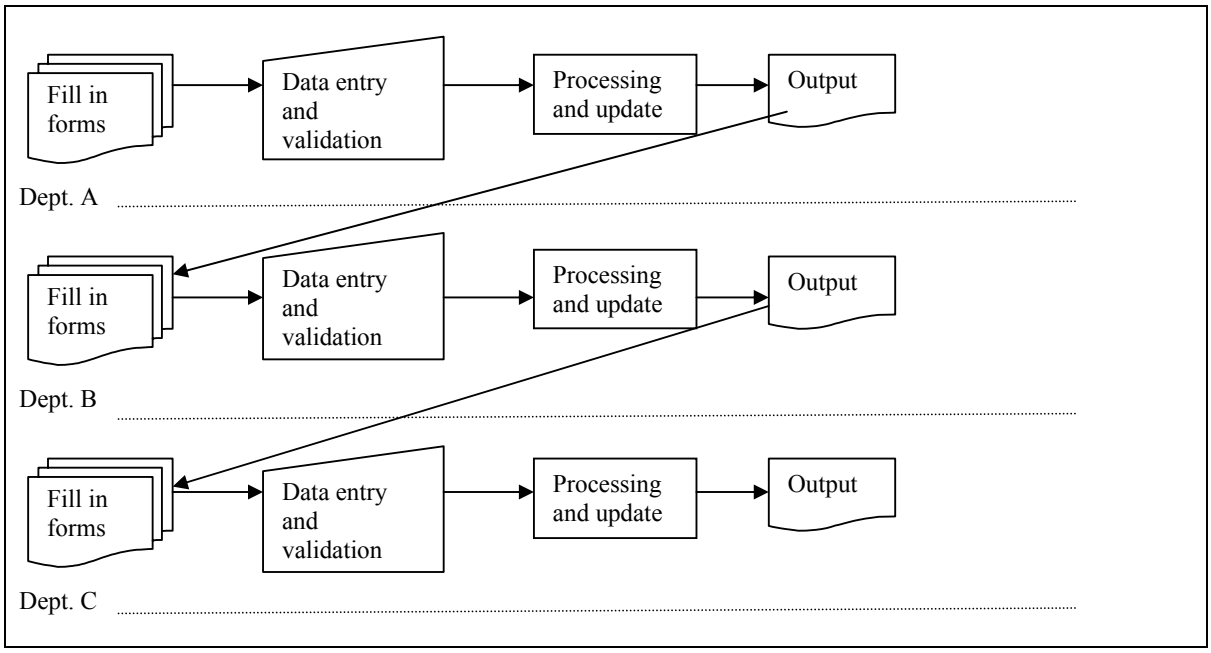

Fig. 1: Business process before systems integration

2. Time taken to process one application/record

As the compulsory number of steps taken to complete a business process is reduced in integrated systems, the time taken to process an application or record will automatically be reduced. This will directly increase the productivity of a department, hence making government departments more efficient.

Time saving is important as most government departments have backlogs and this is bad for the public that it is trying to serve. Backlogs are partly due to the numerous steps of processing required in a transaction. Examples of such cases include the normal purchasing of a house, insurance claim and the application for a business license. Each of these transactions requires input from other department/s and this accounts for part of the overall delay. With systems integration, some of the processing time can be reduced and this will finally result in shorter time taken to process one application or record.

