

How to Present Performance Data to Decision Makers in Healthcare

by

Heather Jennings
BSc, University of Victoria, 2004

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

Master of Science

in the School of Health Information Science

© Heather Jennings, 2013
University of Victoria

All rights reserved. This thesis may not be reproduced in whole or in part, by
photocopy or other means, without the permission of the author.

Supervisory Committee

How to Present Performance Data to Decision Makers in Healthcare

by

Heather Jennings
BSc, University of Victoria, 2004

Supervisory Committee

Dr. Andre Kushniruk, Health Information Science
Supervisor

Dr. Elizabeth Borycki, Health Information Science
Departmental Member

Larry Frisch, Health Information Science
Departmental Member

Abstract

Supervisory Committee

Dr. Andre Kushniruk, Health Information Science
Supervisor

Dr. Elizabeth Borycki, Health Information Science
Departmental Member

Larry Frisch, Health Information Science
Departmental Member

Healthcare organizations are moving towards the use of dashboards for presenting performance data and away from the use of balanced scorecards, but there is little research that addresses whether dashboards are better than balanced scorecards. This study gathers qualitative and quantitative data from interviews with decision makers, 6 directors and 10 managers, from a large healthcare organization. Decision makers were presented with the most commonly used graphic formalisms from both the dashboard and the balanced scorecard, which were a gauge and tabular format respectively. The presentation contained information about healthcare decision making scenarios. Neither of the formats affected the decision maker's ultimate decision on whether to take action and for both display formats the decision maker requested more information than what was presented to them. However, it was found that the gauge format was perceived as being easier to understand, better supported decision making and that it contained more complete information. Overall, the analysis reveals that 94% of participants preferred the graphic formalisms from a dashboard to the graphic formalisms in the balanced scorecard. This study shows that decision makers prefer dashboards to balanced scorecards when comparing the most common graphic formalisms found in balanced scorecards (tabular format) and dashboards (gauge format). The results are consistent

with a move towards greater use of dashboards in healthcare. Theoretical implications of the work are discussed.

Table of Contents

Supervisory Committee	ii
Abstract	iii
Table of Contents	v
List of Tables	vii
List of Figures.....	viii
Acknowledgments	ix
Dedication	x
Chapter 1: Introduction.....	1
Chapter 2: Literature Review	4
2.1 Evolution of Performance Data Formats	4
2.1.1 Introduction.....	4
2.1.2 Evolution of Performance Data Display Formats	5
2.2 Current Formats Used to Display Performance Data.....	7
2.2.1 Balanced Scorecards	7
2.2.2 Dashboards	14
2.2.3 Summary	21
2.3 Theoretical Perspectives	22
2.3.1 Cognitive Fit Theory	22
2.3.2 Cost-Benefit Theory	23
2.3.3 Representational Congruence.....	24
2.3.4 Cognitive Load Theory	25
2.3.5 Hibbard Framework.....	25
2.3.6 Summary	26
2.4 Past Studies	30
2.4.1 Fields That Address Methods of Information Presentation	30
2.4.2 Studies With No Preference of Information Presentation.....	31
2.4.3 Studies that Examine the Reason Behind Difference in Data Presentation Methods.....	31
2.4.4 Balanced Scorecards and Dashboards in Healthcare.....	32
Chapter 3: Research Questions	34
3.1 Statement of Problem.....	34
3.2 Significance and Purpose of the Study	34
3.3 Research Objectives	34
3.4 Research Questions.....	35
Chapter 4: Methodology	36
4.1 Participants.....	36
4.1.1 Participants Recruited	36
4.1.2 Participant Inclusion Criteria.....	36
4.1.3 Participant Exclusion Criteria	37
4.2 Participant Recruitment Method	38
4.3 Setting and Procedure.....	39
4.3.1 Setting	39
4.3.2 Materials.....	40
4.3.3 Procedure.....	40
4.4 Methods.....	45
4.4.1 Data Collection	45

4.4.2 Data Analysis	46
4.5 Case Justification, Controls and Assumptions	47
4.5.1 Case Justification	47
4.5.2 Controls	49
4.5.3 Assumptions	49
Chapter 5: Study Findings.....	51
5.1 Introduction.....	51
5.2 Demographic Characteristics of Participants	51
5.3 Impact on Decision Making	55
5.3.1 Informs Decision Making	55
5.3.2 Action	56
5.4 Comparison of Formats.....	58
5.4.1 Understandability of Information.....	58
5.4.2 Level of Support for Decision Making.....	60
5.4.3 Completeness of Information	61
5.5 Decision Maker's Preference	68
5.6 Other Results	70
5.6.1 Previous Experience With Performance Data Presentation Formats.....	70
5.6.2 Change Method of Display of Performance Data	72
5.6.3 Learning	73
5.6.4 Quantitative Results	74
Chapter 6: Discussion and Conclusion	75
6.1 Healthcare decision makers prefer the gauge display format	75
6.2 Healthcare decision makers need more information to make an informed decision	75
6.4 How the Hibbard Framework Explains the Preference of Performance Data Presentation Methods	76
6.4.1 Process 1: Lowering the Cognitive Effort Required.....	76
6.4.2 Process 2: Helping People to Have a Better Idea of What the Actual Experience of a Choice Might Be Like	77
6.4.3 Process 3: Highlighting the Meaning of the Information.....	79
6.5 Limitations	80
6.6 Implications	82
6.6.1 Implications for the Future Implementation of Performance Display Methods.....	82
6.6.2 Implications for Healthcare Decision Makers	82
6.6.3 Implications for the Health Informatics Field	83
6.7 Future Research.....	83
6.8 Conclusion.....	84
Bibliography	85
Appendices	
Appendix A.....	90
Appendix B.....	91
Appendix C.....	92
Appendix D.....	93
Appendix E.....	95
Appendix F	99
Appendix G	100
Appendix H.....	101

List of Tables

Table 1: Demographics	54
Table 2: Information Needed.....	61
Table 3: Causes	62
Table 4: Key	66
Table 5: Definitions	67
Table 6: Key	70
Table 7: Paired T-Test Results	74
Table 8: Question 6 Results	101
Table 9: Question 7 Results	102
Table 10: Question 8 Results	102

List of Figures

Figure 1: The balanced scorecard Link Performance Measures (Kaplan et al., 1992)	6
Figure 2: Huron Perth Hospitals Partnership's Balanced Scorecard for clinical outcomes and utilization and financial performance and condition.	11
Figure 3: Balanced Scorecard Legend.....	12
Figure 4: Active Strategy Balanced Scorecard	13
Figure 5: Informatica Dashboard.....	17
Figure 6: Cognos Dashboard	18
Figure 7: Corda Airlines Dashboard.....	19
Figure 8: Hospitality Dashboard.....	20
Figure 9: Cognitive Fit in Problem Solving (Shaft, 2006)	22
Figure 10: Extended Cognitive Fit Model (Shaft, 2006)	24
Figure 11: Hibbard Conceptual Model	27
Figure 12: Modified Divisional Organizational Design (Shortell, 2006, p. 331)	38
Figure 13: Study set-up.....	40
Figure 14: Tabular Format	42
Figure 15: Gauge Format.....	42
Figure 16: Marked Line	47
Figure 17: Length of Time at Current Skill Level.....	52
Figure 18: Distribution of Participants by Position.....	53

Acknowledgments

I wish to express my appreciation and gratitude to:

My supervisor:

Dr. Andre Kushniruk, for his guidance, patience and advice throughout the program.

My committee members:

Dr. Elizabeth Borycki, for her suggestions and advice.

AND

Dr. Larry Frisch, for his insights and help.

My participants, without whom this research would not be possible.

Dedication

For my parents, Jane and Roger, and my brother, Andrew, for always supporting me through whatever was happening in my life. For my husband, Fred, for whom I am forever grateful. Thank you all for your encouragement and love.

Chapter 1: Introduction

Throughout history, humans have always presented data in one form or another. Data representation began with pictographs on cave walls and evolved into the modern day graphs now found in business presentations. Currently, we have an almost exponential increase of information due to the evolution of computer technology. Anyone who uses a computer, is aware of the vast amount of information available online, which is one example of the need for meaningful organizational systems. Large amounts of data bombard decision makers in healthcare organizations daily, especially due to increasing information accessibility and the complexity of the field. Since decision makers must find ways to organize and interpret the data they require, selecting an appropriate data representation methodology is a very important issue.

Organizational performance is important in many areas of business including healthcare, and there needs to be methods to present this type of data. Increasingly, healthcare organizations will be asked to justify their existence to the shareholders and stakeholders on the basis of providing quality, cost-effective care. They will be asked to submit information according to standardized data sets (McLaughlin and Kalunzy, 2006, p. 58). These standardized data sets may involve a combination of organization-specific criteria and required outcome measures (McLaughlin et al., 2006, p. 58) and can be measured in the form of indicators. One way in which indicators are presented to decision makers is in the form of balanced scorecards. Kaplan and Norton (1996) developed the premise for this approach through a series of articles in the early 1990s and later compiled this work together with a more in-depth discussion of examples from the field (McLaughlin et al., 2006, p. 144). Although balanced scorecards are now widely used, dashboards started to become more popular as a means to present performance

data. Around 2001 dashboards emerged when corporations felt the pressure to demonstrate their ability to closely monitor what was going on with their organizational performance. The marketplace soon offered a vast array of dashboard software from which to choose (Few, 2006, p. 7). Balanced scorecards and dashboards are two methods used to present performance data, and this thesis will explore their perceived impact on decision making. With these different display methods having being developed, the question arises which may be more effective, and in which contexts.

Balanced scorecards and dashboards may serve different purposes. A balanced scorecard's function is solely to display performance data, whereas a dashboard, by definition "provides[s] visibility into key performance indicators (KPIs) through simple visual graphics such as gauges, charts and tables within a web browser" (Rivard et al., 2004). Since dashboards contain many different forms of visual display of information, the most common type of display was used in this study, which is the gauge format. In summary, this thesis compares the most common graphic formalisms of each method of displaying performance data in healthcare; the most common balanced scorecards graphic formalism is the tabular format; the most common dashboard graphical formalism is the gauge.

As our society in general is being introduced to more sophisticated technology and becomes more accustomed to computers, so does the healthcare society. This thesis will explore the current trend of healthcare organizations in terms of the presentation of performance data using dashboards and balanced scorecards. This thesis will look into various aspects of the two display formats but will first examine the general question of whether performance data impacts decision making. It will then compare the two display formats in terms of: understandability of the information, the level of support they provide

for decision making and the completeness of information from the end user's perspective.

Chapter 2: Literature Review

In this chapter we will explore how certain performance data display formats evolved and how they became popular. We will then define the current formats used to display performance data. The theory behind different display formats will be discussed. Finally, selected previous studies will be discussed which are relevant to this thesis.

2.1 Evolution of Performance Data Formats

2.1.1 Introduction

There are two main types of formats used to display performance data in healthcare: balanced scorecards and dashboards. Two of the main points about a balanced scorecard are the following” 1) “a well-crafted balanced scorecard should tell the story of the organization`s strategy through a series of cause-and-effect linkages inherent in the Scorecard measures” (Niven, 2002, p. 23) and 2) “a balanced scorecard does not have to always display graphic formalisms as the Scorecard can display numbers and text only”. (Active Strategy) Distinct from the balanced scorecard, Rivard (2004) explains that dashboards “provide visibility into key performance indicators (KPIs) through simple visual graphics such as gauges, charts and tables within a web browser”. In many respects a reporting dashboard can be likened to a dashboard in an automobile. It provides an 'at-a-glance view' of the current operational state of the vehicle.

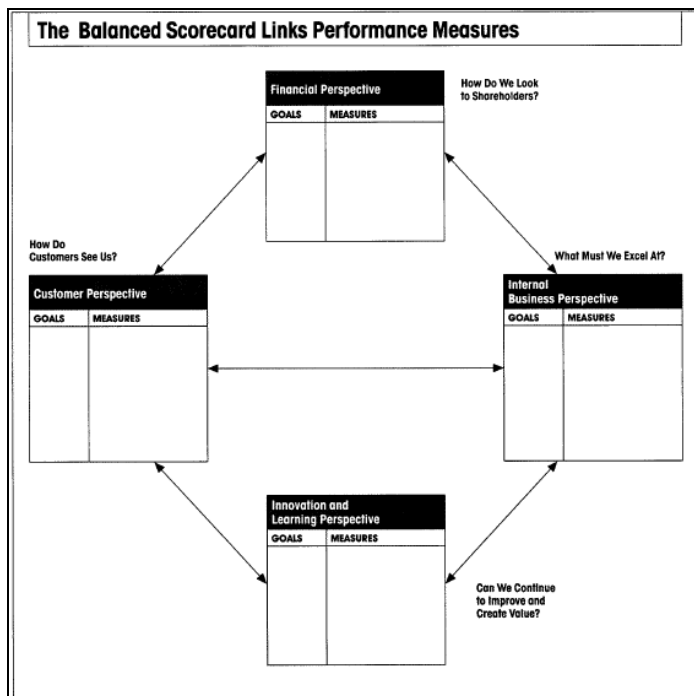
The evolution of performance data display methods will be discussed, each of the formats will be examined in terms of their definition and examples will be given for both the balanced scorecard and dashboard.

2.1.2 Evolution of Performance Data Display Formats

The balanced scorecard was developed by Robert Kaplan, a professor at Harvard University, and David Norton, a consultant also from the Boston area. In 1990, Kaplan and Norton led a research study that examined a dozen companies who were exploring new methods of performance measurement. The impetus for the study was a growing belief that financial measures of performance were ineffective for the modern business enterprise. The group discussed a number of possible alternatives but settled on the idea of a Scorecard featuring performance measures that capture activities from throughout the organization – customer issues, internal business processes, employee activities, and of course, stakeholder concerns. Kaplan and Norton labelled this new tool the balanced scorecard and later summarized the concept in the first of three Harvard Business Review Articles, "The Balanced Scorecard – Measures that drive Performance" (Niven, 2002, p. 11).

Kaplan and Norton outlined four balanced scorecard perspectives and how they are linked. This is shown in figure 1.

Figure 1: The balanced scorecard Link Performance Measures (Kaplan et al., 1992)



Dashboards evolved from the balanced scorecard and as Rivard and Cogswell (2009) point out, the dashboard also owes a great deal to the earlier development of the balanced scorecard. Kaplan and Norton set the stage for idea of performance measurement. In 2001 dashboards started to emerge as corporations felt the pressure to demonstrate their ability to closely monitor what was going on in their environments (Few, 2006, p. 7).

2.2 Current Formats Used to Display Performance Data

This section will define the two of the current formats used to display performance data which are balanced scorecards and dashboards.

2.2.1 Balanced Scorecards

2.2.1.1 Definition of Balanced Scorecards

The balanced scorecard is an integrative approach to performance evaluation that examines performance related to finance, human resources, internal processes and customers (Oliveira 2001). A balanced scorecard requires that substantial amounts of widely disparate data be captured (Oliveira 2001). The instrumentation of a balanced scorecard focuses on a single strategy where multiple, relevant measures are linked together in a cause-effect network (McLaughlin et al., 2006, p.144). Niven describes a balanced scorecard as a carefully selected set of measures derived from an organization`s strategies. Leaders use Scorecard measures when communicating with employees and external stakeholders, especially in regards to organizational mission outcomes and performance drivers. Niven also describes the scorecard as three things: a measurement system, a strategic management system and a communication tool (Niven, 2002, p.12).

Balanced scorecard characteristics display measures (or indicators) which link to an organization`s goals. They can also display performance-measurement targets. When using software to operationalize balanced scorecards, it is often not a static report and can include much functionality. Niven describes a variety of reporting and analysis tools

that should be considered during the selection process of balanced scorecard software: Drill-down capabilities, statistical analysis, alerts, commentaries, flexible-report options, automatic consolidation, flag missing data, forecasting and what-if analysis, linked documents, automatic email (2002, pp.262-264).

A balanced scorecard does not have to always display graphic formalisms as the Scorecard can display numbers and text only. Often graphic formalisms do help the client to understand the information. Balanced scorecards are most often characterised in tabular format. Traffic lights or stoplight indicators are also sometimes used: red, yellow, or green symbols that provide an at-a-glance view of a Measure's performance (Active Strategy).

Niven describes the development of the balanced scorecard by outlining the steps in the planning and development phases. The planning phase consists of the following steps:

- Step 1: Develop the balanced scorecard objectives
 - Step 2: Determine the appropriate organizational unit
 - Step 3: Gain executive sponsorship
 - Step 4: Build your balanced scorecard team
 - Step 5: Formulate your project plan
 - Step 6: Develop a communication plan for your balanced scorecard project
- (Niven, 2002, p. 59)

Niven explains the following steps for the development phase:

- Step 1: Gather and distribute background material
- Step 2: Develop or confirm mission, values, vision, and strategies
- Step 3: Conduct executive interviews

- Step 4: Develop objectives and measures in each of the balanced scorecard perspectives
- Step 5: Develop cause-and-effect linkages
- Step 6: Establish targets for your measures
- Step 7: Develop the ongoing balanced scorecard implementation plan (Niven, 2002, pp. 61-63)

The intent of the balanced scorecard for companies, as described by Kaplan and Norton, is to

- clarify and update strategy,
 - communicate strategy throughout the company,
 - align unit and individual goals with the strategy,
 - link strategic objectives to long-term targets and annual budgets,
 - identify and align strategic initiatives, and
 - conduct periodic performance reviews to learn about and improve strategy.
- (Jan/Feb96)

Niven explains that the balanced scorecard assists organizations in overcoming two fundamental problems: effectively measuring organizational performance and successfully implementing strategy (2002, p. 23). A well-crafted balanced scorecard should tell the story of the organization's strategy through a series of cause-and-effect linkages inherent in the Scorecard measures (Niven, 2002, p. 23).

