# Measuring Information Health: A Planning and Evaluation Tool to Support IRM Practice

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## ABSTRACT

*Most Information Resource Management (IRM) groups do not have any quantitative basis for planning, prioritising or measuring the results of their activities. As a result, the practice of IRM tends to be based on anecdotal evidence and conjecture about organisational information needs rather than hard facts. This paper describes a survey instrument, called the Information Health Survey, which was used as part of developing an Information Management Strategy for one of Australia's largest organisations. The survey methodology was based on the approach used to conduct population health surveys. The instrument measures levels of information support ("information health status") of information users across the organisation using a set of Information Health Indicators. Use of the instrument enabled much wider consultation than would otherwise been possible, and provided a quantitative basis for developing recommendations. It also provided a way of measuring the outcomes of the strategy over time. While the instrument proved useful in this particular case, it also provides the starting point for developing a general purpose tool to support IRM practice.*

## 1. INTRODUCTION

### Information Resource Management (IRM)

The goal of Information Resource Management (IRM) is to manage information as a corporate resource, in the same way that other organisational resources such as finance, personnel and property are managed (Henderson, 1987). In the absence of explicit management, different parts of an organisation are likely to collect their own copies of information and store it in different and incompatible formats. The costs of an uncoordinated approach include duplication of capture, storage and update effort, system integration problems and difficulty in consolidating information for reporting. The terms Data Resource Management (English, 1992), Data Administration (Hufford, 1991), Data Management (Goodhue et al, 1992) and Information Management (Davenport, 1997) are also used for both the philosophy of IRM and the group responsible for implementing it.

### Measurement of IRM Effectiveness

Measurement of results has been a perennial problem in information resource management (Moody and Simsion, 1995). While there is considerable literature on IRM techniques and their potential benefits (e.g. Martin, 1989; Kerr, 1991; Love, 1994), there has been little serious attempt at quantification of these benefits. One reason for this is that many of the benefits of IRM are perceptual and difficult to measure in a formal way. A survey carried out of leading practitioners in the United States and Europe (Figure 1) showed that only 13% of IRM groups had implemented procedures for measuring their performance (English and Green, 1991). The vast majority of the respondents had no performance measurement program in place nor any intentions of establishing one in the next year.

In the absence of any measurement of the impact of IRM in practice, the assumption that it adds value to the business remains essentially an unproven one. Aside from purely anecdotal evidence, there is little evidence to say whether IRM has had a net positive or negative effect in most organisations.

### The Need for An Empirical Base for IRM Practice

Most IRM groups do not have a quantitative basis for planning, prioritising or measuring the results of their activities. As a result, the practice of information resource management tends to be based on anecdotal evidence and conjecture about organisational information needs rather than hard facts. There is rarely any attempt to formally measure the nature and extent of the problems that exist (*diagnosis*), even though this is essential to ensure that improvement efforts (*treatments*) are directed where they will have the most impact. The lack of "hard" data makes it very difficult for IRM practitioners to justify their activities and to obtain management support (Moody and Simsion, 1995). It is somewhat surprising and also ironic that professionals in the area of information management do not use information to manage their own activities. The objective of this paper is to develop an instrument which will provide a quantitative basis for IRM practice.
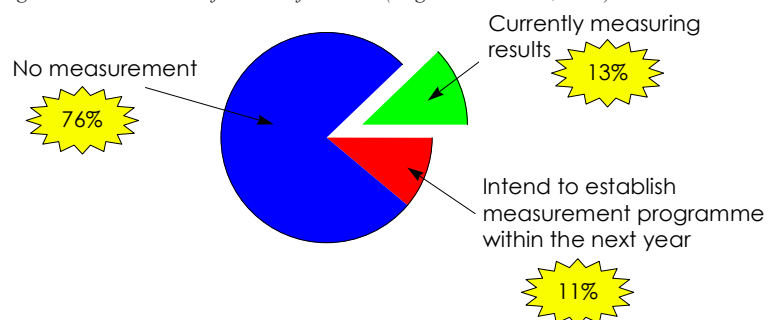
### Data Quality Measurement