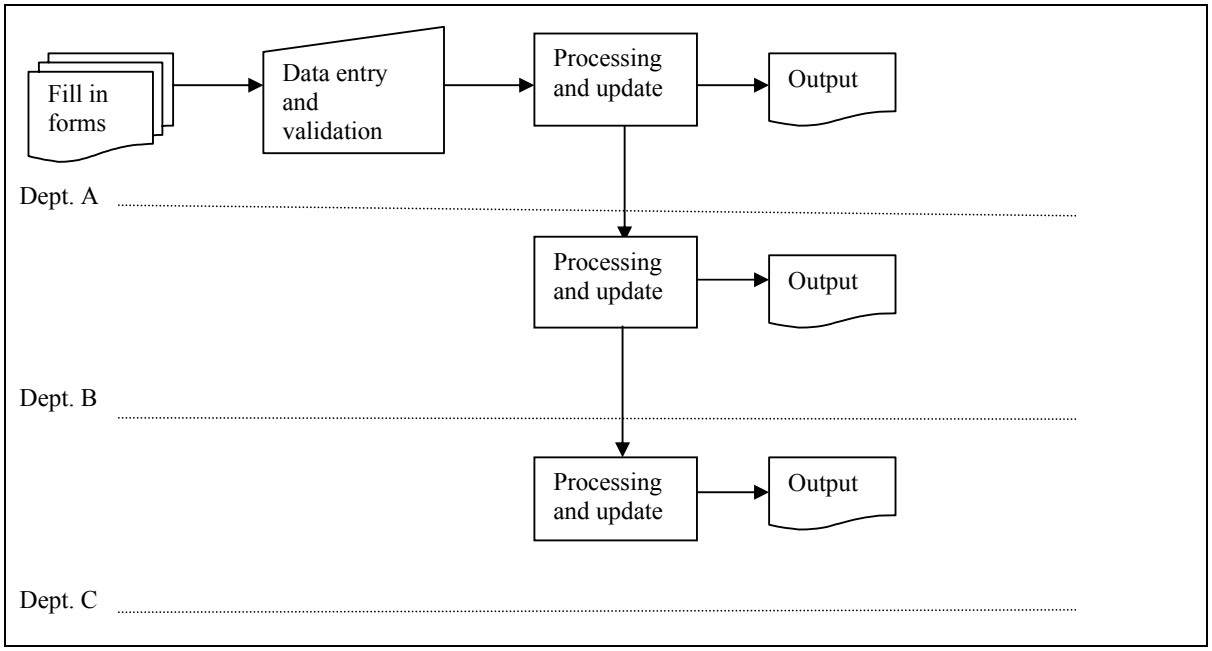

Fig. 2: Business process after systems integration

3. Less complaints from members of the public

The respondents have agreed that this is the third best way to quantify the advantages of systems integration. It is not uncommon to read in the newspapers about the criticisms from members of the public on how incompetent and laggard the public service is. Examples of such grouses concern the public dissatisfaction with the Road Transport Department, Inland Revenue Department and the Immigration Department. With the introduction of systems integration, these departments will be able to be more effective and satisfy the members of the public better.

4. No. of applications/records processed over a period

When systems are integrated, processing steps will be reduced, thus saving time taken to process a transaction. Therefore, within a given time period, the number of applications or records processed will increase. The respondents have chosen this to be the fourth best way to quantify the benefits of systems integration. This is due to the fact that government departments handle high volume of record processing. For example, the Public Services Commission handles annual records of 500,000 and the Election Commission processes around 200,000 to 800,000 application for transfers or new registration to become electors annually.

3.2 Qualitative Benefits

We asked the respondents what is the best qualitative measure of the benefits of systems integration and the summary of their response is given in Table 2 and 3. The results obtained can be categorised into two groups. The first category consists of the positive effects systems integration has on the members of an organisation. The second category comprises the positive effects systems integration has on the public that an organisation serves.

Table 2: Qualitative benefits of systems integration to members of an organisation

Qualitative Benefits of Systems Integration	**Mean**	**Std. Dev.**
1. Improved working procedures	4.564	.680
2. Better communication with other related organisation	4.282	.724
3. Job satisfaction	4.128	.864
4. Redefine job specification	3.811	.908

Table 3: Qualitative benefits of systems integration to members of the public that an organisation serves

Qualitative Benefits of Systems Integration	Mean	Std. Dev.
1. Shorter waiting time	4.342	.708
2. Improved data accessibility	4.289	.835
3. One-stop service	4.237	.852
4. More friendly public service	4.083	.732

1. Improved working procedures

The most obvious qualitative benefits of systems integration is the innovation involved in business processes. When information systems of organisations with related functions are integrated, the existing business processes will inevitably have to be changed. Current business processes will be critically analysed and radically designed to achieve breakthrough improvements in performance measures. These workflows and processes can be within and between organisations. Davenport and Short in [11] have defined this phenomenon as Business Process Redesign (BPR).

As Government departments are operating independently of each other, many processes are repeated involving duplicated and inconsistent data. Lengthy data capture and validation is carried out in every department. If these workflows are critically analysed and reengineered, there will be a marked changed in processing time, efficiencies and end-user satisfaction. Process reengineering will result in an overall simplified business process. When information systems are integrated both within and between organisations, the same effect will be achieved. As to the extent of workflows being improved, will depend entirely on how interrelated the functions are; the degree of information exchange between each organisations; and how many repetitive procedures can be eliminated. According to Malhotra in [12], this manner of collaboration between organisations will lead them to potential strategic advantages.

2. Better communication with other related organisations

When systems are integrated, the improved connectability will increase the accessibility of information not only to organisations participating in the operation. Organisations will find that they can share more information that was previously difficult, costly and/or time consuming to compile non-electronically [13].

Presently, as it was a decade ago, communication between organisations in the public sector has been limited to manual and periodical basis. Information exchange has been on a predetermined and unaltered periods. It would have been ideal if these time intervals are changed as required by events. When information systems are integrated, data will be retrieved from participating systems as and when it is required. The question as to what data will flow from which system/s need only be defined and agreed upon at the initial stages of integration. In this way, communication between organisations can be enhanced. The level of communication between organisations will ameliorate correspondingly with the degree of functional dependencies between departments.

3. Job satisfaction

In essence, Job satisfaction implies doing a job one enjoys, doing it well, and being suitably rewarded for one's efforts. Currently, there is no published report on the level of job-satisfaction amongst civil servants, particularly in the IT divisions. In the past few years, on an annual average, ten IT personnel have left the service for greener pastures. The usual grouses amongst IT personnel are; slow promotion to higher positions, monotonous or routine tasks, lack of new challenges, difficult to implement changes and insufficient training budget. To maintain a consistent high level of job satisfaction amongst civil servants is important as this will ensure an increase in individual productivity and eventually lead to the improve efficiency of an organisation.