Now we will look at some examples of balanced scorecards, one from the area of healthcare and one from business.

2.2.1.2 Examples of Balanced Scorecards

Balanced Scorecard Example 1

The following example (shown in Figures 2 and 3) is from "The hospital Report `99: A balanced scorecard for Ontario acute care hospitals." In 1998 and 1999, the Ontario Hospital Association provided funds to researchers at the University of Toronto to develop a report on the performance of Ontario acute-care hospitals. Performance indicators were identified in four sectors of hospital activity:

- Clinical Outcomes and Utilization
- Financial Performance and Condition
- Patient Satisfaction
- System Integration and Change (Baker, Anderson, Brown, McKillop, Montgomery, Murray, and Pink, 1999)

The first two are shown here for Huron Perth Hospitals Partnership.

Figure 2: Huron Perth Hospitals Partnership's Balanced Scorecard for clinical outcomes and utilization and financial performance and condition.

Seaforth			
Huron Perth Hospitals Partnership			
<i>Clinical Utilization and Outcomes</i>		1997/98	
Acute Myocardial Infarction			
Use of Selected Diagnostic Technologies			●
Complications			●
Readmissions			●
Asthma			
Readmissions			●
Pneumonia			
Complications			●
Stroke			
Length of Stay			●
Cholecystectomy			
Percent Day Surgery			●
Complications			●
Hysterectomy			
Length of Stay			●
Complications			●
Readmissions			NR
Prostatectomy			
Readmissions			NR
<i>Financial Performance and Condition</i>		1996/97	1997/98
Financial Viability			
Total Margin		●	●
Efficiency			
Unit Cost Performance		●	●
Corporate Services		●	●
Days in Inventory		●	●
Liquidity			
Current Ratio		●	●
Working Capital		●	●
Capital			
Equipment Expense		●	●
Human Resources			
Nursing Care Hours as Percentage of			
Total Inpatient Nursing Hours		●	●
Patient Care Hours as a Percentage of			
Total Staff Hours		●	●

The symbols are represented by the following legend:

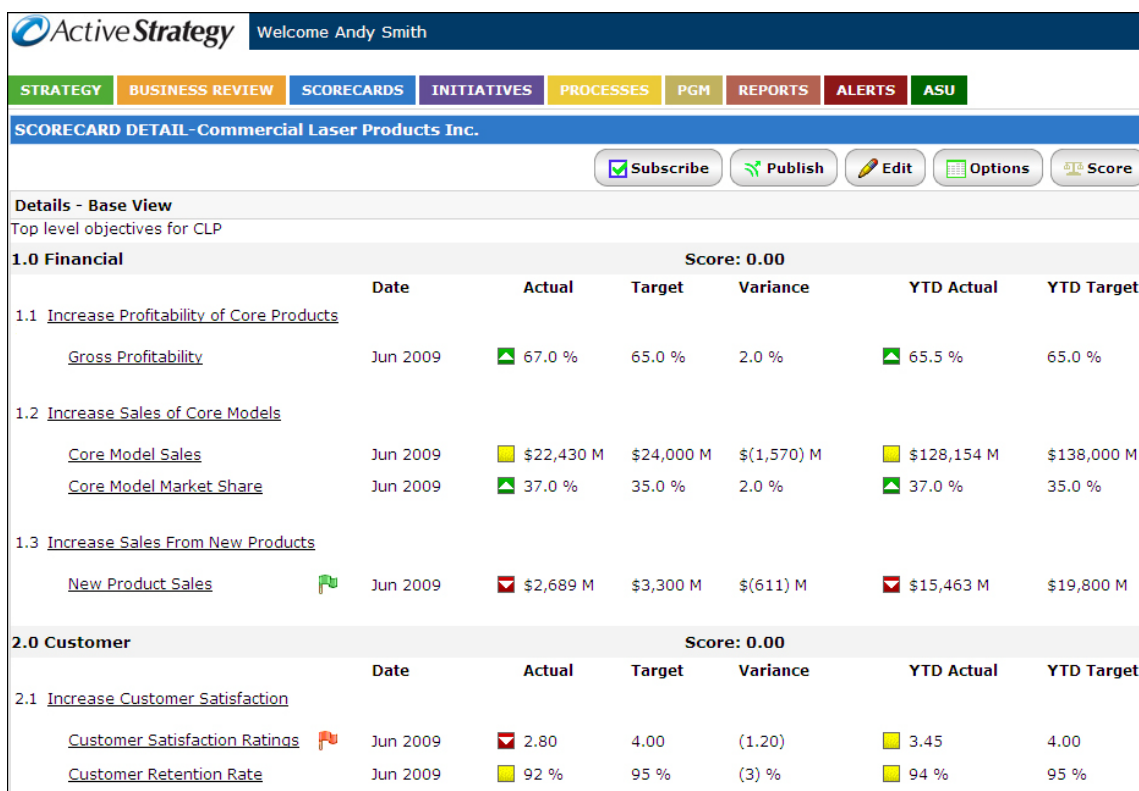
Figure 3: Balanced Scorecard Legend

Legend	
Above Average Performance	●
Average Performance	◐
Below Average Performance	○
Non-Reportable	NR

Balanced Scorecard Example 2

The example in Figure 4 was taken from a software company and shows an example of their balanced scorecard. Note the use of tables and traffic lights as graphic formalisms.

Figure 4: Active Strategy Balanced Scorecard



2.2.2 Dashboards

2.2.2.1 Definition of Dashboards

A dashboard is a visual display of the most important information needed to achieve one or more objectives, consolidated and arranged on a single screen so the information can be monitored at a glance (Few, 2004). The information on a dashboard is presented visually, usually as a combination of text and graphics, but with an emphasis on graphics (Few, 2006, p. 35). Another definition from Rivard et al. is that:

[Dashboards] provide visibility into key performance indicators (KPIs) through simple visual graphics such as gauges, charts and tables within a web browser. In many respects a reporting dashboard can be likened to a dashboard in an automobile. It provides an 'at-a-glance view' of the current operational state of the vehicle. (2004)

One of the few characteristics that most vendors seem to agree on is that for something to be called a dashboard it must include graphical display mechanisms such as traffic lights and a variety of gauges and meters, many similar to the fuel gauges and speedometers found in automobiles (Few, 2006, p. 34). The characteristics that make dashboards appealing are that they:

- Present a wide number of different metrics in a single consolidated view
- Roll up details into high-level summaries
- Provide intuitive indicators, such as gauges and stoplights, that are instantly understandable - for example, red bar means problem, green bar means everything is on plan (Rivard et al., 2004).

Dashboards themselves have no one way of displaying information. Many dashboards use different graphical formalisms to display their information. Few (2006, pp. 118 - 160) discusses a wide range of graphic formalisms used in dashboards:

- Graphs: radial gauges, meters, bullet Graphs, bar graphs, stacked bar graphs, combination bar and line graphs, line graphs, sparklines, box plots, and treemaps
- Icons: communicate the following three meanings: Alert, Up/Down, and On/Off
- Images: photos, illustrations or diagrams
- Drawing objects: connect pieces of information (e.g. arrows)
- Organizers: tables and spatial maps

Rivard et al. (2004) describe the development stages of a dashboard which is slightly different than that of the balanced scorecard:

- Stage I: Selecting the Key Metrics
- Stage II: Populating the dashboard With Data
- Stage III: Establishing Relationships Between the dashboard Items
- Stage IV: Forecasting and Scenarios
- Stage V: Connecting to Financial Consequences

Pauwels (2009) best describe the intent and use of the dashboard in four ways:

- A dashboard enforces consistency in measures and measurement procedures across department and business units.
- Second, a dashboard helps to monitor performance.
- Third, a dashboard may be used to plan (what should our goals and strategies be for the future given where we are now?).
- Fourth, a dashboard may be used to communicate to important stakeholders.

2.2.2.2. Examples of Dashboards

The following are examples of dashboards which have all been taken from Few (2006).

Dashboard Example 1

This dashboard from Informatica Corporation (see Figure 5) displays measures of revenue by sales channel along with a list of reports that can be viewed separately. The predominance of graphical display media in the previously discussed dashboards appears on this one as well, notably in the form of meters designed to look like speedometers. The list of reports adds portal functionality, enabling the dashboard to operate as a launch pad to complimentary information (Few, 2006).

Figure 5: Informatica Dashboard

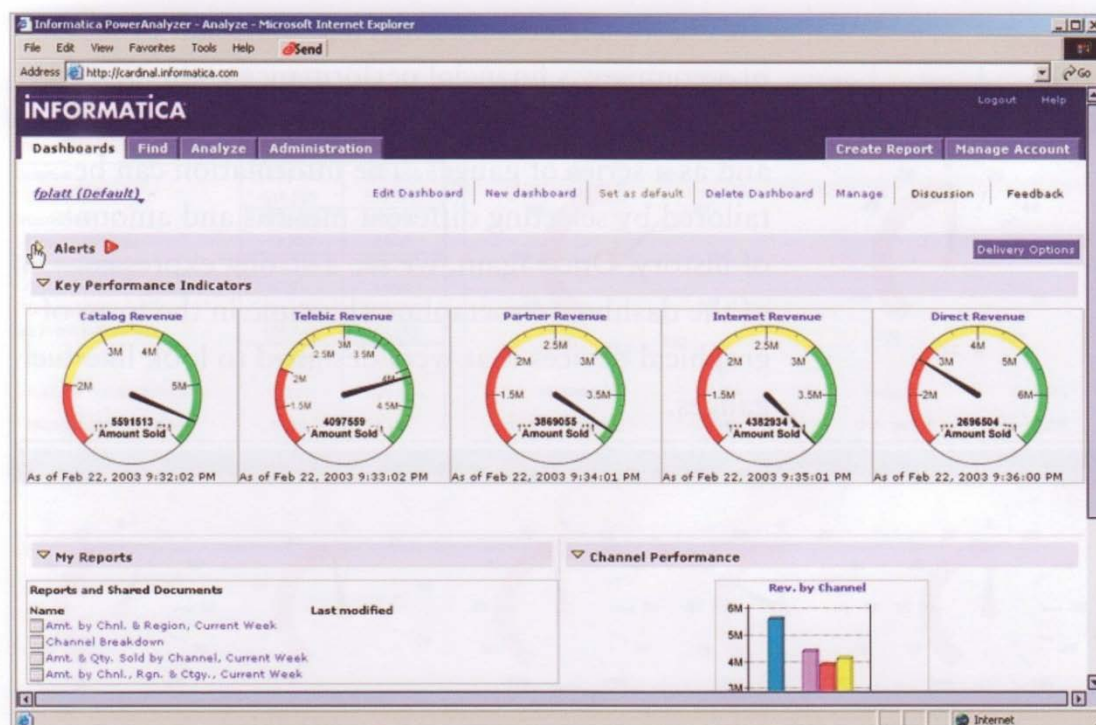


Figure 1-4

Dashboard Example 2

This dashboard from Cognos, Inc. (see Figure 6) displays a table and five graphs – one in the form of a world map – to communicate sales information. Despite the one table, there's a continued emphasis on graphical media. Notice also that a theme regarding the visual nature and need for visual appeal of dashboards is emerging in these examples (Few, 2006).

Figure 6: Cognos Dashboard

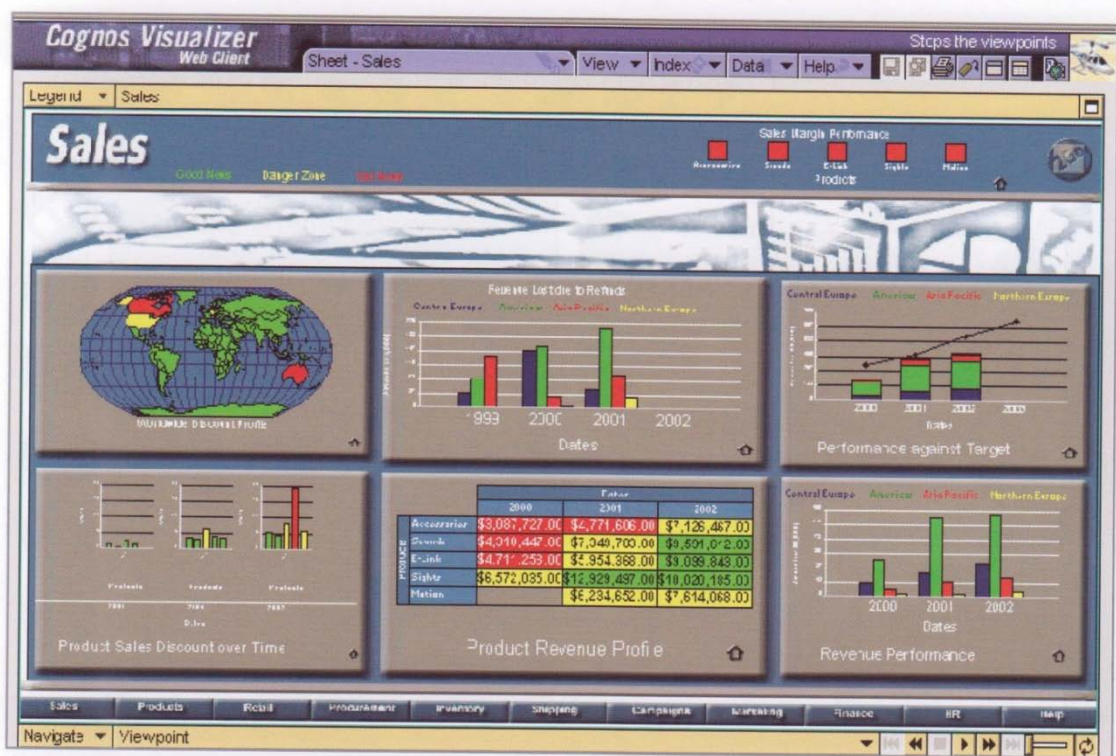


Figure 1-6

Dashboard Example 3

This dashboard from Corda Technologies, Inc. (see Figure 7) features flight-loaded measures for an airline using four panels of graphs. Here again we see an attention to the visual appeal of the display. Notice also in the instructions at the top that an ability to interact with the graphs has been built into the dashboard, so that users can access additional information in pop-ups and drill into greater level of detail (Few, 2006).