One area of measurement in the IRM field which has attracted considerable interest recently is that of *data quality measurement* (Wang and Strong, 1996; Haebich, 1997; Wang, 1998; Shanks and Darke, 1998). This involves comparing data values stored in databases to real world values and developing measures of data accuracy using formal statistical methods. This can be used as a basis for improving data quality and also to provide an error margin for users of the information, which they can incorporate into their decision making processes. However there are a number of problems with data quality measurement:

- It is very time-consuming and expensive to carry out, and hence can only be applied in a very narrow scope, usually a single database table. It is a "micro" level measurement and impractical to apply on a global basis—it cannot be used as a tool for measuring the quality of an organisation's information resources as a whole.
- It only measures one aspect of information "health"—accuracy. While accuracy is important, other characteristics of information such as integration (the ability to compare or link data sources together), analysis (the ability to analyse information) and the format it is presented in may be equally important in assessing its business value.

The medical equivalent of data quality measurement is a pathology

*Figure 1. Measurement of IRM Performance (English and Green, 1991)*



No measurement **76%**

Currently measuring results **13%**

Intend to establish measurement programme within the next year **11%**

test. Like pathology tests, data quality measures are very expensive and should only be used sparingly. To be most effective, they should only be carried out after a global assessment of information health—this will indicate which areas need to be investigated in more detail.

## 2. LESSONS FROM THE HEALTH INDUSTRY
### The Need for a New Paradigm

Information Resource Management is a relatively new discipline, and has a lot to learn from other, more mature disciplines. In the past, IRM has borrowed from mechanistic disciplines such as architecture (*information architecture*) and engineering (*information engineering*). The typical approach is to develop an information architecture and use this to achieve integration and sharing of data (Martin, 1989; Finkelstein, 1989). Such approaches have proven to be extremely difficult to implement in practice (Goodhue et al, 1988; 1992; Davenport, 1994; Shanks, 1998; Simsion, 1999).

One explanation for the failure of such approaches is that they fail to recognise that information management is primarily a human/organisational issue rather than a technical one (Davenport, 1994; 1997). IT simply provides a mechanism for storing and distributing information. People are the producers and consumers of information, and therefore form the starting point for all solutions to information management problems. Improving information management involves organisational and behavioural change— IT is only ever a minor part of the solution. As a result, disciplines such as engineering and architecture may not be the most appropriate paradigms to draw on.

In this section, we look at the discipline of health management as a source of ideas for IRM practice. The reason for choosing this field is partly serendipitous, in that the project described in this paper was a health department. However there are a number of reasons why health care management could provide a useful source of ideas for IRM:
- It is highly quantitative and based on rigorous analysis of needs
- It is a human-based discipline, which may be more appropriate as a basis for transfers of idea than disciplines which focus on construction of inanimate objects (although these may be appropriate for systems development)
- It focuses on *integration* of services. While individual service providers focus on meeting the needs of their patients, the health planning process is about providing the most appropriate mix of services to meet community needs.
- It is strongly focused on measuring outcomes: expenditures on health services must be justified in terms of improvements in the health of the population.