Through the implementation of systems integration, working procedures will be revised, shortened and processes improved. This change will reduce the monotony and pointless steps or procedures that are affecting the morale of civil servants. To what extent systems integration will improve job satisfaction is difficult to quantify and the question is very subjective.

4. Redefine job specification

When systems integration is implemented, the whole working procedures will be revised and staff will take up different roles. The organisation will be able to utilise its employees' capability more effectively and at the same time, the staff will have a more challenging job. The question of how many job specifications will be redefined is again difficult to measure and will be a useful research project to be carried out in the future.

According to CTG [10], one of the trends that are shaping the nature of intergovernmental relations is the public demand for sensible and cost effective services. Increasingly, members of the public demand that government programs make sense, work predictably and efficiently. Citizens expect one-stop, same-day customised services instead of the fragmented, duplicative and lengthy processes.

On the positive effects of systems integration an organisation will have on the public it serves, the respondents have chosen to rank the qualitative benefits in the following manner:

1. Shorter waiting time
2. Improved data accessibility
3. One-stop service
4. More friendly public service.

1. Shorter waiting time

Departments like the Immigration, National Registration, Inland Revenue, Road Transport and the Election Commission, deal with the public daily. To them, public satisfaction is very crucial. With shorter and improved procedures through systems integration implementation, shorter waiting time for their customers is very much applauded. Presently, dissatisfaction amongst the public on long waiting time to get service is not an uncommon complaint.

2. Improved data accessibility

Despite the vast campaign on multimedia information systems to make the country an information rich society, data accessibility to the public leaves much to be desired for. With the advent of technology, various information systems in the public service can be integrated so that data accessibility to the public can be greatly improved. The SMPKE, a unit in the Prime Minister's Department, has already embarked on an integration exercise with other ministries. This effort is towards providing a comprehensive one-stop information kiosk that will provide accessibility to the public.

3. One-stop service

There are very few one-stop service made available to the public at the moment. An example of such a service is the payment centre where members of the public can pay their electricity, water and telephone bills at the post office. This is only a very low level of systems integration since there is no interoperability amongst the participating systems involved. With the full implementation of systems integration, the public can get services such as settling payments for quit rents, renewing road tax for vehicles, driving licenses and also make queries to such systems. Obviously, with the adoption of systems integration, the one-stop service to the public can be greatly improved.

4. More friendly public service

Complaints of poor and unfriendly counter service at government departments are a well-known fact. With improved procedures leading to easy and user-friendly systems, brought about by systems integration, civil servants will be able to serve the public better. Counter operators will no longer be bogged down with slow and tedious process of data entry and verification. In fact, they can now afford to spend more time attending to the public needs.

4.0 QUALITATIVE OR QUANTITATIVE

Table 1 summarises what the respondents think of the quantitative benefits of systems integration, while Table 2 and Table 3, summarise what the respondents think of the qualitative benefits of systems integration. To test the hypothesis, HI, the scores from the three tables were combined and their means compared in a t-test. Table 4 contains the results of the computation.

The quantitative benefits are:
1. *Shorter/reduced steps in business processes*
2. *Time taken to process one application/record*
3. *Less complaints from members of the public*
4. *No. of applications/records processed over a period*
5. *Less complaints from end- users*
6. *Reduced number of errors*
7. *Reduced software development time/effort*
8. *Reduced maintenance*
9. *Reduced no. of IT personnel*

The qualitative benefits are:
1. *Improved working procedures*
2. *Better communication with other related organisations*
3. *Job satisfaction*
4. *Redefine job specification*
5. *Improved data accessibility*
6. *One-stop service*
7. *More friendly public service*

On the average, qualitative benefits received higher rankings than the quantitative benefits group. However, it is not statistically significant as proven by the t-test that the *benefits of systems integration are more qualitative than quantitative.*

Table 4: Paired sample test between quantitative and qualitative benefits of systems integration

Pair	Total Mean	Mean of group	Mean Difference	*t*	Sig. (2-tailed)
Quantitative	33.5588	3.7287	Quantitative – Qualitative	-.206	.838
Qualitative	30.9091	4.4155	-0.6869		

5.0 CONCLUSION

The survey showed that respondents could think of more quantitative benefits of systems integration then its qualitative benefits. Even though the quantitative benefits of systems integration are numerous, they are not easily measured. For an organisation to get actual figures of improvement benefits, comparative studies need to be carried. These studies are time consuming and dependent on many variables. The qualitative benefits of systems integration can be categorised into two aspects. The first category affects the employees of an organisation and the second is the members of the public that it serves. The services rendered by public agencies are mostly essential services and cannot be measured by demand. This further makes it difficult to quantify public satisfaction. The qualitative benefits of systems integration to an organisation again are difficult to measure and the choice indicators of measurement are very subjective. Qualitative benefits of systems integration, though non-measurable, seem to have a bigger impact on an organisation and are more important than the quantitative benefits. Comparing the benefits of systems integration to the Malaysian public sector, it is concluded that the benefits of systems integration are more qualitative than quantitative. Hence, the findings of the survey support the hypothesis:

HI Benefits of systems integration are more qualitative than quantitative.

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BIOGRAPHY

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