Figure 7: Corda Airlines Dashboard

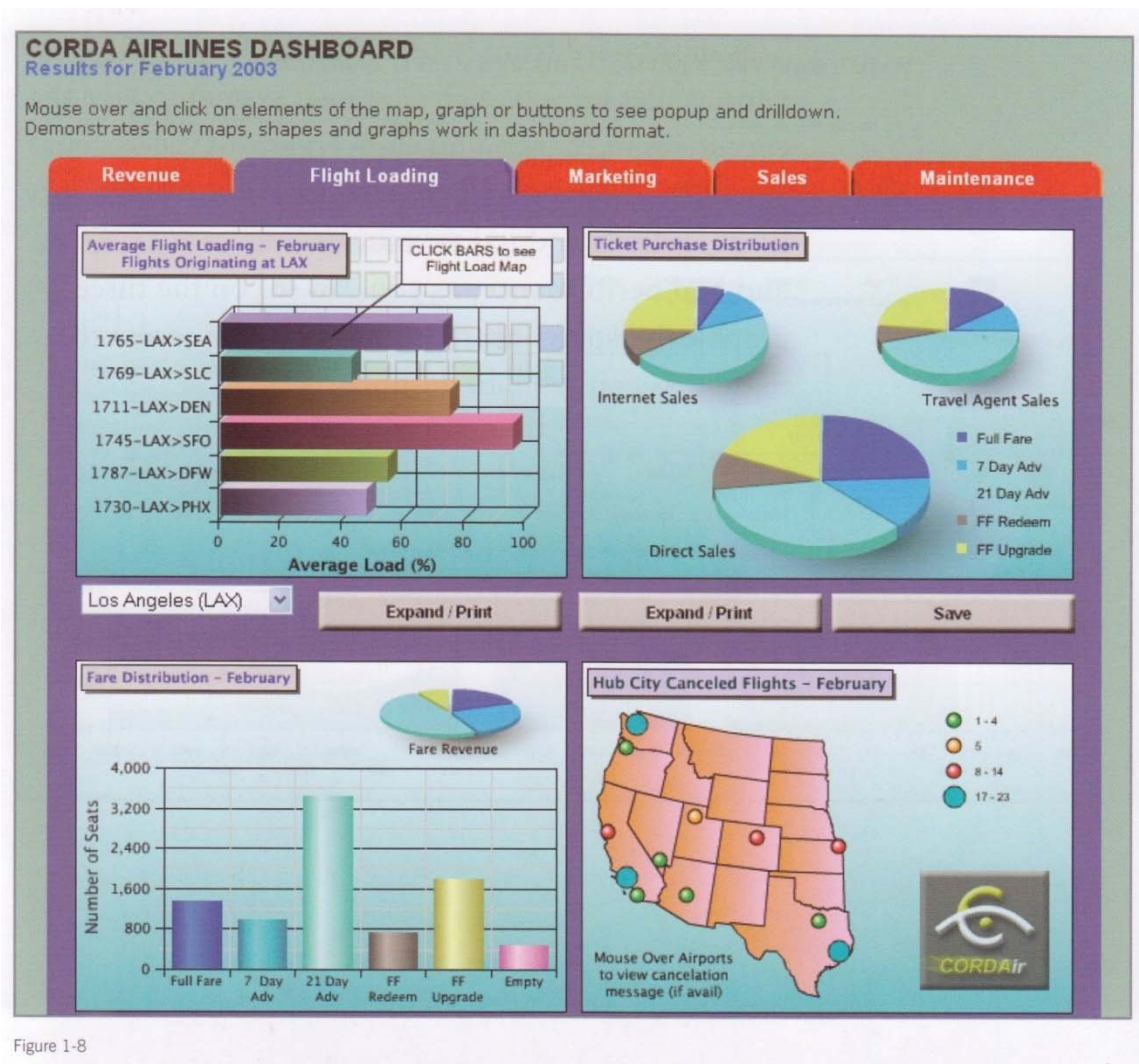


Figure 1-8

Dashboard Example 4

This dashboard from Infommersion, Inc. (see Figure 8) gives executives of a hotel chain the means to view multiple measures of performance, one hotel at a time. It is not unusual for dashboards to divide the full set of data into individual views, as this one does by using the listbox in the upper-left corner to enable viewers to select an individual hotel by location. The great care that we see in this example to realistically reproduce the dashboard metaphor, even down to the sheen on polished metal, is an effort that many vendors take seriously (Few, 2006).

Figure 8: Hospitality Dashboard



Figure 1-10

2.2.3 Summary

Balanced scorecards and dashboards themselves are not the same thing. As Rivard et al. (2009) describe, the balanced scorecard is primarily internally focused whereas the dashboard primarily considers the context (the market) within which the company operates. Balanced scorecards most often display indicators in tabular displays whereas dashboards display much more information using many graphic formalisms. Although the perspectives of the two are slightly different, the issue of which graphic formalism used in both is most appropriate for performance data presentation has come to the fore. In this thesis we will compare the graphic formalism that is most used to present performance data in balanced scorecards (tabular) against the graphic formalism that is most used to present performance data in dashboards (gauges).

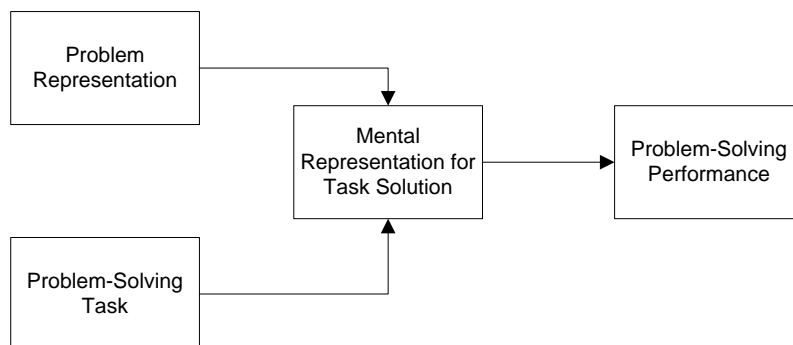
2.3 Theoretical Perspectives

To create a basis for this study, theoretical perspectives relevant to this thesis will be examined. The theories are included here as they endeavour to link between a presentation format and a decision maker's action. It is this thesis we will compare two performance data display formats and determine whether it had an influence on a decision maker's actions and perceptions. A number of relevant theories include cognitive fit theory, representation congruence theory, cognitive load theory and a theoretical framework proposed by Hibbard.

2.3.1 Cognitive Fit Theory

Vessey first introduces cognitive fit theory in her paper *Cognitive Fit: A Theory-Based Analysis of the Graphs Versus Tables Literature* and states that the correspondence between task and information-presentation format leads to superior task performance for individual users (Vessey, 1991). Cognitive fit theory applies when the information emphasized in a particular presentation format matches that required to complete the task. Figure 9 represents the idea of cognitive fit.

Figure 9: Cognitive Fit in Problem Solving (Shaft, 2006)



Vessey goes on to describe that “matching representation to tasks leads to the use of similar problem-solving processes, and hence the formulation of a consistent mental representation. There will be no need to transform the mental representation . . . to extract information from the problem representation and to solve the problem. Hence, problem solving with cognitive fit leads to effective and efficient problem-solving performance” (Vessey, 1991). Vessey continues to specify that tables are appropriate for presenting discrete sets of symbols while graphs are appropriate for depicting relationships among discrete symbols (Vessey, 1991).

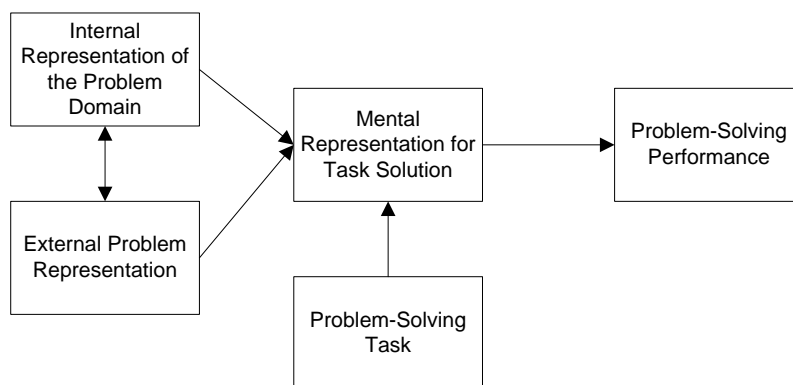
2.3.2 Cost-Benefit Theory

In a further paper, Vessey goes on to further her cognitive fit theory by presenting cost-benefit theory. According to cost-benefit theory, decision makers trade-off the effort required to make a decision vis-a-vis the accuracy of the outcome. Vessey applies two aspects of the theory: cognitive fit and strategy shift. Cognitive fit seeks to identify specific task characteristics that can be supported by the problem representation and the task environment, thus effectively controlling the decision-making process as explained above (Vessey, 1994). Strategy shift arose from a desire to identify strategies that are invariant across tasks and the subsequent observation that decision makers change strategy with minor variations in the task and its environment. Vessey suggests that task complexity induces decision makers to conserve effort by using perceptual rather than analytical processes and to forgo accuracy for a substantial reduction in effort (Vessey, 1994).

2.3.3 Representational Congruence

Chandra and Krovi (1999) extend the idea of cognitive fit and introduce the theory of representational congruence. They explain how the theory predicts a more favourable effect on decision performance when the external presentation format matches the user's cognitive model or internal representations (Chandra, 1999). Along the same lines, Shaft and Vessey introduce another dimension to cognitive fit by saying both the internal and external representations, and the interactions among them, contribute to the mental representation for task solutions that are developed to solve the problem. We can see this in Figure 10.

Figure 10: Extended Cognitive Fit Model (Shaft, 2006)



While a growing body of empirical evidence supports the tenets of cognitive fit theory for simple tasks, it has not been extended to more complex tasks (Speier, 2006). When a certain task is easily broken down into a simple form, it is easier to apply theory. As Speier indicated, when such tasks cannot be broken down and are very complex, then it is much harder to apply theory. In healthcare, for example, many decision-making tasks are very complex as there are many facets to a healthcare-related decision.

2.3.4 Cognitive Load Theory

Sweller introduces the theory of cognitive load, which describes how learning can be enhanced by information-presentation formats. Cognitive load assumes a limited working memory and a virtually unlimited long-term memory. Schemas, which categorize information by the manner in which it will be used, are acquired over time. Repeated exposures to related problems are automated as rules and stored in the long-term memory for recall when needed. Although working memory is shown to only process a limited number of items at a time (approximately seven), it treats schemas as one item—which may be incredibly detailed and complex and represent a large body of information. Thus, structuring information so that the learner can quickly develop schemas and automated rules to store in the long-term memory enhances knowledge acquisition and performance (Sweller, 1988). Once a schema has been constructed, the interacting elements are incorporated within the schema and do not need to be considered individually within working memory. The schema can act as a single element in working memory and will impose minimal working memory demands, especially if it is automated. Once constructed, this schema can act as an interacting element in higher order schemas (Sweller, 1998).

2.3.5 Hibbard Framework

Hibbard writes about enhancing healthcare consumer use of information and proposes a framework for evaluating and choosing comparative information presentation

approaches. The framework discusses three process goals to enhance consumer use of information:

1. Lowering the cognitive effort required
2. Helping people to have a better idea of what the actual experience of a choice might be like
3. Highlighting the meaning of information

The evidence shown in this paper suggests that comprehension, motivation, and the actual use of information are increased when the above three criteria are reached (Hibbard, 2003). Although Hibbard refers to healthcare-consumer information, we can also think of consumers as decision makers.

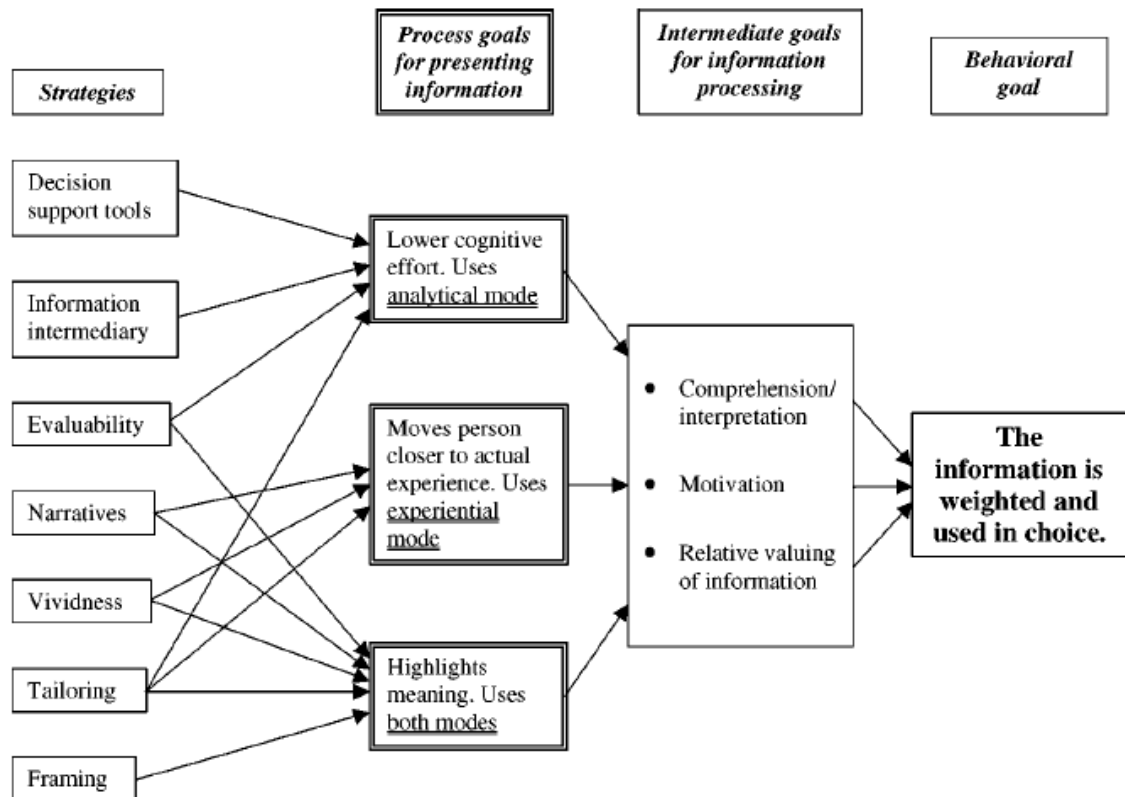
2.3.6 Summary

A variety of theories have been introduced above but the most relevant to this thesis is the Hibbard framework. Hibbard sets out to:

Delineate the types of decisions that consumers and patients are making, the barriers to using information effectively in choice, and draw upon the evidence for the efficacy of different presentation strategies to propose an initial framework for evaluating and choosing comparative information presentation approaches. (2003)

Hibbard's conceptual model is shown in Figure 11.

Figure 11: Hibbard Conceptual Model



Hibbard describes the following three processes to enhance consumer use of comparative information.

Process 1: Lowering the Cognitive Effort Required

Hibbard explains the process by identifying the fact that simpler information will help a decision maker make their decisions more easily.

- Simpler information then influences the interpretation and comprehension of information about the choice attributes. By providing information in an explicitly evaluative form, it can be used more easily to evaluate the overall goodness or badness of any one option.

- Decision tools can ease the burden in decisions by structuring the decision process and by highlighting the important factors for consideration.
- A third approach, using evaluability, focuses on the visual display of information and is designed to lower cognitive effort by providing cues to transform the information to an evaluative good/bad scale

Process 2: Helping People to Have a Better Idea of What the Actual Experience of a Choice Might Be Like

Hibbard suggests a few examples to help people have a better idea of what the experience of a choice is.

- Narratives, or stories about someone else's experiences, provide a promising approach to help fulfill the requirements of good-quality decision processes.
- More vivid information also can influence judgments and decisions. Vivid presentations of information can provide greater emotional interest, and they appear to have a greater impact on judgments relative to more pallid or bland presentations of the same information content.
- Tailoring is the process of providing customized information based on characteristics that are unique to that person. In general, studies have shown that individually tailored health materials are more effective than generic materials in promoting behavioral change.

Process 3: Highlighting the Meaning of the Information

- While intended to be beneficial, this "more complete" information appears to actually undermine the information's evaluability and, therefore, its meaningfulness. The research suggests that a precise point estimate (e.g., a

score of 8) is more evaluable and carries more affective meaning than a less precise range such as in a confidence interval (e.g., a score that ranges from 7 to 9). As in other examples of evaluability, more evaluable information (in this case through precise point estimates rather than confidence intervals) affects choice more by highlighting meaning more. What the precise estimates lack in completeness, they make up for by providing more complete meaning.

- Research carried out with both experts and the general public shows that information presented as frequencies rather than probabilities carries more meaning and, as a result, greater weight in decisions (24). Using percentages appears to be a more “bland” way of describing risk, whereas highlighting the number of people who could be at risk appears to be more vivid and more effective in drawing attention to the actual number of people who could be harmed.
- A final way to highlight the meaning of information is through framing. Framing may not make information more useable necessarily, but it does provide the decision-maker with alternative ways to think about a decision. Framing tends to “highlight” either the potential loss or the potential gain involved in a choice

This framework will be used to compare the two methods of performance data presentation formats, tabular and gauge.

2.4 Past Studies

Decision making plays a fundamental role in many fields and has always been important in the healthcare industry. Much of decision-theory research is based in fields such as business, accounting and human-computer interaction. Decision makers constantly use data to help them in their decision processes and to allow them to use evidence to make their decisions (Bertin, 1981).

An important part of decision theory is the area of information presentation and the study of its impact on decisions. Bertin refers to the process of obtaining information cues from an information presentation as a key part of the question-answering process. However, the issue of how to optimally present information to decision makers in healthcare remains to be explored. Therefore this research will present decision makers with case studies and a questionnaire to determine their data-format preferences and the ways in which data format differs.

2.4.1 Fields That Address Methods of Information Presentation

A number of studies about how to present information to decision makers have been performed in fields such as business, accounting, information technology and psychology, whereas only a limited number have taken place in healthcare. Some studies from accounting include Cardineals (2008), Davis (1989) and So (2004); studies from business include Dickson (1986) and Jarvenpaa (1988); a study from information technology includes Speier (2006); some studies from psychology include Harvey (1996), Lalomia (1987) and Unanath (1994); also one study from healthcare includes

Marshall (2004). They each differ in how they evaluate data presentation to decision makers. Researchers' views about how data should be presented to decision makers conflict, but studies have tried to further break down these analyses by incorporating factors such as task complexity, decision makers' experiences and varying data types.

2.4.2 Studies With No Preference of Information Presentation

Some studies found that no one method of presentation was better than another (Davis, 1989; Dickson, 1986). Whereas other studies showed that presentation format did influence decision making (Jarvenpaa, 1988; Marshall, 2004; Unanath, 1994).

2.4.3 Studies that Examine the Reason Behind Difference in Data Presentation Methods

Further studies described different types of data; one such study was Harvey (1996) who showed that un-trended data had higher error rates in graphical formats, and trended data had a higher error rate in tabular formats. Lalomia (1987) determined that display type affects user performance. The graphical presentation of information facilitates performance with problems involving interpolation, trend analysis and forecasting, whereas tables facilitate performance when the problem requires the identification of specific values.