### Health Services Planning

Health services planning is a very complex task, which requires balancing limited public funds with a virtually unlimited demand for services. For this reason, a great deal of effort is spent making sure that funds are spent where they are most needed. A key tool in health services planning is the *population health survey*. This is carried out on a random sample of the population and results in a snapshot of the health status of the population. A population health survey is based on a number of key concepts:
- Health Status: This is a measure of how healthy particular individuals or groups are, and therefore their needs for health services. Health status is a multi-dimensional concept based on a number of discrete variables (health indicators).
- Health Indicators: these are factors which contribute to an individual's overall health status.
- Health Determinants: these are characteristics of people which may affect their health status. For example, age, sex, income, employment status, occupation category and ethnic background.
- Population group: these define particular segments of the population based on a particular characteristic or combination of characteristics. The health status of different population groups are compared to identify *inequalities* between them.
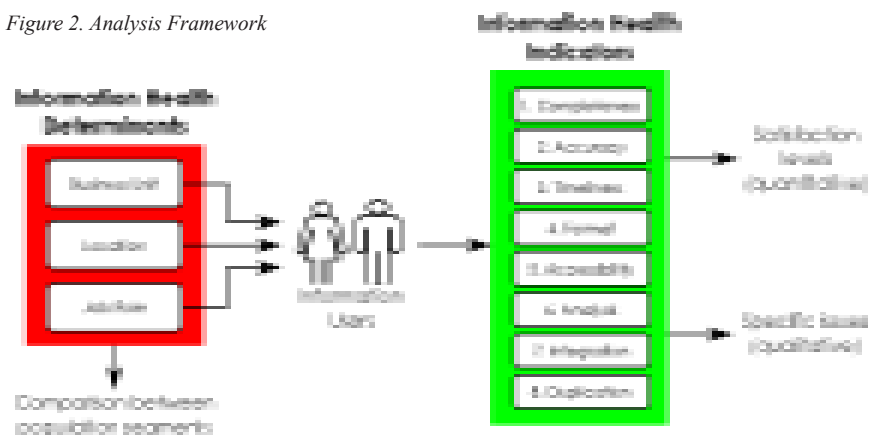
The data collected by the population health survey is used in the following ways:
- Diagnosis: Survey data is used to identify the most critical health problems which exist in the community.
- Comparison: Survey data is used to identify inequalities in health status between different population groups (e.g. rich vs. poor, different ethnic backgrounds and age groups).
- Planning: The information gathered provides a quantitative basis for planning the most appropriate mix of health services to meet community needs. Programmes can be developed to address the most critical health problems and inequalities in health status between groups.
- Evaluation: The survey can be used to measure improvements in population health over time (e.g. reduction in morbidity or mortality). This provides a basis for measuring the effectiveness of health programmes (*outcome measurement*).

### Implications for IRM Practice

In the same way that planning of health services begins by looking at population health needs, effective planning of IRM activities should (but rarely does) begin by looking at the needs of information users. Users of information include staff, but may also include customers and suppliers. The next section describes an instrument which can be used to measure levels of information support ("information health status") at all levels and in all areas of an organisation. The information obtained can be used to identify IRM actions which will be most effective in addressing organisational information needs.

## 3. SURVEY DESIGN
### Project Background

The survey instrument was developed as part of a project to develop an Information Management Strategy for one of Australia's state health departments. The Department is one of the largest organisations in Australia in either the public or private sector, with a budget of over six billion dollars in 1998 and over one hundred thousand staff. It is divided into 20 Area Health Services, each of which administers health care facilities in a defined geographical area. Health care facilities include hospitals, community health centres and other specialist facilities (e.g. drug and alcohol centres).

Information Management Strategies are typically developed as a result of interviews and workshops with a cross-section of business users and IT staff (Martin, 1989; McGee and Prusak, 1993). There is never time in such projects to consult everyone in the organisation, so the strategy is built on anecdotal evidence gathered from an often unrepresentative sample of people. Most strategies are heavily biased towards the needs of administrative and management staff, because they are more accessible and hence over-represented in interviews and workshops. Front-line operational staff, who deal directly with customers, are generally under-represented even though this is where improving the quality of information would have the greatest impact. In the health sector, clinicians, who are people who deal directly with patients (this includes doctors, nurses and allied health professionals) are frequently left out of the consultation process. This has resulted in an information infrastructure which mainly supports administrative processes but does little to support clinical needs (Moody and Shanks,



*Figure 2. Analysis Framework*

1999).

A major objective of the project was to develop the strategy based on the widest possible consultation and to involve staff from all areas and levels of the organisation. Clearly, this would be a major challenge in such a large and geographically distributed organisation. To address this issue, an instrument (called the Information Health Survey) was developed to measure levels of information support across the organisation. This was based closely on the concepts used in population health surveys. Figure 2 shows the conceptual framework underlying the Information Health Survey.

A set of *Information Health Indicators* and *Information Health Determinants* were developed in consultation with members of the Steering Committee for the project. Information Health Indicators were used to develop survey questions, while Information Health Determinants were used as a basis for sampling and analysis of data. The indicators and determinants used are described in detail in this section.