2.4.4 Balanced Scorecards and Dashboards in Healthcare

There is much evidence in the literature regarding balanced scorecards. Some papers of note include Hwa (2013) et al. where he discussed the development and implementation of a balanced scorecard in an academic hospitalist groups in San Francisco California. Another paper by Bernardo et al. (2009) focused on a large healthcare organization in British Columbia that evaluated their balanced scorecard. Yap et al. (2005) describe how balanced scorecards are being implemented and they compare system wide hospital-specific measurement tools. There are many other papers in the literature and the above papers are just a small selection.

Another example was that described by Wyatt for the St. Luke's Hospital. The health system not only initiated a balanced scorecard but also developed a single portal through which it could import financial data from its multi-vendor application. This approach allows St. Luke's managers to view balanced scorecard key performance indicators (KPIs), such as employee turnover, patients wait times, and supply expenses, through a variety of "visual dashboards". (Wyatt, 2004)

There is some evidence of dashboard use in healthcare. Koopman et al. (2011) describe a study that compared the newly developed dashboard to the previously used electronic health record. Byrnes (2012) describes the idea that an executive dashboard can solve the issue of data overload in health systems. Morgan et. al (2006) demonstrate a digital dashboard to navigate a complex picture archiving and communication system (PACS) environment. Lastly an example of dashboards used in healthcare is demonstrated by Mazzella-Ebstein et al. (2004) by way of a web-based nurse executive dashboard.

Much literature was found explaining each of the two methods of displaying performance data, balanced scorecards and dashboards. However, no literature was found comparing the two formats to one another. Furthermore, the comparison of the specific graphic formalisms of tabular and gauge format were not found either. Therefore this study attempts to address this gap in the literature.

Chapter 3: Research Questions

This section will outline the statement of the problem and the purpose of the study. It will also layout the research objectives and the research questions that the this study will address.

3.1 Statement of Problem

As shown in the last section (2.4.4) there is a growing recent literature around balanced scorecards and dashboards. However, none of the literature found directly compares the two methods of displaying performance data and therefore this thesis will attempt to address this gap in the peer reviewed literature.

3.2 Significance and Purpose of the Study

This study will potentially help people in the healthcare field that are involved with the dissemination of data, particularly performance data. This will be useful for any person involved with decisions about performance. This study should help inform methods of decision analysis applied to healthcare.

3.3 Research Objectives

The main research objective is to compare balanced scorecards to dashboards in a meaningful way. In detail the research will endeavour to address the following:

1. Examine the impact of performance data presentation methods on decision making

2. Reveal the preference between the two formats of performance data presentation (balanced scorecard and dashboard)
3. Determine whether the two performance data presentation formats are understandable, support decision making and contain complete information.

3.4 Research Questions

The following are the research questions:

Primary research question:

- (1) Does the presentation of performance data (either through balanced scorecard formalisms or dashboard formalisms) affect healthcare decision making?

Secondary research questions:

- (2) How do graphical formalisms used in balanced scorecards compare to the graphic formalisms used in dashboards in terms of a healthcare decision maker's perception of:
 1. understandability of information,
 2. level of support for decision making, and
 3. completeness of information?
- (3) Which format (tabular or gauge) do healthcare decision makers prefer and why?

Given the increasing importance of presenting healthcare data effectively, the above questions have important implications for understanding the best way to present performance information.

Chapter 4: Methodology

This section will describe the methodology used for the study including the participants, study set up, methods and data analysis performed.

4.1 Participants

The participants included in this study were a representative sample of the managers and directors in a health authority that use performance data on a regular basis.

4.1.1 Participants Recruited

The participants for the study were decision makers from a large healthcare organization. The decision makers were managers and directors taken from a portfolio concerned with direct patient care. Managers and directors were recruited in this study, as their primary task is to maintain and improve performance (Shortell, 2006, p. 317). The large Health Authority was Vancouver Island Health Authority, where there were around 152 managers involved in direct patient care (managers in Integrated Health Services) and around 48 directors above them. Therefore there was a possible 200 participants. There were a total of 6 directors and 10 managers.

4.1.2 Participant Inclusion Criteria

Participants were included if they were:

- Employees of a large healthcare organization

- At a management level or director level in the Integrated Health Services Portfolio
- In charge of making decisions for an organizational group of a large healthcare organization

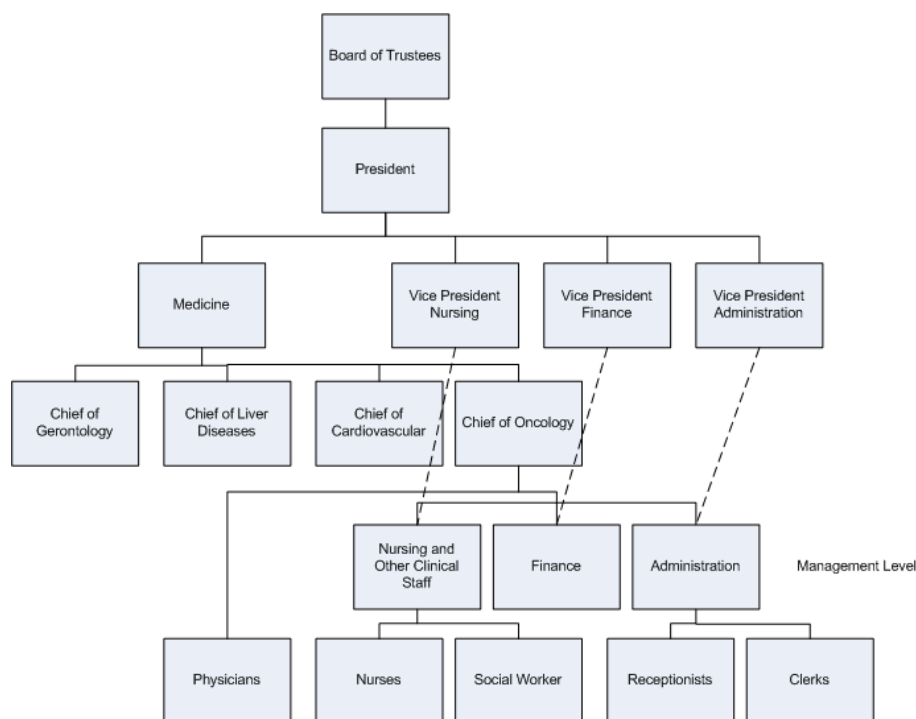
4.1.3 Participant Exclusion Criteria

Participants were excluded if they:

- Were not an employee of a large healthcare organization
- Did not manage any employees
- Were at a level lower than a manager or higher than a director
- Were a manager/director other than a manager/director of the Integrated Health Services portfolio

Figure 12 shows a typical organizational chart from a large healthcare organization and the study focuses on the management level of the organization.

Figure 12: Modified Divisional Organizational Design (Shortell, 2006, p. 331)



4.2 Participant Recruitment Method

Participants were first approached by email. This email came from the Director of the Performance Monitoring and Improvement Department of VIHA (see Appendix A for the recruitment email). Due to low participation another email was sent five months later, again from the director. As indicated in the e-mail, participants then contacted the researcher if interested to participate. Communication over e-mail then determined if the participant wanted to meet for more information or to participate in the study.

All participants that contacted the researcher indicated that they would like to participate in the study, meetings were subsequently arranged and a letter of information was emailed to the participant (see Appendix B for the letter of information). When participants agreed to participate, they arranged a time to meet with the researcher. During the meeting the participant was given a consent form to review. If they consented

to participate in the study they then were given a set of instructions and two cases along with a set of questions. The participants were also informed that any identifying information will be removed from their answers to keep their identity confidential.

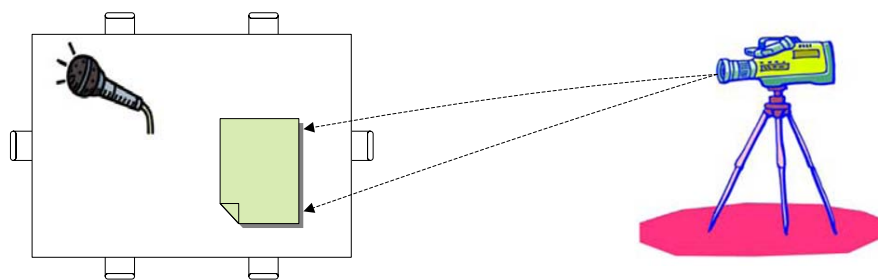
4.3 Setting and Procedure

This section will outline the setting, study set-up, materials used and the procedure followed during the study. Included in the procedure section are the cases and questions presented to each of the participants.

4.3.1 Setting

Participants and the researcher were in a room chosen by the participant located at their healthcare organization. A room in their organization was used as researchers have found settings that are representative of work environments produce more ecologically representative findings (Borycki, Lemieux-Charles, Nagle, Eysenbach, 2009). The participants sat at a table with the video recorder pointed at the table where the participant answered the questions (recording focussed on the paper). The participant's faces were not captured on video which allowed the participant's identity to remain confidential. They had a paper and a pen and the video recorder recorded the sound. This approach has been used by other researchers to gather data in paper-based environments (Patel, Kushniruk, Yang, Yale 2000, Borycki et. al. 2009).

Figure 13: Study set-up



4.3.2 Materials

Each participant had a pen to answer the questions which were presented to them on paper. The participants were audio recorded and their movements on the paper were video recorded.

4.3.3 Procedure

Once consent was received (see Appendix C for consent form), each participant was given a set of instructions on how to proceed and then received two matched cases (see Appendix D for cases). The cases were given to the participants in both tabular format and gauge format. They had to answer the same questions for both display formats. Each participant randomly received either the gauge or the tabular format first. The first participant will receive the tabular format first and then the gauge format. The next participant will receive the gauge format first and then the tabular format and so on throughout all of the participants. This approach is taken so that an equal amount of participants will receive the gauge format first and the same amount will receive the tabular format first to avoid order effects. The following are the instructions that participants received along with the each display of the cases.

Instructions

You will be given a case containing performance data, the context of the performance data and a set of questions. As you answer the questions for each of the examples you are asked to think aloud and an audio recorder will record your thoughts. There is no time limit so please take your time and “verbalize” your thoughts as you answer the questions. A video recorder will also be recording your movements on the paper. Once you finish with both of the examples you will be asked a set of questions by the interviewer.

4.3.3.1 Cases

There were two matched cases, one for each type of display format (table and gauge). The cases contained a scenario, the display format and then a set of questions. The scenario was almost identical (except for the numbers) and one example is shown here:

You are the manager of a surgical unit and you have been receiving pressure from the community with respect to wait times. You have been told that overall wait times are at an all time high. In order to familiarize yourself with the state of affairs you decide to look at the wait time performance data. You look at the wait time data from last quarter, which was 13.7 weeks for MRI wait time, 9.8 weeks for CT wait time, and 3.5 days for surgical wait time. Below shows the wait time data for this quarter.

If presented with the following display:

- (a) how does this inform your decision making?, and
- (b) would you take action? Yes or No? Please explain your answer.

For the complete cases see Appendix F. The two formats, tabular and gauge format are shown in figures Figure 14 and Figure 15 below.

Figure 14: Tabular Format

Wait Times

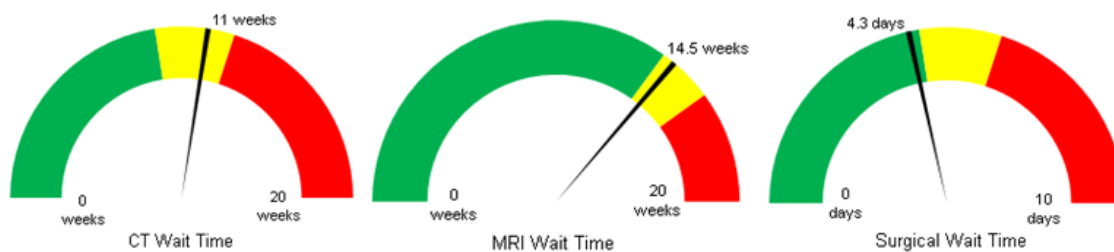
Performance Measure	Light	Actual
MRI Wait Time	▲	14.2 weeks
CT Wait Time	▲	10.5 weeks
Surgical Wait Time	■	3.9 days

Key

Light	Description
■	Performance is within acceptable range
▲	Performance is outside acceptable range
●	Performance is significantly outside acceptable range

Figure 15: Gauge Format

Wait Times



Key

Colour	Description
Green	Performance is within acceptable range
Yellow	Performance is outside acceptable range
Red	Performance is significantly outside acceptable range

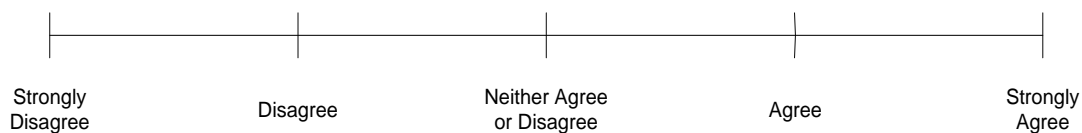
Along with each case there were the identical 8 questions which were the following:

1. Did you find the information easy to understand?
2. Did you find that the information supported your decision making?
3. Did you have all of the information that you needed?
4. What other information, if any, would you want to see?

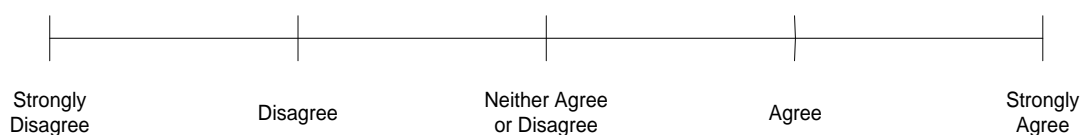
5. Please comment on the way the data was presented to you.

Please answer questions 6-8 by making a mark on the line.

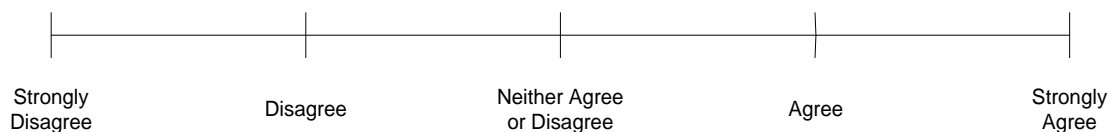
6. I find the information easy to understand.



7. I find the information supports my decision making



8. I find the information that was presented to me to be complete



4.3.3.2 Semi-structured Interview

After each participant answered all of the questions for both cases a set of interview questions were asked. These questions compared between the two formats and were (see Appendix E for full interview questions):

1. Did one of the forms of data presentation help you answer the question more easily? Why?
2. Which format did you prefer? Tabular format or gauge format.
3. Why did you prefer that format?
4. Which format
 - a. is the easiest to understand? Why?
 - b. most supports you decision making? Why?
 - c. had the most complete information? Why?
5. Compare and contrast the two formats you have seen - when would one be better to use than the other? Why?

6. Please comment on what additional type of information you would have liked to see.
7. Have you ever used either or both of these formats (i.e. scorecards and/or dashboards) in your workplace? If yes, what did (or do) you use them for? And for what purposes? What has your experience been with either or both of them (did they convey information in a meaningful way)? Please discuss and give some examples of their use in your organization.
8. What way of presenting data do you prefer? Why?
9. What is the way that performance data is typically used in your organization?
10. Did you learn anything or was this helpful to you in any way from this study that you participated in?
11. Does this make you want to change the way performance data is presented to you? Why?
12. Any other comments?

4.3.3.3 Post-Interview

After the interview the participants were will be handed a sheet to fill in post-interview questions and the questions are below (see Appendix F).

1. How long have you been in the healthcare field?
 - a. 0-5 year(s)
 - b. 5-10 years
 - c. 10-15 years
 - d. 15-20 years
 - e. More than 20 years
2. How long have you been in your current position?
 - a. 0-5 year(s)
 - b. 5-10 years
 - c. 10-15 years
 - d. 15-20 years
 - e. More than 20 years
3. How long ago did you enter the workforce?
 - a. 0-5 year(s)
 - b. 5-10 years
 - c. 10-15 years
 - d. 15-20 years
 - e. More than 20 years
4. How long have you been at your current skill level?
 - a. 0-5 year(s)
 - b. 5-10 years
 - c. 10-15 years
 - d. 15-20 years
 - e. More than 20 years
5. What education level have you achieved?

- a. Some College
 - b. Undergraduate degree
 - c. Masters degree
 - d. PhD degree
 - e. Other (please describe)
6. What is your current position?
- a. Manager
 - b. Director

4.4 Methods

This section will explain how the data was collected, by think-aloud, semi-structured interview and questionnaire and also will show how the data was analysed.

4.4.1 Data Collection

Data was collected using three formats, think aloud, interview and multiple choice questions.

4.4.1.1 Think aloud

Each participant was asked at the beginning of each case to think aloud as they reviewed the scenario and thought about the main question. While doing this, the participants were video recorded, which captured the thoughts they vocalized along with any movements or interactions they performed with the scenario on the paper.