### Information Health Indicators

Information Health Indicators define the characteristics of information which contribute to its overall quality or "health". The set of information health indicators identified were:

1. Completeness: this measures whether people are receiving all the information they need and if there are any specific information "gaps".
2. Accuracy: this measures people's perceptions of the accuracy of the information they receive.
3. Timeliness: this measures whether information is received within required timeframes.
4. Format: this measures whether people are receiving information in the most appropriate format.
5. Accessibility: this measures how difficult it is for people to find and/or access the information they need.
6. Analysis: this measures people's ability to analyse and manipulate information in appropriate ways.
7. Integration: this measures how easy it is to compare or combine information from different sources.
8. Duplication: this measures whether the same information is collected and stored redundantly.

These indicators were used to develop questions on the Information Health Survey. Both quantitative data, in terms of levels of satisfaction, and qualitative data, in terms of specific issues, were collected for each indicator.

### Information Health Determinants

Information Health Determinants are characteristics of staff which may affect their level of information support. Three information health determinants were identified:

- Location: this was defined by the Area Health Service to which respondents belonged
- Service delivery area: five service delivery areas were identified based on the type of services provided. These were based on existing organizational classifications.
- Job Role: six primary job roles were identified.

Information Health Determinants were used as a basis for sampling and analysis of data. In particular, they were used to analyse differences in levels of information support between different groups of users. As well as looking at differences between different locations, service areas and job roles, it is also possible to look at differences between combinations of these. In the matrix shown in Figure 3, each cell forms a particular *population segment* for analysis purposes.

### Questionnaire Design

The Information Health Indicators and Information Health Determinants were used as a basis for designing the survey. Each Information Health Indicator was measured by one or more questions on the survey. Respondents were asked to identify their level of satisfaction on each of the eight information health indicators using a five point Likert scale. They were also asked to identify specific problems or issues they had experienced in textual form.

### Method

Questionnares were distributed to over 400 staff in the organisation,

*Figure 3. Analysis by Population Segment*



by internal mail and email. Staff from all Area Health Services, service areas and job roles were included in the sample. The set of Information Health Determinants were used as a basis for selecting the sample.

### Data Analysis

Descriptive statistics were used to analyse the results by question, location, service area and job role. Qualitative analysis of textual data was carried out for all questions to identify the most frequent responses to each question.

## 4. HOW THE SURVEY DATA WAS USED

### The Information Health Report

The results of the survey were published as a report in its own right, called the Information Health Report, and distributed to key people across the organisation, and published on the Departmental intranet. The reaction from most people, particularly management, was that they found it useful to have a picture of how well information needs were being satisfied in the organisation, which they had never had before.

### Development of Information Management Strategy

The results of the survey provided useful input into the development of the Information Management Strategy and formed the basis for most of the recommendations in the strategy. The results of the survey were used in the following ways:

- The qualitative results of the survey were used to identify the most critical information management issues in the organisation. Qualitative data analysis was used to rank the issues based on their frequency. The top issues were then investigated in detail and recommendations were developed to address them.
- Analysis of differences in levels of satisfaction highlighted groups of users who were disadvantaged in terms of information support. These identified priority areas for improvement efforts. These groups were specifically targeted in the Information Management Strategy.

### Outcome Measurement

A problem with most Information Management Strategies (and most strategies in general) is that it is difficult to determine whether they have been successful or not. The Information Health Survey provided a tool for measuring the effectiveness of the Information Management Strategy. This first survey forms a baseline measure (the "before" photograph) to be used for comparison over the life of the strategy. The survey will be carried out every year to measure improvements over time. This provides important feedback as to whether the strategy is working or not.

### Benefits in Practice

*Level of Consultation*

Use of the Information Health Survey enabled much wider consultation than would have otherwise been possible in such a large and geo-

Figure 4. Outcome Measurement Approach
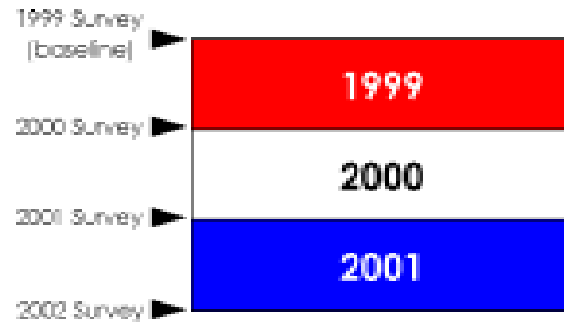


graphically distributed organisation. It also resulted in a much more accurate picture of the state of information management in the organisation than would have been possible otherwise.