Kushniruk and Patel (2004) have employed this method usually when participants are using a computer system, but the principles were applied here also. The principles of think aloud have been used in the analysis of human computer interaction in order to determine usability issues of computer systems (Kushniruk et. al., 2004) and using paper records (Patel et. al, 2001). In this research study it was employed in order to capture usability issues in the presentation of the performance data.

A coding system was applied to the video data to identify specific occurrences of user problems and aspects of the cognitive processes from transcripts of the participant.

4.4.1.2 Semi-structured Interview

Each participant was asked questions pertaining to both cases as shown in 4.3.3.1 and then after they each reviewed each data presentation format were asked to compare the two in an interview (see 4.3.3.2).

4.4.1.3 Questionnaire

Finally, in order to obtain some demographic information, the participants were asked to complete a post-interview questionnaire with multiple choice questions (see 4.3.3.3).

4.4.2 Data Analysis

Think aloud and interview data were analysed using a modified grounded theory approach. Grounded theory is a specific methodology developed by Glaser and Strauss for the purpose of building theory from data (Corbin, 2008, p 1). This study used a grounded theory approach to coding and identifying themes (i.e. for conducting thematic analysis). After the video data was transcribed the think aloud and interview portions were reviewed. The transcriptions were read through and coded according to themes. The transcripts were then read a second time and the themes were amalgamated. The themes were subsequently further refined after multiple read-throughs.

Some of the questions resulted in quantitative data analysis, those being the three questions (6-8) that were presented to the participants after the case interviews. The

participants were asked to mark on a continuous line whether they agreed or disagreed with the statement. Figure 16 shows an example of what a marked line would look like.

Figure 16: Marked Line



Each of the three questions 6 - 8 for both the gauge and tabular formats were measured using a ruler and recorded in millimetres. This data was then analysed using a paired t-test.

Lastly post-interview questionnaire multiple choice answers were added up to arrive at the demographic results. These demographics included how long a participant was in the healthcare field, how long they worked in their current position, how long ago they entered the workforce how long they had been at their current skill level, the level of education they received and their position in the organization.

4.5 Case Justification, Controls and Assumptions

4.5.1 Case Justification

The cases used in this study draw on use wait time data as a basis for the comparison of performance data using tabular and gauge graphic formalisms. Timeliness is one of the Institute of Medicine's six aims for improving the quality of health care where timeliness refers to reducing waits and sometimes harmful delays for both those who receive and those who give care (Institute of Medicine, 2001). Wait times were chosen to be used in the cases as they are a significant issue in healthcare today (Paterson, 2010)

for a variety of reasons. These reasons include patient viewpoints, occurrence of adverse events, government policy, and health authority manager responsibility.

First and foremost wait times are an important issue for patients. Patients do not want to wait for services when they require medical attention. They would like to be able to treat their illnesses as soon as possible and therefore wait times are the bases for many complaints about healthcare (Frisch, 2010). A study found that that a significant proportion of Canadians with digestive problems are not satisfied with their wait time for gastroenterology consultation (Paterson et. al., 2010).

In particular wait times for surgical procedures can lead to adverse outcomes. A study found that a wait time for surgery of more than 14 days was associated with a doubling of the risk of hernia incarceration among infants and young children with inguinal hernia (Zamakhshary, 2008). Another study determined that while awaiting consultation, many patients experience an impaired quality of life because of their gastrointestinal symptoms (Paterson et. al., 2010).

Often wait times occur because organizations have allowed inefficient processes to accumulate that do not add value to care and therefore wait times must be addressed in health policy. A study in Ontario reported that there is a trend for increasing wait times especially for total hip and knee replacements (Snider 2005). Wait times has become an issue for required service standards in Canadian Healthcare since we cannot deny most care because of the Health Act, but we can greatly slow people's access to it (Frisch). In a news release from the BC Ministry of Health Services, "patients will benefit from more timely, accessible care as British Columbia invests an additional \$250 million over the next two years to launch its patient-focused funding model to the 23 largest hospitals

across the province” (BC MoHS, 2010). This means that if the hospital lowers surgical wait times and increases throughput then they will receive more money (Frisch, 2010). Therefore managers will likely be rewarded for their success in bringing wait times down if this results in more revenue for the system.

The cases in this study involve managers and directors and wait times are important to them as they hold a great responsibility to reduce them. It also makes managers/directors proud when they can lower wait times and serve people better. Where the BC Ministry of Health Services requires certain wait times be met, managers/directors may be held accountable for achieving these targets (Frisch, 2010). For all of the reasons above the issue of wait times is an important one to health authorities and also the managers/directors working within them.

4.5.2 Controls

Each participant had the same scenarios and the same graphical formats in which to answer the questions so as to not cause any bias in the answering of the questions.

4.5.3 Assumptions

Certain assumptions were made in order for the study to be viable.

- 1) Representations of balanced scorecard and dashboard

Balanced scorecards and dashboards are not in themselves comparable as they can represent diverse things. As shown in the initial research, a balanced scorecard usually only shows the performance measures (Kaplan, Jan/Feb 1996) whereas a dashboard

can contain any number of measures (Few, 2006). It was first determined that the balanced scorecard and dashboards could take a variety of forms. In order to determine the best way to compare each of the forms of data presentation, the researcher examined the most common types of displays for each. It was determined that balanced scorecards most often come in the form of a table and therefore a tabular format was used to represent a balanced Scorecard. The display most often found in a dashboard was that of gauges similar to a speedometer and therefore a gauge display was used to represent a dashboard.

2) Each format was simplified. In order to compare each of the forms of data presentation the displays had to be comparable (Corbin, 2008, p 195). This meant that the following elements were included in each form of presentation

- a. Wait time – the exact wait time was included in each format for each of the three performance measures
- b. Measure of wait time relative to target – each of the formats included an indication of how close one measure was to the target
- c. Colour representation – the same colour was used in each display to show the measure of the wait time relative to the target
- d. Key – this table explained each of the measures

3) Used a display concept for both formats previously known to participants.

To make each of the formats comparable each display contained the traffic light format and the same colours were used to represent the same groups in each format.

Chapter 5: Study Findings

5.1 Introduction

The study findings will illustrate the depth and complexity of information that was obtained from the participants. While the core of the interview questions asked of the participants were primarily formulated to address the research questions, there were some questions that also led to some other unexpected findings. The demographics of the participants will first be reviewed (which arose from the post-interview questions). Secondly, the results of the research questions will be addressed and thirdly the findings from the remainder of the questions will be analysed.

5.2 Demographic Characteristics of Participants

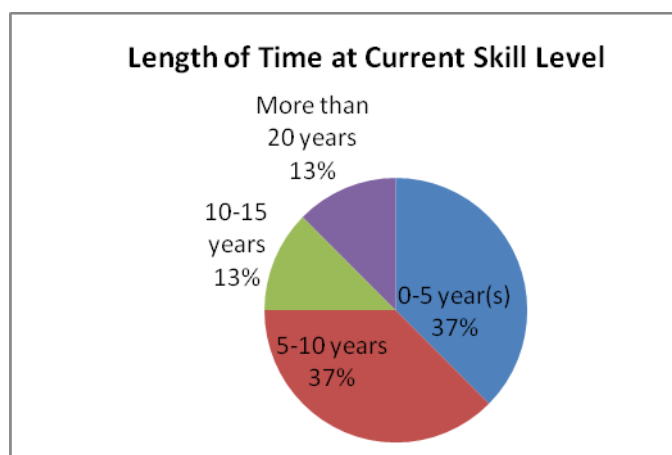
In order to determine the demographic information of the participants, each participant was asked to answer a set of six multiple choice questions. The six questions addressed how long a participant has been in the healthcare field, how long they have worked in their current position, how long ago they entered the workforce, how long they had been at their current skill level, the level of education they have received and also their position in the organization.

For a few of the questions there was a clear majority in the responses. 75% of the participants had worked in the healthcare field more than 20 years. The majority of participants (56%) had been at their current position from zero to five years. More than four fifths of participants (81%) had entered the workforce more than 20 years ago. Finally most of the participants held a Masters degree at 63% of the study sample, 19%

had an undergraduate degree, 13% had PhDs and only 1 participant (6%) had only some college.

One of the questions showed interesting results. When asked how long participants had been at their current skill level the answers received were varied. Figure 17 below shows the results.

Figure 17: Length of Time at Current Skill Level



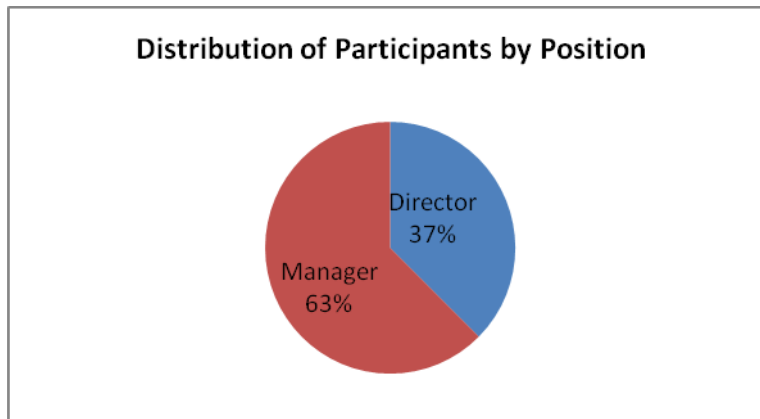
One of the reasons for this split in the answers is that the question is very subjective and open to interpretation. Often the participant would comment on this question and sometimes ask how this question should be interpreted. The researcher made sure not to skew the answers of the participants and therefore would often explain that “you [the participant] should answer it however you [they] see fit.” Some of the comments made in regards to this question were:

Well this is a loaded question because my skill level is always increasing, I have been in this job for over 10 years but it has been an evolving job and so I developed my skill. (Participant 13)

My job title has changed. (Participant 6)

The final question concerned with demographics of the participants, asked what position the participant currently held; manager or director. Figure 18 shows the results.

Figure 18: Distribution of Participants by Position



It must be noted that this sample is a close representation of the population of managers and directors at the organization in question. When the population of managers and directors at the healthcare organization was analysed approximately 24% were directors and 76% were managers, which results in a percent difference of 13%.

The results of the demographics are shown in the following table.

Table 1: Demographics

Demographic	Frequency (n)	Percentage (%)
Length of Time in Healthcare Field		
0 - 5 Years		
5 - 10 Years	1	6%
10 - 15 Years	2	13%
15 - 20 Years	1	6%
More than 20 Years	12	75%
Length of Time in Current Position		0%
0 - 5 Years	9	56%
5 - 10 Years	3	19%
10 - 15 Years	3	19%
15 - 20 Years	0	0%
More than 20 Years	1	6%
Length of Time since Entered Workforce		
0 - 5 Years	0	0%
5 - 10 Years	1	6%
10 - 15 Years	1	6%
15 - 20 Years	1	6%
More than 20 Years	13	81%
Length of Time at Current Skill Level		
0 - 5 Years	6	38%
5 - 10 Years	6	38%
10 - 15 Years	2	13%
15 - 20 Years	0	0%
More than 20 Years	2	13%
Level of Education		
Some College	1	6%
Undergraduate degree	3	19%
Masters degree	10	63%
PhD degree	2	13%
Current Position		
Manager	10	63%
Director	6	38%

5.3 Impact on Decision Making

This section aims to answer the primary research question:

- (1) Does the presentation of performance data (either through balanced scorecard formalisms or dashboard formalisms) affect healthcare decision making?

Participants were asked to answer the following questions after they reviewed a scenario and were shown wait time data in both the gauge format and the tabular format:

- 1) How does this inform your decision making?
- 2) Would you take action? Yes or No? Please explain your answer.

Both of these questions are relevant to answering whether the graphic formalism affects a decision maker's decision. Firstly, we will address how the graphic formalism informs decision making and then we will examine whether a participant would take action and what action they would take.

5.3.1 Informs Decision Making

Some of the participants were unsure as to how to answer the question regarding whether the display informs their decision making which resulted in variation in their being able to explain how it informed their decision making. The results are broken up by the responses to the tabular and gauge graphic formalisms.

Both the tabular and gauge formats cued the participants to thinking that something needs to be changed in a department. While looking at the tabular format one participant indicated:

One would want to take a look at those yellow lights first because it cues the manager that there is something not in line (Participant 5)

A participant explained the following while answering questions using the gauge format “well it is telling me that I need to get back in the green!” (Participant 3).

When looking at the gauge format a few participants indicated that it informed their decision making by giving them an initial idea of the state of the department. One participant said “it informs decision making because I know it is not acceptable” (Participant 4), while another stated it “gives data to start critically thinking” (Participant 9) and another said “the ranges are helpful” (participant 8).

5.3.2 Action

Participants were more forthcoming with comments as to whether they would take action. The two main responses given by participants as to the action that they would take were firstly to acquire more information and secondly to alert the responsible party of the situation. For both of the graphic formalisms, the number one action given by the participants was that they would acquire more information. The participants answered other more direct questions regarding the completeness of information and these results are included in the analysis in section 5.4.3. The second most common action that participants would take was to alert someone to the state of the situation. For the tabular situation two participants (participant 2 and 6) indicated that they would explain the situation to the community as the community was the cohort concerned about long wait times. Along these lines, one participant said:

The only actions I would probably take at that point would be to speak to people who were concerned in the community to explain the standard we have and what they can reasonably expect. (Participant 2)

The same participant that would inform the community when presented with the tabular display would do the same when shown the gauge display:

Well first of all I have been receiving pressure from the community, none of this [points to gauge] is in red, but because I don't know what this means as far as who has set these but I could at least say that the surgical wait times is within acceptable parameters. And I would be able to get back to the community with some feedback. (Participant 6)

Another cohort that participants suggested alerting regarding the situation in the scenario, were fellow coworkers in the organization that may be related to the situation. For example, one person suggested going to the Medical Imaging manager to find out more information to see if there is something occurring in medical imaging that is forcing the surgical department to result in wait times. In healthcare the medical imaging teams and surgical teams can be affected by one another due to the very fact that sometimes one is reliant upon another. One participant explained:

I would go and talk to the manager, go look at the data, um, ask him what is going on. (Participant 3)

In summary the graphic formalisms informed decision making by cueing the decision maker that a change is needed and gave initial feedback as to the state of the healthcare situation. The large majority of the participants indicated that the action they would take would be to gather more information. Some participants indicated that they would communicate the wait time data to the community and some would communicate the wait time data to the relevant managers in charge of the relevant departments.

5.4 Comparison of Formats

This section will address the following research question(s):

(2) How do graphical formalisms used in balanced scorecards compare to the graphic formalisms used in dashboards in terms of a healthcare decision maker's perception of:

1. understandability of information,
2. level of support for decision making, and
3. completeness of information?

In order to address the research question above, each participant was asked each of the three questions separately. The results are shown below as 1) understandability of information, 2) level of support for decision making and 3) completeness of information.

5.4.1 Understandability of Information

The study addressed the issue of understandability of the formats in three ways. Firstly the participants were asked whether the information was easy to understand and then they were asked to compare the two formats for the understandability of information.

When the participants were presented with the gauge format and asked if the information as easy to understand, 90% said that they found the information easy to understand. One of the participants said that they "like gauge graphics and colours" (participant 1) and on the other hand one said "when coupled with text the gauge is harder to understand" (participant 6).

When the participants were presented with the tabular format and asked if the information was easy to understand, 90% found the information easy to understand. The

explanations were that “the tabular [format] is not visual” (participant 4) but another said “the tables are clear” (participant 5). In addition it was thought that additional information was needed in the tabular format which included the need for definitions.

Finally, much more information was obtained during the comparison of the two formats when the participants were asked “which format is the easiest to understand and why?” 60% of the participants found that the gauge was easier to understand, whereas the remaining 40% thought the tabular format was easier to understand. Of the 60% that found the gauge easier to understand, participant 3 describes that the gauge is preferable because:

there are targets there. It is a visual. I think the first one [points to tabular] would have been better if there was a graph. A trend over time, like if it is going up or down. But it is just boxes, tables and numbers and I have to still do the math in my head....it is going up....This one [points to gauge] I can see if I was at 10 weeks or 13 weeks (participant 3)

Another participant explains why they prefer the gauge format for ease of understanding:

I think the gauge format, it relates to the symbol of a car speedometer and with the red, yellow green it has that symbolism for me so my brain is instantly fluid with that. It is a lot quicker for me not to have to go to the graph below or to where I last trends were. (participant 9)

A few participants indicated that they were not familiar with the shapes that graphically showed the state of the indicator for the gauge display format. Another participant said “different shapes are confusing in [the] tabular [format]” (participant 6). One of the participants who found the tabular format easier to understand explained the following:

I think that this is easier to understand [tabular] if I am looking at a whole bunch of them [indicators] because I can quickly go down and look at the ones and go oh yeah so I know how they measure. 14.2 weeks is not good [MRI Wait time]...and that is fine or I need to take action. Because wow that is more than last time and we are going in the wrong direction we are getting to the edge of green. If I had more information. Everybody wants more information. (participant 12)

5.4.2 Level of Support for Decision Making

The study addressed whether a format provided support for their decision making in three ways. Firstly the participants were asked whether the information in each format supported their decision making and then they were asked to compare the two formats. When the participants were presented with the gauge format and asked if the information supported their decision making, 80% of participants said that the information supported their decision making, whereas 20% said that it did not. One of the reasons given for the fact that it supported decision making was that the gauge gave a “good starting point” (participant 8) whereas a reason for not supporting decision making was that there “was not enough information” (participant 6). When the participants were presented with the tabular format and asked if the information supported their decision making, 60% said that the information supported decision making and 40% said it did not. The reason given for the tabular format not supporting decision making was that they “need more information” (participant 12).