### Quantitative Basis for Recommendations

The survey also provided a quantitative basis for making decisions about information management priorities in the organisation. Recommendations of the strategy were backed up by empirical evidence rather than having to rely on anecdotal evidence alone. At the end of the process, the recommendations were mapped back to issues raised in the survey, which provided a useful check that the most critical issues had been addressed.

### Focus on Information rather than Technology

The survey was highly successful in getting people to focus on information management issues in the broadest sense rather than focusing only on IT aspects. A problem with many Information Management Strategies is that they focus on computer-based data while ignoring other types of information: manual records, electronic documents and knowledge stored in people's heads. Evidence for this is that *less than a quarter* of the recommendations in the strategy were IT-related.

## Lessons Learned

A number of lessons were learned as a result of the use of the instrument in practice.

### Sampling Techniques

A problem was found with the sampling technique used, which aimed for equal representation of each group based on the Information Health Determinants. This resulted in over-representation of particular groups relative to their proportions in the total population. A better approach would be in the future to use *stratified random sampling*, where each group is proportionally represented.

### Qualitative Analysis

The qualitative analysis of comments on the survey proved time-consuming and difficult. In many cases, it required specialist knowledge about the organisation to understand what people were talking about, so could not be done by clerical staff. However the results of this analysis proved to be the most useful output of the survey, since it was used to identify the most critical information management issues, which formed the basis for most of the recommendations.

### Question Format

A common criticism received about the questionnaire was that it was difficult to give responses to general questions about information quality when the answer was different for different sources of information. For example, the accuracy of information may be low for one source (e.g. the financial system) and high for another source (e.g. medical records). To address this, the questionnaire could be redesigned to

include responses for each source, although this would make it much more complex—each question would have to be answered for each source used. Work is currently in progress to develop and test a new version of the questionnaire which allows this.

### Validation of Information Health Indicators

Four new Information Health Indicators were discovered as a result of issues raised by respondents not fitting into any of the categories defined. An additional Information Health Determinant was discovered called Role. This defines the role of the respondent in the organisation: staff member, patient (customer) or service provider (supplier). While customers and suppliers were not included in this survey, they represent important consumers of information who should also be involved in the consultation process. The revised framework is shown below:

## 5. CONCLUSION

### Summary

This paper has described an instrument (the Information Health Survey) which provides a means for measuring levels of information management support (*information health status*) across all areas of an organisation. It provides quantitative data on the level of information support, as well as qualitative data about the key problems, issues and opportunities. It therefore provides an empirical basis for developing an organisation-wide Information Management Strategy.

### Practical Significance

While the instrument was found to be useful on the project described in this paper, we believe it also provides the starting point for developing a general purpose tool to support IRM practice. Such an instrument would provide a quantitative basis for managing information, as opposed to the largely anecdotal and model-based approaches currently used in practice. Importantly, it provides an example of how *information* can be used to guide IRM activities, instead of relying on anecdotal evidence or conjecture about what users of information need. The major practical uses of the instrument are:

- Diagnosis: to identify the most critical information management issues which exist in the organization. Currently this is done based on anecdotal evidence rather than empirical analysis.
- Comparison: to identify inequalities in information support between different groups of information users.
- Prioritisation: to identify where improvements in the level of information support will have the greatest impact.
- Planning: to identify actions which can be taken to address the most critical information management issues.
- Outcome measurement: to measure improvements in information support over time.