Lastly, the participants were asked to compare the two formats and explain which one better supported their decision making and 70% of participants agreed that the gauge format most supported their decision making. A few reasons were given which were the “gauge has the range” (participant 9) and “the gauge most supports decision making because of the visual” (participant 3). One of the reasons that the tabular format

supported decision making was that the “tabular guides the participant directly to the concern” (participant 5)

5.4.3 Completeness of Information

The main theme that arose during the interviews was the need for more information. According to the participants, both of the formats were missing vital information. Table 2 shows the main categories of information that was requested by the participants. The table shows the categories of information needed, the percent of participants that mentioned the category and the total times the category was mentioned.

Table 2: Information Needed

Theme	Definition	Number of Participants	Percent of Participants (%)	Number of Mentions
Causes	The reasons for the wait times	8	62	24
Trends	Past data that shows the older values for the wait time by time of year.	7	54	15
Target	The optimum number for the performance measure, in this case this refers to the goal of the wait time average	6	46	11
Range	This refers to the lowest and highest values of the red, yellow and red traffic lights ranges	5	38	9
Definition	The definitions of each of the variables contained within the graphic formalisms such as the statistic used for the wait time, or how it was measured.	5	38	12
General information	Refers to information that did not fit into any other theme	5	38	5
Communication with others	When the participant wanted to get more information from others in the organization it was included here	4	31	7
Drill Down	Drill down is a term used in information technology to refer to the values that are contained "beneath" the shown value. For example if a manager wanted to know more	4	31	6

Theme	Definition	Number of Participants	Percent of Participants (%)	Number of Mentions
	information regarding the wait time, they could click on the value and it would show more information such as the trend.			
Comparison	A participant would want to sometimes compare their unit (surgical unit in this case) to another unit in the organization to see if the wait time values for the surgical unit were abnormal	3	23	4
Abnormalities	Participants wanted to see if this period was different from other periods and therefore if there was some abnormality in the data.	3	23	4
Correlation	This refers to when a participant wanted to know if one wait time was dependent upon another, therefore was there a correlation between wait times.	3	23	3
Percent Difference	This refers to the value calculated by taking the last period's value away from this period's value and then dividing by this period's value.	1	8	3
Total		13	100	103

There were many requests by participants for more information. Below I examine the first five information needs where the number of participants that mentioned the category was 9 or more and these consisted of the most mentions. These included causes, trends, target, range and definitions.

5.4.3.1 Causes

Cause of the wait times was the most requested piece of information. Table 3 shows the information that was requested by topic of information requested:

Table 3: Causes

Theme	Definition	Number of Mentions
Staffing	Are staff sick, on maternity leave, etc?	8
Surgical Procedure	Are the surgical procedures of rare and therefore occur more often?	4
Resources	Are there certain resources missing, such	3

Theme	Definition	Number of Mentions
	as staffing or equipment?	
Bottlenecks	Is there somewhere in the process of receiving a surgery that there are bottlenecks?	2
Area	What is happening in each area of the hospital? Are there long wait times because of another hospital unit's problems?	2
Physician Orders	Are physicians writing excess orders that make a patient wait longer?	1
Low Isotopes	Some surgical procedures require isotopes and therefore is there a shortage in isotopes?	1
Acuity of Patients	How sick a patient is	1
Diagnostics	Laboratory and imaging, for example	1
Equipment	Is a piece of equipment not functioning properly?	1
Total		24

The main information that was requested by the participants was regarding staffing, for example, were there staff on sick leave? Several participants' comments are shown below:

I mean is it a simple thing as restricted access, was the CT scanner broken for a while, was there problems with staffing? (participant 1)

Secondly are there things that we can change to shorten that wait time that are reasonable? Is it because we are short staffed (participant 10)

...is there something going on with their staff? (participant 3)

The next suggested cause was due to the nature of the surgical procedure. Some participants asked if certain surgical procedures were causing the wait time to be high:

I would be drilling down to see if there is a particular procedure that we need to focus on. (participant 2)

So I guess I don't know what the target is, but if it is high overall then I would probably want to drill down because some of the procedures may be way shorter and there might be some long tails somewhere so I

would need to drill down into more detail about what kinds of surgeries are waiting but they are saying that overall wait times are at an all time high so what's the? (participant 12)

Lastly, one of the most common causes for the wait times was suggested to be available resources. The following comments were made in regards to this by one participant:

Is it because we are short staffed, is it because we don't have the proper resources, is it because physicians are ordering tests because the patients are expecting more to be done like...what I would do is compare this to ultrasounds. (participant 10)

5.4.3.2 Trends

As participants answered questions based on the scenario presented, trending information was the most requested piece of additional information. 44% of participants mentioned that they would like to see previous data for the wait times. The previous quarter's data was disclosed to the participants, but according to them, this was not enough information. The participants said the following regarding their need to see the trends:

I want to know how do I compare at the same amount of time last year? So is last year comparison the same trend because maybe it is a particular time of the year where it is always going to be a bit higher than the last quarter. (Participant 3)

I would need to know trending, so it does tell me that I looked at the wait time data from last quarter and it hasn't changed much from quarter to quarter. But I don't know year over year or trending. (Participant 4)

Yes as long as I could go back and look at previous reports, I would need to go back and look at quarters. And ours are graphed in bars so that if we could look back at trending, that would help me. I like that this

is a start, but as long as supportive statistics that I could look back and compare, trending. (Participant 9)

It seems that the main reason for requesting more historical data was in order to determine if the time of year had anything to do with the rise in surgical procedures. Therefore the managers and directors were interested to see if the wait time data was the same last year; if it was then most likely it was due to the time of year and if not then it was cause for concern.

5.4.3.3 Target

The next most commonly requested piece of information was the wait time target. Participants were eager to know whether they were close to a target for that period. 31% of participants requested the target wait time for that period. This is what was said:




Because except for surgery the other two were in yellow so we are not meeting our targets. And I want to know how far are we from target? (participant 3)

It is easy to understand what it says here, but I don't have the information underneath on how you came upon and how these measures were decided and I also don't see any targets. (participant 12)

5.4.3.4 Ranges

Along with specific targets, participants were interested in knowing what the ranges were for each wait time. The range referred to the traffic lights as previously discussed are in Table 4,

Table 4: Key

Light	Description
	Performance is within acceptable range
	Performance is outside acceptable range
	Performance is significantly outside acceptable range

31% of participants indicated that they wanted to know the ranges. Something of note is that only the ranges were requested for the tabular format as the range was given for the gauge format. The only comments regarding the gauge ranges had to do with the definitions. The following was stated by the participants when presented with the gauge format,

And how do we know what the green is “performance is within acceptable range”, yellow...? How do we know...those are just arbitrary? Somebody made those? (participant 8)

Well the first thing that leaps to mind is that 2 out of the three indicators are showing that you are outside of acceptable range. Who determined the acceptable range? (participant 7)

When presented with the tabular format the participants just wanted to know what the ranges were:

It might be helpful to know what that range is. (participant 5)

How close am I in all of them to the next stage. So I don't know the range there so I don't know that acceptable range. (participant 6)

But what I liked about the other one that this one doesn't have is its range. Like it doesn't really show me where we are on this range, so after looking at that one I feel like this one is incomplete. (participant 8)

5.4.3.5 Definitions

38% of participants referred to wanting more information in the way of definitions.

Table 5 shows the definitions that were mentioned by participants,

Table 5: Definitions

Theme	Definition	Number of Mentions
Statistic	What is the statistic used to calculate the wait time performance measure? How is it calculated?	7
Collection of Information	How is the information collected that is used to calculate the wait time performance measure?	2
Wait time	What does wait time refer to here? For example, Is it time from admittance to hospital to time of surgical procedure?	1
Correct Indicators	What are the definitions of the indicators? Are we using the correct ones?	1
Scope	What is the scope of the performance indicators? Are they just including the surgical unit from one hospital or many?	1
Total		12

The most requested definition that was needed was about the statistics that would apply to the scenario. This was worded a few different ways, such as “What is the metric?” (participants 5 and 12), “What is being measured?” (participant 12), and “Is this an average?” (participant 8).

Participant 12 explained the following:

And would there be descriptors underneath that, what is the wait time is that wait time from the first day they go and see their physician, is it when they go and see the surgeon? What is this measuring? So I would expect another page underneath that would tell you how you came to that measure.

Some of the other definitions that were needed were how the information was collected that led to the indicators, what is the definition of wait time, are they the correct indicators to be used in the scenario and finally the scope, are the numbers presented provincial or for the health authority?

5.5 Decision Maker's Preference

This research has shown that 94% of the study participants preferred the gauge display of performance data over the tabular display. When asked why they preferred the gauge format, half of the participants thought that the gauge contained more information,

Because I know what the targets are. (participant 3)

it gives me a sense of where we are at in terms of the norms. I can immediately see where the goal is and I can see how far away the goal is. (participant 4)

It is because it shows me how close it is. So it does set priorities a little bit better. It also alerts me that the fact that this one [surgical gauge] is getting there. So it shows you where you are a lot better than this one [points to tabular] because this one is a very static, is a very...it is just one picture. (participant 6)

But it [gauge] gives me that perspective of where we are in the overall performance where this one doesn't [points to tabular] (participant 8)

Yeah it is more efficient for me because I can eliminate steps. (participant 9)

So the gauge is easier for me to see where I am on the concern list. (participant 10)

the gauge probably does inform, because it does give me that one step more (participant 13)

This one here [gauge] would provide a little more direction on where I wanted to start (participant 15)

44% of participants found that the gauge was more visually pleasing and this is shown by the comments below:

It is easier to look at (participant 4)

Well it is interesting because the tabular is actually more comfortable at first, but if I was using this routinely I would probably prefer the gauge. (participant 2)

It is more immediately apparent in scale than the other one. The other one you have to digest what the information is telling you and yes you have the colours to relate to but this [gauge] is visual...I don't know how to explain it but it leaps out at you. (participant 7)

I like this one because graphically its [gauge] gives a more complete picture than this one. (participant 14)

it was a little more fun to look at. Visually it helps me think about which way I want to go. (Participant 15)

The quick grab of the eye to draw you to the issue would be the gauge. (Participant 16)

Because I think that the graphic display of information holds more potential for presenting more information without expecting people to extract the meaning from numbers. The graphical display, you can in effect display graphical relationships, whereas if you were presenting it numerically you would have to be doing your own computation. And if you don't spend a lot of time working with those types of numbers and knowing the relevant computations are you might miss it. So I would say the graphical format, the gauge format. (participant 11)

The qualitative results described above have provided interesting insights into healthcare decision maker's preferences when it comes to performance data presentation. The results show that overall participants found that they preferred the gauge for two reasons; the gauge provides more information than the tabular display and the gauge is more visually pleasing.




5.6 Other Results

This section outlines some other interesting results that were found including participant's previous experience with wither one of the formats, whether or not a participant wanted to change the way that performance data was presented to them, any other items they learned and the quantitative results from the marking on a line questions.

5.6.1 Previous Experience With Performance Data Presentation Formats

More than half (57%) of the participants had used performance data in a tabular format and only 6% of participants had used the gauge format. Most of the participants had used the tabular format in the health authority's balanced scorecard. A feature of the balanced scorecard is the use of traffic light system which is the same as used in the scenario in the study (Table 6).

Table 6: Key

Light	Description
	Performance is within acceptable range
	Performance is outside acceptable range
	Performance is significantly outside acceptable range

One participant writes,

What happens with projects is that you do use the lights to see if you are on track (participant 5)

The participants were asked what they used the balanced scorecard for and they mentioned specific indicators they used along with the general uses of the balanced scorecard. Below all of the uses and the indicators that were mentioned.

5.6.1.1 Indicators

- wait times (participant 4)
- mental Health (participant 4)
- access (participant 6)
- workload management (participant 6)
- wellness indicators (participant 9)
- performance indicators (participant 9)
- sick time (participant 10, 12)
- overtime (participant 10)
- budget (participants 6 and 12)
- hand hygiene rate (participant 12)

5.6.1.2 General Uses

- for strategic plans (participant 4)
- use scorecard to compare and contrast and to explain (participant 4)
- use of BS for project management (participant 5)
- looked at scorecards from quality improvement program (participant 6)
- used for priority setting (participant 6)
- Measuring of quantitative data (participant 10)
- Comparison of data (participant 10)
- use for patient flow scorecard review in a committee every 2-3 months (participant 12)
- part of planning (participant 9)
- measure progress towards goals and objectives (Participants 1 and 5)
- family practice clinic to see if we can take more patients (participant 6)

The above show all of the examples that the participants mentioned where they used either a balanced scorecard or a dashboard for.

Lastly participants described how the balanced scorecard was communicated at their workplace. They explained that the balanced scorecard was “used to report up” (participant 1), “to defend wait times internally” (participant 4), “taken to nursing and physician meetings” (participant 6 and 9), the information was also communicated in “project reports” (participant 8), “patient flow committee” (participant 12) and “used in performance reviews” (participant 9).

5.6.2 Change Method of Display of Performance Data

Participants were asked whether they would change the way performance data is presented to them since being introduced to different methods of viewing performance data. 31% of participants said they would change to the gauge format, which was an interesting finding. Out of the 31%, 40% said they would use the gauge format for specific purposes, which were to “use in staff meetings” (participant 4) and to “report to teams” (participant 1). Some of the participants’ comments were,

Yeah this [tabular format] seems so inadequate now (participant 8)

Well we have been getting this one [tabular format] and I would in general prefer this one [points to gauge] because it is easier to read. (participant 6)

Some of the participants (25%) did not want to change the way performance data was presented to them, where most of the participants used the tabular format. The reasons behind not changing were the following,

not so much because the way the data is presented to me is comparable with the tabular display so I cannot say that oh wow this [gauge format] is far superior (participant 5)

I don't need it changed, but if I had an opportunity to move it forward I would support it and I would share it. (participant 9)

5.6.3 Learning

Finally participants were asked if they had learned anything from the study. Many of the comments had to do with their experience with the gauge format of performance data display. Many (38%) of the participants indicated that they had learned something new, that being the gauge display format. One went on to say,

Yeah I like these gauge ones. I want to learn how to draw them. (participant 8)

Further comments about the gauge included that they liked the gauge the more they looked at it (participant 2) and they found the gauge to be more visually pleasing (participant 4). Some other general comments included,

When I do anything with stats or put things in tables, I see these as options and playing about, but it is nice to see something how it can be used. Because I wouldn't have known that term [point to Gauge title]. And I actually didn't know that this was called a tabular [point to tabular] display even though I view these lots (participant 4)

Yes it just validates and reinforces to me that the communication style has to continue, it has to continue effectively. And it brings home the fact that it is challenging times to meet such directives in health care because we are under such scrutiny and fiscal responsibility and stewardship. And I like to give that feedback back as this is what we have done differently and this is how we have changed. Or say that you are asking for the moon and that's not going to happen, but I can meet part way and these are my reasons why. (participant 10)

Overall, 2 out of 5 participants stated that they had learned something from participating in the study.

5.6.4 Quantitative Results

Questions 6 – 8 on the gauge and tabular cases resulted in quantitative data for analysis. The participants were asked the following:

Please answer questions 6-8 by making a mark on the line.

6. I find the information easy to understand.
7. I find the information supports my decision making
8. I find the information that was presented to me to be complete

A paired t-test was used to compare the tabular format to the gauge format. The hypothesis was that the mean = 0. Table 7 shows the results.

Table 7: Paired T-Test Results

Question	T-Value	P-Value
6	0.0456	0.8576
7	0.2357	0.3608
8	0.6740	0.0153

For question 6 and 7 the p-value was not statistically significant. For question 8, the calculated P-value is less than 0.05 (0.0153), the conclusion is that the mean difference between the paired observations is statistically significantly different from 0. Since the t-value is positive and the difference used was value(gauge) – value(tabular) this means that the participants agreed more with the gage format for the statement “I find the information that was presented to me to be complete”.

Chapter 6: Discussion and Conclusion

The main findings from the results show that 1) the majority of healthcare decision makers who participated prefer the gauge display format and 2) Healthcare decision makers need more information to make an informed decision that could supplement the display format (gauge or table). This chapter will also examine the reason behind the main findings using the Hibbard Framework. Finally the implications of the study and future research will be reviewed.

6.1 Healthcare decision makers prefer the gauge display format

The results show that overall the participants preferred the gauge display over the tabular display. When asked which display format they preferred, 94% said that they preferred the gauge format. Also 60% of participants found that they understood the gauge format better than the tabular format. Furthermore, 70% found that the gauge better informed their decision making. Finally when asked to grade how much they agreed to the statement "I find the information that was presented to me to be complete" it was shown to be statistically significant that the participants agreed more with the statement for the gauge.

6.2 Healthcare decision makers need more information to make an informed decision

For both the tabular and gauge formats, all of the participants indicated that they required more information and that performance data display alone was not enough to make a decision of whether or not to take action. The five most common types of information requested was the causes, past data (trends), targets, ranges and definition of the wait times.

6.4 How the Hibbard Framework Explains the Preference of Performance Data Presentation Methods

In the previous literature that was reviewed many theories were explored including cognitive fit theory, representation congruence theory, cognitive load theory and a theoretical framework proposed by Hibbard. These are inter-related and all lead up to the final Hibbard framework examined below. Hibbard uses these theories in order to develop his framework.

One way to help explain the reason behind the preference for the gauge format is to review the Hibbard Framework. The Hibbard framework suggests examining three processes in order to make an informed decision in healthcare. Those three processes are:

- 1) Lowering the Cognitive Effort Required
- 2) Helping People to Have a Better Idea of What the Actual Experience of a Choice Might Be Like
- 3) Highlight the Meaning of the Information (Hibbard, 2003)

The Hibbard framework explains the results of this research and the following breaks down the framework process by process.

6.4.1 Process 1: Lowering the Cognitive Effort Required

Hibbard explains that “the amount of information alone can be overwhelming to decision-makers” and “faced with too much information, some decision-makers may determine that the effort required is not worth it” (Hibbard, 2003). Therefore Hibbard suggest lowering cognitive effort, which involves three main concepts, 1) simpler information, 2) decision tools and 3) visual display of information.

Hibbard explains the process by identifying the fact that simpler information will help a decision maker formulate their decisions more easily. In this study instead of simplifying information, the participants were asked what display format was the easiest to understand and 60% said the gauge was easier to understand. One participant indicated

it relates to the symbol of a car speedometer and with the red, yellow green it has that symbolism for me so my brain is instantly fluid with that. It is a lot quicker for me not to have to go to the graph below or to where the last trends were. (participant 9)

Hibbard explains that decision tools would be helpful to reduce cognitive effort. In this study, traffic lights (red, yellow and blue) were used, but since both formats contained that decision tool it does not explain any preference over display formats.

Finally to help to reduce cognitive effort required Hibbard suggests that the visual display of information would help. The gauge was said to be a better visual display of information because it showed ranges. One of the differences in the two formats was the fact that the gauge display included the ranges and the tabular format did not.

Participant 7 says “well the first thing that leaps to mind is that two out of the three indicators are showing that you are outside of acceptable range.”

In summary, Hibbard’s process 1 confirms that the gauge is preferred since it had simpler information and the gauge reduced cognitive effort.

6.4.2 Process 2: Helping People to Have a Better Idea of What the Actual Experience of a Choice Might Be Like

Hibbard argues for “good-quality decision processes, in which the consumer comprehends provided information and brings it to bear on choice using his or her own values as a guide, may be more likely to emerge” (Hibbard, 2003). Hibbard suggests three possibilities to help people have a better idea of what comprise the experience of a choice are, which include narratives, more vivid information and customized information.

In this study both the gauge and tabular formats include the same narratives (also called scenario) therefore this particular possibility does not have any bearing on the result of preference of performance data display format.

Hibbard suggests that more vivid information will help people have a better idea of what the actual experience of a choice might be. This option came up many times during the study and the participants often thought that the gauge gave more vivid information. Many participants indicated that the gauge display was more visual than the tabular display. Participant 16 explained that “the quick grab of the eye to draw you to the issue would be the gauge.” And participant 15 said “it [the gauge] was a little more fun to look at. Visually it helps me think about which way I want to go.”

The third suggestion that Hibbard gives to help people to have a better idea of what the actual experience of a choice might be like would be to show customized information. There was no difference between the gauge and tabular cases for customizing information but a couple of participants indicated that if they were the surgical manager then they would have a better understanding of the state of the department. Along these lines, one participant explains,

“yeah especially if I am the manager of the surgical unit. Surgical wait time, receiving pressure, is it just hips, right? But then because we can get something in one day does it balance out the hips that take so long that that is why we are getting pressure? And what does the CT and MRI actually have anything to do with surgical?” (participant 6)

Overall the gauge display was more vivid and therefore satisfied Hibbard’s second item in process 2.

6.4.3 Process 3: Highlighting the Meaning of the Information

Hibbard suggests a final process to help make an informed decision and that is to highlight the meaning of the information. Hibbard suggests having a precise estimate, showing actuals and not percents and framing the decision. For this process in regards to this study, neither the gauge nor tabular format is different here for any of the three options. The participants did indicate that they would like more information and some of the information requested will highlight the importance of the three options given by Hibbard for this process.

There is no difference in the data provided for each of the display formats and therefore the precise estimate that Hibbard suggest will not help to explain why the gauge display is better for informing a participant on whether to take action. One item of note is that during the study participants indicated that they needed more information and in particular they requested definitions to be included in the performance data display. This was worded a few different ways such as “What is the metric?” (participants 5 and 12), “What is being measured?” (participant 12), and “Is this an average?” (participant 8). Therefore by having definitions it would mean that the value being explained would be more precise.

Finally the framing of the problem was the same for both of the display formats but in both cases the participants asked for more information to frame the problem. The two most common pieces of information requested by the participants were the causes of the wait times and the trend of past data. Both of these pieces of information would help to better frame the problem. An example of how the trending would better frame the problem is shown in what participant 3 said; “so is last year comparison the same trend because maybe it is a particular time of the year where it is always going to be a bit higher than the last quarter.”

This discussion has shown how the Hibbard Framework explains why participants preferred the gauge format over the tabular format. This perspective argues that the gauge lowers cognitive effort required to make a decision by providing simpler information, decision tools and visual display of information. It also indicates that the gauge helps people to have a better idea of what the actual experience of a choice might be like by providing more vivid information.

6.5 Limitations

Due to the fact that the entire set of interview questions were developed by the investigator some of the responses to the questions indicate that participants did not fully understand all the questions. One example being “What way of presenting data do you prefer? Why?”. This question should have been more specific to elaborate on what type of data there was to present. Another limitation was the use of only one large healthcare organization. This meant that any experience that the decision makers have at that one organization may have biased the results and also limits the generalizability of the results. Generalizability refers to the ability of extending the validity of one's case study conclusions to other cases of the kind (Mills, 2010). It would have been useful to examine other similar large healthcare organizations and further research along these lines is recommended.

There were a few things that were not assessed in this study and could have affected the results. Firstly by presenting the participants with performance measures it is assumed that the participants understood numbers so in future work the participants level of numeracy could be assessed. Another thing that wasn't assessed was if a

participant had colour blindness which could have affected the participant's understanding of the graphic formalisms.

Another limitation to this study is the fact that all of the participants had seen the tabular format in their regular work life. The fact that they had seen this format already could have skewed the results. The qualitative portion of this study did show that the participants did have specific reasons why they generally liked the dashboard better. For future work a suggestion would be to test people that have never used or seen either the balanced scorecard or dashboard formats.

6.6 Implications

6.6.1 Implications for the Future Implementation of Performance Display Methods

The research has shown that the move towards dashboards as a method of displaying performance data is warranted when comparing the graphic formalisms found in the dashboard and balanced scorecard. Therefore, for future implementations of performance data displays a system that includes a gauge should be considered. Furthermore, a dashboard should be considered as a way to display an organizations performance data that can reduce cognitive effort.

Another implication of this study shows that although a gauge format is easier to understand and better supports decision making, the decision maker requires more information. They would like to be better informed before they make a decision to take action, therefore when developing systems in the future there should be better connectivity between information. A suggestion would be that the decision maker be able to access other information directly from the performance data display. Due to the nature of the dashboard, including more information would be much easier than using a balanced scorecard.

6.6.2 Implications for Healthcare Decision Makers

This study showed that a gauge or tabular format of displaying performance data is not enough to make an informed decision. This study may help healthcare decision makers in the future by suggesting some other options for finding more information in order to

help make an informed decision. Some of the methods mentioned in this study include talking with others in the organization that may have a better understanding of the problem, looking at past data and analyze trends to discover whether there is an aberration or a pattern, and making sure that one understands the data that is being presented.

6.6.3 Implications for the Health Informatics Field

This study has implications in the health informatics field with respect to secondary use of data. Performance measurement, in this case, is calculated from data gathered from the electronic health record and is therefore a secondary use of the electronic health record. This study has helped to shed light on the presentation of performance data and should be used when assessing when to use a balanced scorecard or a dashboard.

6.7 Future Research

A possible future study would be to look at a dashboard and balanced scorecard electronically. This research has only analysed the graphic formalisms found in each display format and has done so using paper. A possibility would be to analyse the differences of online versions of a dashboard and balanced scorecard to explore further the attributes of each display format.

6.8 Conclusion

We are seeing the move towards the use of dashboards to present performance data and away from the use of balanced scorecards. There has not been much research to show whether dashboards are better than balanced scorecards. This study looked at comparing the most common graphic formalism used in dashboards, the gauge, to that used in balanced scorecards, the tabular format. It was shown that the majority of participants in this study, decision makers in a large healthcare organization, preferred the gauge format over the tabular format. The gauge was shown to be more understandable, better supported decision making and the information contained within the gauge was more complete than the information in a tabular format. The Hibbard Framework was used to help explain why the gauge was format was preferred over the tabular format by outlining the idea that the gauge format lowers cognitive effort required to make a decision and the gauge helps people to have a better idea of what the actual experience of a choice might be like. Further research is needed to determine if these results are generalizable and under what contexts the different formats are preferred.

Bibliography

- Active Strategy. Balanced Scorecards vs. Dashboards.
http://www.activestrategy.com/strategy_execution/scorecards_vs_dashboards.aspx.
 Accessed February 19 2010.
- Ariely, D. (2000). Controlling the Information Flow: Effects on Consumers' Decision Making and Preferences. *The Journal of Consumer Research*, 27(2), 233-248.
- Baker, G. R., Anderson, G. M., Brown, A. D., McKillop, I., Montgomery, C., Murray, M. A., Pink, G. H. (1999) The hospital report '99: a Balanced Scorecard for Ontario acute care hospitals. December 1999. *Department of Health Administration, University of Toronto and the Ontario Hospital Association*.
- Barnardo, C. And Jivanni, A. (2009) Evaluating the Fraser Health Balanced Scorecard – a formative evaluation. *Healthcare Management Forum*. Summer; 22 (2): 49-60.
- Bertin, J. (1981). *Semiology of Graphs*. Madison, WI: University of Wisconsin Press.
- Campbell, D.J., 1988. Task complexity: a review and analysis. *Academy of Management Journal* 13 (1), 40–52.
- Borycki, E. M., Lemieux-Charles, L, Nagle, L., Eysenbach, G. (2009). Evaluating the impact of hybrid electronic-paper environments upon novice nurse information seeking. *Methods of Information Medicine*, 48(2), 137-43.
- British Columbia Ministry of Health Services (BC MoHS). News release: B.C. Launches Patient-Focused Funding Province-wide. April 12 2010.
http://www2.news.gov.bc.ca/news_releases_2009-2013/2010HSERV0020-000403.htm#
- Byrnes, J. (2012) Driving Value: Solving the Issue of Data Overload with an Executive Dashboard. *Healthcare Value*. October 2012.
- Cardinals, E. (2008). The Interplay between Cost Accounting Knowledge and Presentation Formats in Cost-Based Decision Making. *Accounting Organizations and Society*, 53, 582-602.
- Chandra A. and Krovi, R. (1999). Representation Congruence and Information Retrieval: Towards an extended model of Cognitive Fit. *Decision Support Systems*, 25, 271-288.

Corbin, J and Strauss, A. (2008) Basics of Qualitative Research 3e. Sage Publications, California, 91320.

Davis, L. R. (1989). Report format and the decision maker's task: An experimental investigation. *Accounting, Organizations and Society*, 14(5/6), 495–508.

Dickson, G.W., DeSanctis, G. and D.J., McBride D. J. (1986) Understanding the effectiveness of computer graphics for decision support: A cumulative experimental approach. *Communications of the ACM*, 29, 40-47.

Few, S. (2004). Dashboard Confusion. Intelligent Enterprise. *Perceptual Edge*. March 20, 2004.

Few, S. (2006) Information Dashboard Design. O`Reilly Media, Inc.

Frisch, L. Personal Communication, October 21, 2010.

Gordis, L. (2004) Epidemiology. Third Edition. Elsevier Saunders. Elsevier Inc. (USA).

Harvey, N., & Bolger, F. (1996) Graphs versus tables: Effects of data presentation format on judgmental forecasting. *International Journal of Forecasting*, 12, 119–137.

Hibbard, J. A. (2003). Supporting Informed Consumer Health Care Decisions: Data Presentation Approaches that Facilitate the Use of Information in Choice. *Annual Review of Public Health*, 24, 413-433.

Hwa, M. Sharpe, B. A., and Wachter, R.M. (2013) Development and Implementation of a Balanced Scorecard in an Academic Hospitalist Group. *Journal of Hospital Medicine*. Mar; 8(3): 148-153.

Institute of Medicine. Crossing the Quality Chasm: A New Health System for the 21st Century. March 2001.

Jarvenpaa, S. L. (1988) The effects of task demands and graphical format on information processing strategies. *Management Science*, 35(3), 285–303.

Kaplan, R. S., Norton D. P. (1992) The Balanced Scorecard – Measures that Drive Performance. *Harvard Business Review*. Jan/Feb92, Vol. 70 Issue 1, p71-79.

Kaplan, R. S., Norton D. P. (1996) *The Balanced Scorecard – Translating Strategy into Action*. Boston, Mass. Harvard Business School Press.

Kaplan, R. S., Norton D. P. (Jan/Feb 1996) Using the Balanced Scorecard as a Strategic Management system. *Harvard Business Review*. Jan/Feb96, Vol. 74 Issue 1, p75-85.

Koopman et al. (2011) A Diabetes Dashboard and Physician Efficiency and Accuracy in Accessing Data Needed for High-Quality Diabetes Care. *Annals of Family Medicine*. 9: p398-405

Kushniruk, A. W., Patel, V. L. (2004) Cognitive and usability engineering methods for the evaluation of clinical information systems. *Journal of Biomedical Informatics*. 37: p56–76

Lalomia, M.J. and Coovert, M.D. (1987) A Comparison of Tabular and Graphical Displays in Four Problem-Solving Domains. *SIGCHI Bulletin*, 19(2), 49-54.

Merriam-Webster Dictionary. <http://www.merriam-webster.com/>. Accessed November 4 2010.

Marshall, T., Mohammed, A.M., and Rouse, A. (2004) A randomized Controlled Trial of League Tables and Control Charts as Aids to Health Service Decision-making. *International Journal for Quality in Health Care*. 16(4), 309 – 315.

McLaughlin, C. P. and Kalunzy, A. D. (2006) *Continuous Quality Improvement in Health Care. Theory implementations, and Applications*. Jones and Bartlett Publishers (USA).

Niven, P.R. (2002) *Balanced Scorecard Step-by-Step. Maximizing Performance and Maintaining Results*. John Wiley & Sons, Inc.

Mazzella-Ebstein (2004) Web-Based Nurse Executive Dashboard. *Journal of Nursing Care Quarterly*. Vol. 19, BNo. 4, pp 307-315

Mills, A. J., Durepos, G. and Wiebe E. (2010) *Encyclopedia of Case Study Research*. Sage Publications, California.

Morgan, M. B. et. Al (2006) Flying Blind: Using a Digital dashboard to Navigate a Complex PACS Environment. *Journal of Digital Imaging*. Vol 19, No 1 (January), pp 69-75

Oliveira, J. (2001). The Balanced Scorecard: An integrative approach to performance evaluation. *Healthcare Financial Management*. 55:42-6.

Patel, V. L., Kushniruk, A. W., Yang, S., Yale, J. F. (2000). Impact of a computer-based patient record system on data collection, knowledge organization, and reasoning. *Journal of the American Medical Informatics Association*, 7(6), 569-85.

Paterson W. G., Barkun, A. N., Hopman, w. M., Leddin, D.J., Paré, P., Petrunia, D.M., Sewitch, M. J., Switzer, C., Veldhuyzen van Zanten, S.. (2010) Wait times for gastroenterology consultation in Canada: The patients' perspective. *Canadian Journal of Gastroenterology*. 24(1). January 2010.

Pauwels, K., Ambler, T., Clark, B. H., aPointe, P., Reibstein, D., Skiera, B., Wierenga, B., and Thorsten, W. (2009) Dashboards as a Service: Why, What, How, and What Research Is Needed? *Journal of Service Research* 12; 175 originally published online Aug 17, 2009.