Figure 5. Revised Analysis Framework
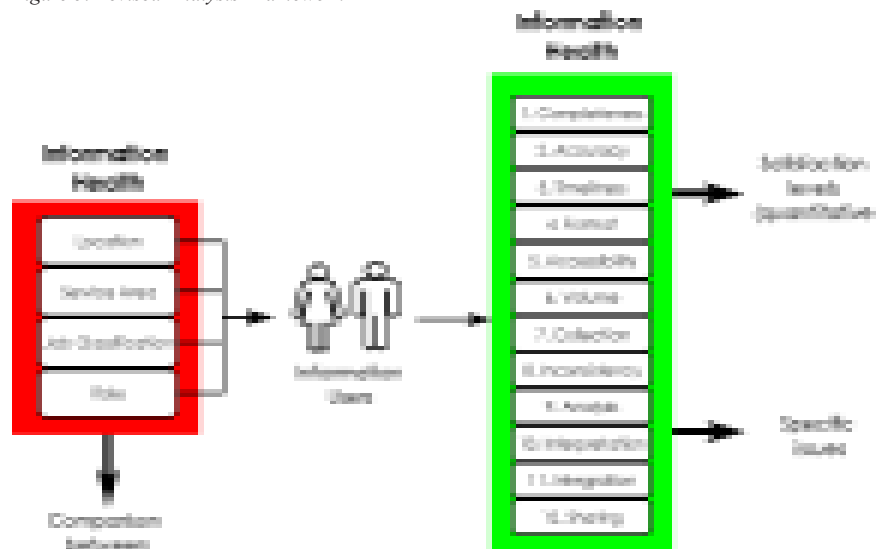
## Theoretical Significance

De Lone and McLean (1992) have defined a comprehensive framework for measurement of IS success measurement, which has been widely accepted in the literature. The instrument defined in this paper clearly fits into the Information Quality dimension in De Lone and McLean's framework. Most previous instruments for measuring information quality have focused at a very detailed level, measuring the quality of data stored in individual information systems or individual data fields (e.g. Wang, 1998; English, 1999; Haebich, 1997). This instrument measures information quality at the level of an entire organisation and covers information of all types: manual records, documents and knowledge stored in people's heads as well as computer-based data. The set of Information Health Indicators and Information Health Determinants were not developed based on theory, but were empirically derived in consultation with users of information. However these concepts could be usefully integrated with theoretical research into dimensions of Information Quality based on ontology and semiotics (e.g. Wand and Wang, 1996; Shanks and Darke, 1998).

## Limitations of the Instrument

There are a number of limitations of the instrument which need to be understood to use the results effectively.

## Self-Reported Data

One limitation of the survey is that it measures *self-reported* information health status. That is, it measures people's *perceptions* of the quality of information rather than its actual quality. In a number of cases on this project, detailed investigation of issues raised in the survey found that perceptions were very different to reality—information people thought was inaccurate was in fact highly accurate and vice versa. This is a common finding in practice (Haebich, 1997). There is often a wide disparity between the perceived quality of information and its actual quality. This suggests that the information gathered by the survey needs to be supplemented by objective assessment of accuracy, timeliness etc. On the other side of this argument, like the stock market, people's perceptions of the value of information are often as important as its "real" value. For example, if information is perceived as inaccurate, it will not be used regardless of whether it is or not.

## Global Assessment

The survey provides a very high level assessment of the state of information management in an organisation. It does not provide enough detail about particular issues to solve them. To develop recommendations for improvement, this information must be supplemented by detailed investigation of issues raised. In many ways, the survey is analogous to a medical examination by a doctor. If any potential problems are identified as a result of the examination, these will be investigated in detail using pathology testing in order to make a reliable diagnosis and recommend treatment.

## Is Democracy a Good Thing in Information Management?

One of the objectives of health planning is provide equal access to health services to everyone in the community. The principles of *access* and *equity*—that everyone has equal rights and access to health services regardless of ethnic background and income—are pervasive in public health provision. However principles of democracy and equality, while important in society, are not necessarily applicable in organisations. Organisations, both in the public and private sector, are concerned with achieving their objectives in the most efficient and effective way—this means deploying resources (which includes information) where they will have maximum impact. While all staff should be entitled to a minimum level of information support, there are clearly areas which should be given priority in information management efforts either because of the nature of their work—*information intensive* occupations—or because of their strategic importance in achieving organisational objectives. For this reason, it is important to understand the roles of different groups of users in the organisation.

## Further Research

Research is currently in progress to validate and refine the instrument, using a number of organisations in the public and private sector. A data warehouse has also been developed to support analysis of the results using an OLAP tool.

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