Rivard, K. and Cogswell, D. (2004) Are You Drowning in BI Reports? *Information Management Magazine*. April 2004.

Schofield, J. W.. (2002). The qualitative researcher's companion. Increasing the Generalizability of Qualitative Research. Sage Publications, Inc. Thousand Oaks, California.

Shaft, T. M. (2006) The Role of Cognitive Fit in the Relationship between Software Comprehension and Modification. *MIS Quarterly*, 30(1), 29-55.

Shortell, S. M. & Kaluzny, A. D. (2006). Health Care Management: Organization Design and Behaviour (5th Ed.). Canada: Delmar Thompson Learning.

So, S., & Smith, M. (2004) Multivariate decision accuracy and the presentation of accounting information. *Accounting Forum*, 283–305.

Sweller, J. (1988) Cognitive Load During Problem Solving: Effects on Learning. *Cognitive Science*, 12(1), 257-285.

Sweller, J. V. (1998) Cognitive Architecture and Instructional Design. *Educational Psychology Review*, 10(3), 251-296.

Speier, C. (2006) The Influence of Information Presentation Formats on Complex Task Decision-Making Performance. *International Journal of Human-Computer Studies*, 64, 1115-1131.

Snider MG, MacDonald SJ, Pototschnik R. Waiting times and patient perspectives for total hip and knee arthroplasty in rural and urban Ontario. *Canadian Journal of Surgery*. 2005. Oct;48(5):355-60.

Umanath, N. S. and Vessey, I. (1994) Multi-attribute data presentation and human judgment: A cognitive fit perspective. *Decision Sciences*, 25, 795–823.

Vessey I. and Galletta D. (1991) Cognitive fit: an empirical study of information acquisition. *Information Systems Research*, 2, 63-84.

Vessey, I. (1991) Cognitive Fit: A Theory-Based Analysis of the Graphs Versus Tables Literature. *Decision Sciences*, 22,(2), 219-240.

Vessey, I. (1994) The Effect of Information Presentation on Decision-Making: A Cost-Benefit Analysis. *Information and Management*, 27, 103-119.

Wyatt, J. (2004) Scorecards, Dashboards and KPIs. Keys to Integrated Performance Measurement. *Healthcare Financial management*. February 2004

Yap, C., Siu, E., Baker, G.R., and Brown, A.D. (2005) A Comparison of Systemwide and Hospital-Specific Performance Measurement Tools. *Journal of Healthcare Management*. Jul-Aug; 50(4); 251-262.

Zamakhshary M, To T, Guan J, Langer JC. Risk of incarceration of inguinal hernia among infants and young children awaiting elective surgery. *Canadian Medical Association Journal*. 2008. Nov 4; 179(10):1001-5.

Zsombok, C.E. and Klein, G. (1997) *Naturalistic Decision Making*. Lawrence Erlbaum Associates, Mahwah, NJ.

Appendices

Appendix A

Key Terms

Balanced Scorecard - is an integrative approach to performance evaluation that examines performance related to finance, human resources, internal processes and customers (Oliveira 2001).

Dashboard - is a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance. (Few, 2004)

Decision Making – is a process by which individuals or teams attempt to apply all available information to the problem at hand so as to make correct decisions. (Shortell, 2006, 528)

Performance - achievement of a desired result. (Shortell, 2006, p538)

Think Aloud - involves the recording of users as they verbalize their thoughts while using a computer or whilst performing work on paper. (Kushniruk 2004)

Understandability – to achieve a grasp of the nature, significance, or explanation of something. (Merriam-Webster)

Appendix B

Participant Recruitment Email

I would like to tell you about a study being performed by a Master's Student in Health Information Science at the University of Victoria (UVic). This student's name is Heather Jennings and she is a third year master's student. While participating in undergraduate courses at UVic she worked at VIHA in two departments which gave her working knowledge of the organization. Her first co-op was with my department, Performance Monitoring and Improvement, and her second was with Information Management/Information Technology. She would like me to extend an invitation to participate in her study.

The study will explore the question of what is the best method to present performance data to decision makers in healthcare. The participants of this study would include members of VIHA managers and directors in Integrated Health Services. The study involves answering a set of questions in person and should take about 1 hour. The letter of information is attached to this email.

Heather would appreciate your consideration and subsequent participation in this study. If you would like to participate I invite you to contact Heather directly at hjenning@uvic.ca. Heather will e-mail you at a later date with more information at your request.

Appendix C

Letter of Information

How to Present Performance Data to Decision Makers in Healthcare Letter of Information

The purpose of this research project is to answer the main research question of does the way performance data is presented (either through Balanced Scorecard formalisms or dashboard formalisms) help to answer performance related questions more easily?

Research of this type is important because currently many organizations are moving away from balanced scorecards towards dashboard formats for the display of performance data and there is no evidence to suggest that either method is better. This research aims to compare and contrast the two formats using your input.

Managers and directors from the Integrated Health Services Portfolio at Vancouver Island Health Authority are being invited to participate in this project.

The procedure is the following:

1. Each participant will be given a set of instructions and will receive one case. This case will be given to them in both tabular format and gauge format. They will have to answer the same questions on both display formats. The participants will be audio recorded as they think aloud and answer the questions. Their movements around the paper will be recorded by a video recorder on a tripod. Their faces will not be captured on video.
2. After the participant has answered the questions to the cases they will then participate in an interview. The interview will be audio recorded and their movements over the papers will be video recorded.
3. After the interview the participants will be handed a sheet to fill in post-interview questions. During post-interview the participants will NOT be audio or video recorded.

The study will take place in a room that the participant chooses and will take place during work hours at the convenience of the participant.

The potential benefits of your participation in this research include:

- To the participant: the results of this study will be disseminated to the director of performance monitoring and improvement. The director is responsible for presenting VIHA performance data to the managers and directors (i.e. the intended participants) and would take any results into consideration of future performance data presentation.
- To society: Balanced scorecards and dashboards are becoming a popular outlet for displaying performance data in many organizations, the results of this study will inform organizations (society) of the preferences of decision makers to view performance data.
- To state of knowledge: This study informs healthcare and business bodies of knowledge in the area of performance data presentation.

Any questions regarding this study can be forwarded to the researcher Heather Jennings by email at hjennin@uvic.ca.

Appendix D

Consent Form

How to Present Performance Data to Decision Makers in Healthcare Consent Form

You are being invited to participate in a study entitled “How to Present Performance Data to Decision Makers in Healthcare” that is being conducted by Heather Jennings.

Heather Jennings is a graduate student in the department of Health Information Science at the University of Victoria and you may contact her if you have further questions by email at hjennin@uvic.ca.

As a graduate student, I am required to conduct research as part of the requirements for a degree in Masters of Science. It is being conducted under the supervision of Andre Kushniruk. You may contact my supervisor at 250-472-5132. Andre Kushniruk is a professor in the school of Health Information Science at the University of Victoria.

The purpose of this research project is to answer the main research question of does the way performance data is presented (either through Balanced Scorecard formalisms or dashboard formalisms) help to answer performance related questions more easily?

Research of this type is important because currently many organizations are moving away from balanced scorecards towards dashboard formats for the display of performance data and there is no evidence to suggest that either method is better. This research aims to compare and contrast the two formats using your input.

You are being asked to participate in this study because you are either a manager or director in the Integrated Health Services Portfolio at the Vancouver Island Health Authority.

If you agree to voluntarily participate in this research, your participation will include a 1 hour time commitment to answer questions comparing balanced scorecards to dashboards. The study will take place at a place in a room that you choose and will take place during work hours at your convenience. This will involve answering questions on two mock cases, participating in an interview comparing the two cases and then answering some post-interview questions. While you are answering the case questions your movements on the paper will be recorded on a video camera. You will be asked to think aloud whilst answering questions and your thoughts will be recorded on a audio tape. At no time will your identity be captured on the video or audio recordings. During the interview your movements on the paper will be recorded by video camera and your verbal answers will be recorded on audio tape. There will be no recording during the post-interview questions. This study will be performed at a location suitable to you as the researcher, Heather Jennings, will come to your location. We are asking the entire set of managers and directors in the Integrated Health Services Portfolio to be involved, therefore there is a possible 160 participants.

Participation in this study may cause some inconvenience to you, which includes the time commitment of 1 hour to participate in the study. There are no known or anticipated risks to you by participating in this research.

The potential benefits of your participation in this research include:

- To the participant: the results of this study will be disseminated to the director of performance monitoring and improvement. The director is responsible for presenting VIHA performance data to the managers and directors (i.e. the intended participants) and would take any results into consideration of future performance data presentation.
- To society: Balanced scorecards and dashboards are becoming a popular outlet for displaying performance data in many organizations, the results of this study will inform organizations (society) of the preferences of decision makers to view performance data.

- To state of knowledge: This study informs healthcare and business bodies of knowledge in the area of performance data presentation.

Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. You will be able to withdraw at any time during the questionnaire and interview. If you do withdraw from the study your data will not be used in the study and any data will be deleted and destroyed.

In terms of protecting your anonymity any data collected from your participation in the study will remain anonymous. Your identity will not be associated with any data as the data will be assigned a participant number.

Your confidentiality and the confidentiality of the data will be protected by the fact that any email communication you have with the researcher will remain private to the researcher and not be shared.

It is anticipated that the results of this study will be shared with others in the following ways, by thesis dissertation, conference presentations, and to the VIHA director of performance monitoring and improvement.

Data from this study will be disposed of after 1 year:

1. paper questionnaire answers – will be shredded
2. audio voice recordings – will be erased from the audio recorder
3. video recordings – the tapes (or cds) will be erased and then physically destroyed.

The transcribed data will be destroyed after 5 years:

1. transcribed questionnaire answers – the electronic versions of the questionnaires will be erased from the laptop hard drive and the external hard drive.
2. transcribed audio recordings - the transcribed electronic versions of the audio recordings will be erased from the investigator's laptop hard drive and the external hard drive.
3. transcribed video recordings - the transcribed electronic versions of the video recordings will be erased from the investigator's laptop hard drive and the external hard drive.

Individuals that may be contacted regarding this study include Heather Jennings, the researcher (hjennin@uvic.ca) and Andre Kushniruk, the graduate advisor (250-472-5132).

In addition to being able to contact the researcher and the supervisor at the above phone numbers, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria at 250-472-4545 or ethics@uvic.ca and the VIHA Research Ethics office at 250-370-8620.

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

Name of Participant

Signature

Date

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix E

Cases

Tabular Display - Case 1

Instructions:

As you look at the scenario below verbalize what comes to mind and say any thoughts that come to mind. Please analyze the scenario and then answer the questions.

Scenario

You are the manager of a surgical unit and you have been receiving pressure from the community with respect to wait times. You have been told that overall wait times are at an all time high. In order to familiarize yourself with the state of affairs you decide to look at the wait time performance data. You look at the wait time data from last quarter, which was 13.7 weeks for MRI wait time, 9.8 weeks for CT wait time, and 3.5 days for surgical wait time. Below shows the wait time data for this quarter.

If presented with the following display:

- (a) how does this inform your decision making?, and
 (b) would you take action? Yes or No? Please explain your answer.

Wait Times

Performance Measure	Light	Actual
MRI Wait Time	▲	14.2 weeks
CT Wait Time	▲	10.5 weeks
Surgical Wait Time	■	3.9 days

Key

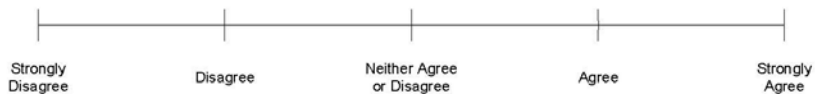
Light	Description
■	Performance is within acceptable range
▲	Performance is outside acceptable range
●	Performance is significantly outside acceptable range

Questions

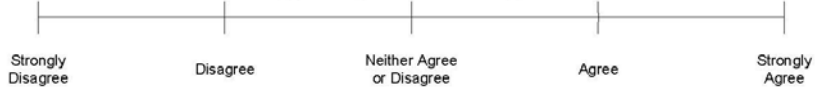
1. Did you find the information easy to understand?
2. Did you find that the information supported your decision making?
3. Did you have all of the information that you needed?
4. What other information, if any, would you want to see?
5. Please comment on the way the data was presented to you.

Please answer questions 6-8 by making a mark on the line.

6. I find the information easy to understand.



7. I find the information supports my decision making



8. I find the information that was presented to me to be complete



Gauge Display - Case 1

Instructions:

As you look at the scenario below verbalize what comes to mind and say any thoughts that come to mind. Please analyze the scenario and then answer the questions.

Scenario

You are the manager of a surgical unit and you have been receiving pressure from the community with respect to wait times. You have been told that overall wait times are at an all time high. In order to familiarize yourself with the state of affairs you decide to look at the wait time performance data. You look at the wait time data from last quarter, which was 14 weeks for MRI wait time, 10 weeks for CT wait time, and 3.8 days for surgical wait time. Below shows the wait time data for this quarter.

If presented with the following display:

- how does this inform your decision making?, and
- would you take action? Yes or No? Please explain your answer.

Wait Times



Key

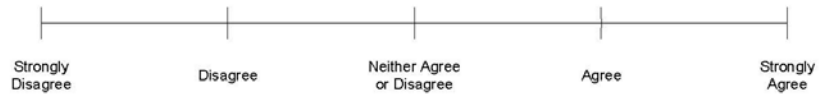
Colour	Description
Green	Performance is within acceptable range
Yellow	Performance is outside acceptable range
Red	Performance is significantly outside acceptable range

Questions

- Did you find the information easy to understand?
- Did you find that the information supported your decision making?
- Did you have all of the information that you needed?
- What other information, if any, would you want to see?
- Please comment on the way the data was presented to you.

Please answer questions 6-8 by making a mark on the line.

6. I find the information easy to understand.



7. I find the information supports my decision making



8. I find the information that was presented to me to be complete



Appendix F

Interview Questions

Interview Questions

1. Did one of the forms of data presentation help you answer the question more easily? Why?
2. Which format did you prefer?
 Tabular format Gauge format
3. Why did you prefer that format?
4. Which format
 - a. is the easiest to understand? Why?
 - b. most supports you decision making? Why?
 - c. had the most complete information? Why?
5. Compare and contrast the two formats you have seen - when would one be better to use than the other? Why?
6. Please comment on what additional type of information you would have liked to see.
7. Have you ever used either or both of these formats (i.e. scorecards and/or dashboards) in your workplace? If yes, what did (or do) you use them for? And for what purposes? What has your experience been with either or both of them (did they convey information in a meaningful way)? Please discuss and give some examples of their use in your organization.
8. What way of presenting data do you prefer? Why?
9. What is the way that performance data is typically used in your organization?
10. Did you learn anything or was this helpful to you in any way from this study that you participated in?
11. Does this make you want to change the way performance data is presented to you? Why?
12. Any other comments?

Appendix G

Post-Interview Questions

Post interview Questions

1. How long have you been in the healthcare field?
 - a. 0-5 year(s)
 - b. 5-10 years
 - c. 10-15 years
 - d. 15-20 years
 - e. More than 20 years
2. How long have you been in your current position?
 - f. 0-5 year(s)
 - g. 5-10 years
 - h. 10-15 years
 - i. 15-20 years
 - j. More than 20 years
3. How long ago did you enter the workforce?
 - k. 0-5 year(s)
 - l. 5-10 years
 - m. 10-15 years
 - n. 15-20 years
 - o. More than 20 years
4. How long have you been at your current skill level?
 - p. 0-5 year(s)
 - q. 5-10 years
 - r. 10-15 years
 - s. 15-20 years
 - t. More than 20 years
5. What education level have you achieved?
 - u. Some College
 - v. Undergraduate degree
 - w. Masters degree
 - x. PhD degree
 - y. Other (please describe)
6. What is your current position?

Appendix H

Quantitative Analysis Data

The results from questions 6, 7 and 8 are shown below in Table 8, Table 9 and Table 10.

Table 8: Question 6 Results

Participant	Gauge	Tabular	Difference
1	140	105	35
2	139	138	1
3	105	105	0
4	140	35	105
5	83	105	-22
6	89	104	-15
7	139	138	1
8	108	105	3
9	105	140	-35
10	140	140	0
11	140	140	0
12	70	105	-35
13	46	70	-24
14	140	131	9
15	138	105	33
16	105	136	-31

Table 9: Question 7 Results

Participant	Gauge	Tabular	Difference
1	105	88	17
2	138	140	-2
3	104	36	68
4	110	35	75
5	94	105	-11
6	92	80	12
7	38	35	3
8	107	105	2
9	70	140	-70
10	88	89	-1
11	0	0	0
12	0	0	0
13	82	70	12
14	121	106	15
15	105	105	0
16	70	70	0

Table 10: Question 8 Results

Participant	Gauge	Tabular	Difference
1	87	77	10
2	52	39	13
3	70	34	36
4	70	35	35
5	76	80	-4
6	92	60	32
7	39	34	5
8	65	55	10
9	140	70	70
10	0	0	0
11	0	0	0
12	0	0	0
13	30	10	20
14	14	24	-10
15	68	60	8
16	34	35	-1